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KAGAWA
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香　川　大　学
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第 14 号
EJEA Conference 2021 in Kagawa 特集号

AI が支援する未来に向けた人間中心のサステイナビリティと
イノベーションを考える：新たなステージへ導く日本とヨーロッパの
学際的な教育と研究の紹介

2021年10月22日～24日
香川県高松市

Journal of Kagawa University International Office
Vol. 14
Special issue on EJEA Conference 2021 in Kagawa

International Conference on Human-centered Sustainability and
Innovation for an AI-assisted Future: New Interdisciplinary
Education & Research for the Next Stages in Japan and Europe

October 22~24, 2021
Takamatsu, Kagawa, Japan

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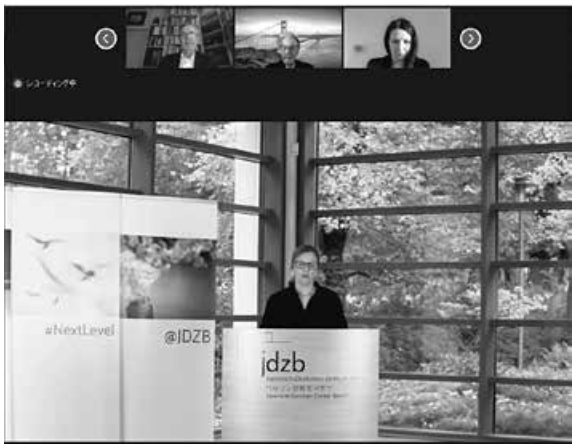

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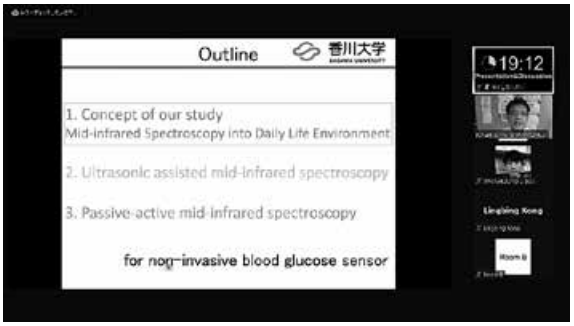

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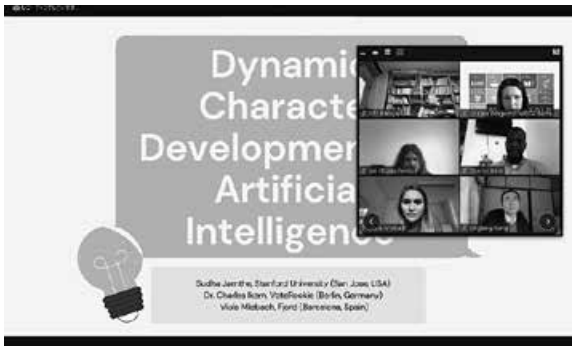

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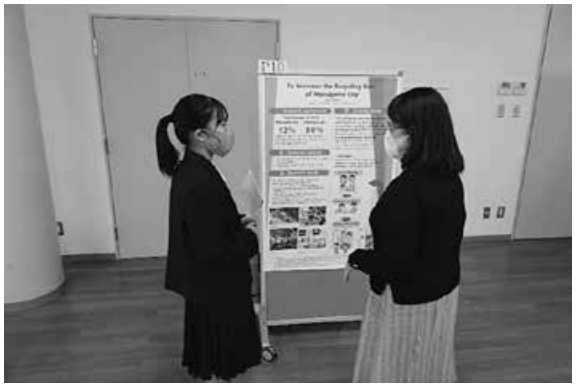

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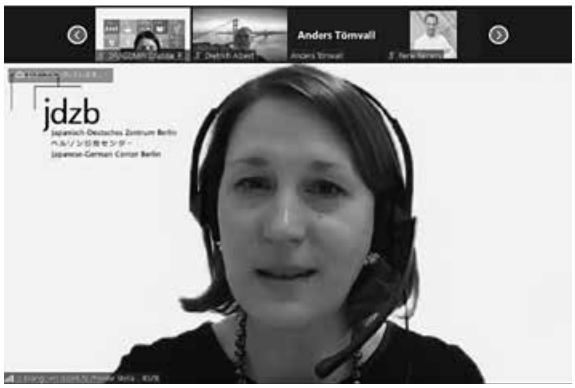

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Mrs. Sabine Ganter-Richter
European Japan Experts Association, EJEA, Germany

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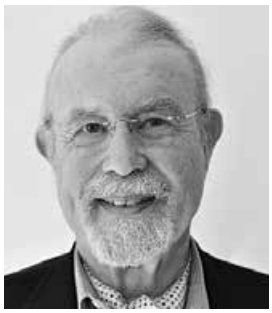
Prof. Dr. Kenji Wada and Prof. Dr. Masaaki Tokuda
Kagawa University, Japan

Organizing committees

International Organizing Committee of EJEA Conference 2021 in Kagawa

Prof. Dr. Dietrich Albert	University of Graz (Austria)
Mrs. Sabine Ganter-Richter	Network for Science (Germany)
Prof. Dr. Yoshiro Imai	Kagawa University (Japan)
Prof. Dr. René Reiners	Fraunhofer Institute for Applied Information Technology FIT (Germany)
Prof. Dr. Anders Törnvall	Linköping University (Sweden)
Prof. Dr. Masaaki Tokuda	Kagawa University (Japan)
Dr. Lars Vargö	Institute for Security and Development Policy (Sweden)

(Alphabetical order)



Dietrich Albert

Sabine Ganter-Richter

Yoshiro Imai

René Reiners

Anders Törnvall

Masaaki Tokuda

Lars Vargö

Steering Committee of Kagawa University

香川大学EJEAカンファレンス実行委員会

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JETRO Kagawa（Japan）

Kagawa Prefecture（Japan）

Modular Management Group（Sweden）

Takamatsu City（Japan）

Women's International Shipping & Trading Association（WISTA）(Romania)

Preface

In publishing the special issue of EJEA Conference 2021 in Kagawa

EJEA (European Japan Experts Association) is a non-profit organization established in 1995 by the Japan-Germany Center Berlin and holds forums to promote partnerships and cooperation in R & D between Europe and Japan. In recent years, EJEA conferences were held in Stockholm, Sweden (April 2018) and in Graz, Austria (September 2019). This time, in October 2021, EJEA - in commemoration of its 25th anniversary - held the first international conference in Japan jointly with Kagawa University as a co-organizer.

Interpersonal encounters often bring about new opportunities and create new bonds. The first important encounter occurred on November 7, 2018, when Japan-German Society Kagawa (President: Mr. Sakae Tadano) took the lead to arrange for Mrs. Sabine Ganter-Richter, President of the German-Japan Society Bonn, and Mr. Marco Invernizzi to visit Kagawa University. She and her colleagues soon made their second visit to Kagawa University on April 2, 2019, whereby they introduced the GRANITE (German Research Ambassadors Network for Industrial Technology Endeavors) project. GRANITE aims to create a sustainable Japanese-German network mainly in the IoT field through the formation of networks among German and Japanese companies, researchers, local governments, etc., and to promote joint research and development together with technology transfer. In response to this development, Kagawa University decided to form a cooperative team led by International Office and the Faculty of Engineering and Design. Substantial exchanges were initiated at the Japan-Germany Networking Meeting that was held on October 10, 2019, at the Faculty of Engineering and Design. Since Mrs. Sabine is simultaneously a member of EJEA Executive Committee, she extended an invitation to Prof. Yoshiro Imai, Professor of Faculty of Engineering and Design, Kagawa University, to participate in the EJEA conference "Human-Centered Digitalization: How to Develop Next Generation of Humans and Robots for a Secure, Harmonic and Prosperous Future of Europe and Japan?" which was held at Graz University of Technology in Austria on September from 20 to 21, 2019. In due of the active participation by Kagawa University in GRANITE, EJEA offered Kagawa University the opportunity to host its conference in Kagawa on suitable days of October 2021, and Kagawa University accepted the offer.

The members of the EJEA Executive Committee and the members of Kagawa University Committee formed the joint Conference Executive Committee to discuss the scopes and directions of the conference. The joint Committee decided on the theme "International Conference on Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe". In addition to the two original organizers (EJEA and Kagawa University), not only the Institute for Security and Development Policy (ISDP) but also the Fraunhofer Institute for Applied Information Technology FIT were officially asked to hold this conference as co-organizers. Moreover, 13 sponsors kindly supported the EJEA Conference 2021 in Kagawa.

At Kagawa University, the Steering Committee for the EJEA Conference 2021 in Kagawa was formed, whose members were appointed from 6 faculties of Kagawa University to share the roles to prepare for the conference. Initially, this conference was planned to be held in a face-to-face manner. The program was to include keynote lectures, workshops, poster presentations, company exhibitions, company visits, excursions to cultural sites, and receptions. However, due to the prolonged outbreak of COVID-19, the Steering Committee decided to hold the conference online. Except for poster presentations which were demonstrated in a face-to-face manner at the Olive Square Multipurpose Hall, Kagawa University, all activities were conducted online. The Steering Committee also invited high school students to participate in the session of poster presentation, in which four presentations had been carried out by high school students among other university students.

The total number of presentations was 80: namely, 1 invited lecture, 7 keynote lectures, 60 oral presentations in 8 workshops, and 12 poster presentations. The number of registered participants was 197 from 13 countries (145 in Japan and 52 from overseas). In all previous EJEA conferences, participants mainly came from EU countries and Japan. At this EJEA Conference 2021 in Kagawa, however, had many participants from Asian countries such as Bangladesh, India and Brunei Darussalam including a foreign student from Africa.

The opportunity to hold this conference originated from the close partnership between the Japan-German Society Kagawa and the German-Japan Society Bonn. This partnership acted as a catalyst for Kagawa University and Fraunhofer Institute for Applied Information Technology FIT to collaborate with the GRANITE project. This collaboration led to the signing of a Memorandum of Understanding between the two institutions on March 1, 2021. With that foundation, Kagawa University and Fraunhofer Institute for Applied Information Technology FIT decided to hold the EJEA Conference 2021 in Kagawa as co-organizers. Symbolically, the EJEA Conference 2021 in Kagawa was also held to commemorate and celebrate the 160th anniversary of Japan-Germany Partnership.

On behalf of Kagawa University, I would like to thank EJEA and the other 2 co-organizers, 4 organizations for their financial support, and 9 organizations for their support which gave Kagawa University the great opportunity to hold this prestigious conference.

Finally, on a sad note, we learned of the unfortunate demise of Mr. Marco Invernizzi. He had been instrumental in creating the opportunity for all of us to hold this conference. We would like to dedicate this volume to his memory.

March 11, 2022
Masaaki Tokuda, M.D., Ph.D.
Chairperson of the Kagawa University EJEA Conference Steering Committee

巻頭言
EJEA Conference 2021 in Kagawa特集号の出版にあたり

EJEA（European Japan Experts Association：ヨーロッパ日本有識者協会）は、日独センターベルリンによって1995年に設立したNPO法人であり、ヨーロッパと日本の間のR&Dを促進しパートナーシップと協力を生み出すためのフォーラム等を開催している。近年では､2018年４月にStockholm（スウェーデン）で、2019年９月にGraz（オーストリア）で、カンファレンスが開催されている。今回2021年10月に、EJEA創立25周年を記念し、日本で初めて香川大学が共同主催者としてカンファレンスを開催した。

人と人との出会いが、機会をもたらし、絆を作る。最初の出会いは、2018年11月７日に、ボン独日協会Sabine Ganter-Richter会長とMarco Invernizzi氏が、香川日独協会（多田野榮会長）の紹介により香川大学を訪問したことに始まる。彼らは、翌2019年４月２日に香川大学を再度訪問し、香川大学にGRANITE（German Research Ambassadors Network for Industrial Technology Endeavors）プロジェクトへの参画を提案した。GRANITEは、ドイツと日本の企業・研究者・自治体等のネットワーク形成を通して、主としてIoT分野における持続可能な日独のネットワークを創り、共同研究・開発や技術移転の促進を目指すものであった。この提案に対して、香川大学として創造工学部を中心として協力体制を組むことを決め、2019年10月10日に、日独ネットワーキングミーティングを創造工学部において開催し、実質的な交流がスタートした。前述のSabine氏は、EJEAのExecutive Committeeの一員であることから、2019年９月に、オーストリアのGraz工科大学を会場にして開催したEJEAカンファレンス「Human-Centered Digitalization: How to Develop Next Generation of Humans and Robots for a Secure, Harmonic and Prosperous Future of Europe and Japan?」に、香川大学から今井慈郎教授が招へいされ、これによりEJEAとの縁が始まった。そしてGRANITEプロジェクトが進む中で、EJEAから次回は香川で開催しないかとの打診があり、2020年秋、2021年10月に香川大学で開催することが決定された。

EJEA Executive Committeeメンバーと、香川大学メンバーとで今回のカンファレンス実行委員会を組織して、方向性を議論し、テーマを「International Conference on Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe：AI が支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介」と決定した。

主催は、EJEAと香川大学に加えて、EJEAに関連のあるThe Institute for Security and Development Policy（ISDP）と､GRANITEに関連のあるフラウンホーファー研究所応用情報技術研究所（Fraunhofer Institute for Applied Information Technology FIT）が加わり、４団体となった。その他共催・後援組織が13団体・機関となった。

香川大学では、全学を挙げての取り組みを行った。各部局から委員を選出し、香川大学内に実行委員会を組織し、役割分担を決めて準備にあたった。当初は、対面での開催を予定していたので、キーノート講演やWorkshopの他に、ポスター発表、企業展示、企業訪問及びエクスカーションの他、レセプションでの交流を企画していた。しかしながら、新型コロナウィルス感染症の蔓延が遷延したため、残念ながら、対面での開催を諦め、オンライン開催とした。ただし、ポスター発表のみは対面での開催（香川大学OLIVE SQUARE多目的ホール）とした。ポスター発表は、県内の高等学校にも働きかけ４演題の応募があった。

発表総数は80演題（招待講演１，キーノート講演７，一般口演60、ポスター発表12）であり、参加登録者は、13カ国から197名（日本145名、海外52名）であった。これまでのEJEAカンファレンスはEUおよび日本からの参加が主であったが、それに加えてアジアからの参加者へも門戸を広げたことが特徴である。

本カンファレンスの開催に至る切っ掛け作りは、香川日独協会およびボン独日協会の交流であった。香川大学とフラウンホーファー応用情報技術研究所との間を取り持っていただいたことで、GRANITEプロジェクトへの参画が決まり、2021年３月１日には、両機関の学術協定締結へとつながった。その基盤があって、香川大学とフラウンホーファー応用情報技術研究所が共同主催として加わりEJEAカンファレンス開催へとなった。なお2021年が日独交流160周年の年であったことから、本カンファレンスは、日独交流160周年記念イベントとして位置付けられた。

最後に、香川大学に名誉ある本カンファレンス日本初開催の機会を与えてくださった、EJEAはじめ共同主催者各位、協賛として支援いただいた４団体・機関、後援の９団体・機関にお礼を申し上げたい。

昨日Sabine氏よりMarco Invernizzi氏が亡くなられたという悲報が届いた。彼はこの会議を香川大学で開催する切っ掛けを作ってくれた。追悼の意を込めて、この特集号を彼に捧げる。

2022年３月11日
香川大学EJEAカンファレンス実行委員会委員長　徳田雅明

日時 Date	EJEAカンファレンス開催に至るまでの重要な出来事 Important events leading up to EJEA Conference
2018.11.7	独日協会ボンSabine Ganter-Richter会長等来学 Mrs. Sabine Ganter-Richter, President of German-Japan Society Bonn visited Kagawa University（1st visit）
2019.4.2	独日協会ボンSabine Ganter-Richter会長等来学 Mrs. Sabine Ganter-Richter, President of German-Japan Society Bonn visited Kagawa University（2nd visit）
2019.9.20-21	EJEAカンファレンス（Graz市）に今井慈郎教授が参加 Professor Yoshiro Imai was invited to the EJEA International Conference in Graz（Austria）
2019.10.10	デジタル化・IoT推進にかかる日独ネットワーキングミーティング開催（香川大学） German-Japan Networking Meeting on Promotion of Digitalization and IoT was held at the Faculty of Engineering and Design, Kagawa University
2021.3.1	フラウンホーファー応用情報技術研究所との協定締結 Conclusion of the Memorandum of Understanding with Fraunhofer Institute for Applied Information Technology FIT
2021.10.22-24	EJEA国際カンファレンス 2021 開催（高松市） EJEA Conference 2021 in Kagawa was held online

Call for the conference（August 12th 2021）

EJEA International Conference 2021

Human-centered Sustainability and Innovation for an AI-assisted Future:
New Interdisciplinary Education & Research for the Next Stages
in Japan and Europe

AIが支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介

October 22nd - 24th, 2021 in Takamatsu, Japan and online

jointly organized by

European Japan Experts Association（EJEA）, Kagawa University, Fraunhofer Institute for Applied Information Technology FIT and Institute for Security and Development Policy（ISDP）

supported by

Japanese German Center Berlin（JDZB）, EU-Japan Centre for Industrial Cooperation, German Research Ambassadors Network for Industrial Technology Endeavors（GRANITE）, Japan-German Society Kagawa (Japan), JETRO Kagawa (Japan), Kagawa Prefecture（Japan）, Modular Management Group （Sweden）, Takamatsu City（Japan）, Women's International Shipping & Trading Association（WISTA Romania）

sponsored by

Toshiba International Foundation（TIFO）, Frontiers in Artificial Intelligence, Kagawa Industry Support Foundation（KISF）

The **conference is planned to be held in hybrid-style**（physical meeting in Takamatsu, **Japan** and online participation daytime in **Europe**）on **Oct. 22nd（Fr）, 23rd（Sat）and 24th（Sun）, 2021（8:00-13:00 CET / 15:00-20:00 JST）**

NEW Due to the outbreak situation of COVID-19 all over the world, the committee decided as follows:

1. The conference will be mainly accomplished **ONLINE**
2. Conference fee is **FREE of charge**
3. The deadline for submission has been extended until **September 15th, 2021.**

Official **language** of the conference is **English.**

The conference program will be published and updated on the

conference's website: https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

Aim of the Conference

In a certain way the aftermath of the COVID-19 pandemic defined the organizer's discussions about the content of this conference. In Europe as well as in Japan we observed, that after a first phase of stagnation immediately after the outbreak of the pandemic has been overcome, people all over the globe tried to adjust and modify their everyday lives. Many of these changes in our private and professional life came along with new technologies. Within a few weeks only we rushed into the "digital transformation" – a process that we have been discussing for years with a long-term perspective became reality almost "overnight"!

Against this background, the organizers of this conference address the current COVID-situation that is also heating-up the discussion on digital transformation. However, the focus of this conference reaches far beyond! Contributions and practical experiences to this conference will deal with questions, such as:

How can these new models and methods help to develop and realize green / sustainable / secure and resilient initiatives to support local and global communities?

- "Green Sustainable Societies" and "SDGs (sustainable development goals)" are gaining more and more importance in the policies of the European Union and of Japan. How can we create innovative forms of close intercultural and interdisciplinary cooperation that are urgently needed in times of "social distancing"?
- How can we in research and education develop new intercultural and interdisciplinary models and methods using advanced Artificial Intelligence (AI) centered concepts?
- What about transparency, understandability and responsibility in using AI technologies in a human-centered way?

Thus, in face of the complexity and interconnectedness of the processes and structures in digital transformation and future usage of AI,

a. holistic, general, and multi-level views must be taken into account, considering
b. the global and cross-cultural contexts, with an explicit focus on
c. harmony created by human wellbeing, human security and social peace.

To achieve these goals and to update the Japanese-European relationship in order to strengthen exchange and collaboration between the two regions the priorities of the conference focus on providing forums for **research and education as well as innovation and industrial application.** Furthermore, we strongly encourage especially the young generation for implementing the above-

mentioned scientific and educational measures in Japan as well as in Europe.

The aim of the conference is to develop integrated views and common European-Japanese recommendations which have the potential to avoid digital risks like division of society, socially incompatible developments, disintegration, leaving behind the elderly, social conflicts etc. and to support digital chances to reach aims like equality and fairness of participation, balance of chances and opportunities, cooperation as well as competition, human wellbeing, social peace and to develop the societal and digital transformation in a peaceful spirit based on high technology.

We invite you for active contribution with lectures, workshops, posters, and discussions in developing new advanced applications of AI for fostering

- new concrete interdisciplinary methods and models to achieve sustainable and resilient societies
- new areas of research and education as well as innovation and industrial application for the benefit of all generations
- new opportunities for and forms of cooperation and partnerships on a local, international, and global level

Target Groups

Individual experts and citizens from all age groups, decision makers and opinion leaders from related organizations, companies, universities, research institutes as well as public administration and governments from Japan and Europe. By this a bank of knowledge and expertise will be created.

Keynote Lectures

- Mr. Colin de Kwant
  "Sustainable Mobility Scenario Modeling: Evaluating Future Resilience of Modular Concepts for Electrified Trucks"
  Vice President Modular Management®; Lecturer at Royal Institute of Technology (Sweden)
- Dr. Yuko Harayama
  "Human in the Loop or Human-centered" (tbc)
  Executive Director RIKEN (Japan)
  former Executive Member of Council for Science, Technology, and Innovation
- Prof. Dr. Fredrik Heintz
  "Education for an AI-assisted Future - From Primary Education to Life-Long Learning"
  Linköping University, Dept. of Computer and Information Science (Sweden)

EU Commission High-Level Expert Group on AI

- Prof. Dr. Satoshi Murayama
  "Environmental humanities: a long-term local history approach to living spaces to be sustained"
  Professor Emeritus, Co-convener of the International Consortium for Earth and Development Sciences, Kagawa University (Japan)
- Dr. Lucas Paletta
  "Cognitive Sensing for Intuitive Interaction, Well-being and Care"
  Human Factors Lab at Joanneum Research Forschungsgesellschaft mbH DIGITAL – Institute for Information and Communication Technologies (Austria)
- Dr. René Reiners
  "Human-Centered System Design for Successful Digital Transformation"
  Head of Human-centered Engineering and Design at Fraunhofer Institute for Applied Information Technology FIT (Germany)
  Coordinator of GRANITE
- Prof. Dr. Hiroshi Tsuji
  "From 45 Years Experience on R&D and Education of Systems Sciences"
  Executive Director, University Public Corporation Osaka (Japan)
  former President of Osaka Prefecture University

Call for Contributions

We welcome **abstract** submissions for the following categories:

1. Oral Contribution

We ask for oral contributions, that should be no longer than 10 minutes and presented during parallel workshops. Currently the following workshops are foreseen for a resilient post-Corona reality shaped by human and artificial intelligence (AI) – contributions for additional workshops are welcome:

- eHealth / Tele-Medicine / Medical Engineering:
  chaired by Prof. Dr. Kazuhiro Hara and Prof. Dr. Ichiro Ishimaru, Kagawa University (Japan)
- Smart City:
  M-Sec project, NTT and Takamatsu "Super City Project", City of Graz, City of Malmö ... (details tbd)
- Human-Involvement in Technology Advancement:
  chaired by Dr. René Reiners, Fraunhofer FIT (Germany) and Prof. Dr. Daisuke Sasaki, Kagawa University (Japan)
- Environmental Humanities: Water, Air and Land for Sustainable Living Spaces:

chaired by Prof. Dr. Satoshi Murayama and Prof. Dr. Toru Terao, Kagawa University (Japan)

- Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence:
  chaired by Prof. Dr. Dietrich Albert, University of Graz (Austria), Prof. Dr. Xiangen Hu, University of Memphis (USA) & Central China Normal University (China), Prof. Dr. Tomoko Kojiri, Kansai University (Japan), and Dr. Paul C. Seitlinger, University of Vienna (Austria)
- GRANITE workshop:
  chaired by Dr. René Reiners, Fraunhofer FIT (Germany) and Prof. Dr. Satoru Takahashi, Kagawa University (Japan)
- Human Security and Sustainability:
  chaired by Prof. Dr. Kazuya Ishii, Kagawa University (Japan) and Dr. Lars Vargö, Director Japan Center, Institute for Security and Development Policy (Sweden)
- Educational Change: New Models and New Thinking in Intercultural Concepts:
  chaired by Prof. Dr. Toshihiro Hayashi, Kagawa University (Japan) and Prof. Dr. Anders Törnvall, Linköping University (Sweden)

Workshops and chairpersons may be modified according to submissions for oral contributions.

2. Organized Workshop

We welcome your offers to organize and co-chair (Europe and Japan) a workshop in the scope of the conference. Please note that organization must be provided by the applicant itself. The platform and premises will be organized by the conference.

3. Posters

Posters focusing on human-centered sustainability and innovation for an AI-assisted future are very welcome, also from a more specific perspective. Submissions are not limited to established academics; we also encourage students and representatives from the industry to submit their posters!

4. Demonstrations

Demonstrations (at site or online) from industry and research institutions dealing with AI-assisted systems (robots, AI-software etc.) are very welcome.

5. Visits at Local Companies

The conference offers participants exclusive insights into the practical aspects and the application of AI-assisted innovations! Please participate in this format for networking and professional exchange on current topics, realizations, and possible collaborations!

Submission Guidelines

All submissions must be original and not simultaneously submitted to another conference.
Submissions should include:

- Given name, family name, title, affiliation, URL, email address, phone number
- Abstract: 1 page is suitable, however, we accept up to 4 pages.
- Optional: CV
- Please indicate whether you want to organize a workshop, contribute to a workshop, to present a poster or a demonstration.
- Also please indicate whether you are interested in publishing in the journal "Frontiers in Artificial Intelligence".

The deadline for submission has been extended, please submit your abstract in English until September 15th, 2021
either via: https://easychair.org/conferences/?conf=ejeac2021conf
or via e-mail to ejea2021conf-c@kagawa-u.ac.jp
by using the template offered by Kagawa University:
https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/
Results will be notified by September 30th, 2021.

Conference Fee

~~On-site participation: 30.000 Yen Students 10.000~~
~~Online participation: 10.000 Yen Students are free~~
The conference fee is FREE since the conference will be mainly accomplished online.

Publication of Contributions

Pending peer-review, extended content will be published within a Research Topic entitled “AI for Human Learning and Behavior Change” in *Frontiers in Artificial Intelligence* (ISSN 2624-8212). More details and dedicated links will follow in summer 2021 (https://www.frontiersin.org/journals/artificial-intelligence)

In addition, **all** contributions can be published in the in **Kagawa University International Journal** (ISSN 1884-8745) after extending it to a two-page mini-paper.

All participants will be informed by the organizing committee if you wish to publish your paper or not. The further instruction of Kagawa University International Journal will also be given to

you and you can finalize your manuscript for submission to this journal with a page limit of less than 6 pages. Your manuscript will have to go through the reviewing process. This issue will be scheduled to be published in June 2022.

Program Committee

- Prof. Dr. Dietrich **Albert**, University of Graz (Austria)
- Prof. Dr. Yoshiro **Imai**, Kagawa University (Japan)
- Prof. Dr. Tomoko **Kojiri**, Kansai University (Japan)
- Dr. Anja **Linnemann**, Fraunhofer Institute for Applied Information Technology FIT (Germany)
- Prof. Dr. Anders **Törnvall**, Linköping University (Sweden)
- Prof. Dr. Masaaki **Tokuda**, Kagawa University (Japan)
- Dr. Lars **Vargö**, Institute for Security and Development Policy (Sweden)

Contact

All questions about submissions should be emailed to:
ejea2021conf-c@kagawa-u.ac.jp

Registration

To **register for the conference**, you are kindly asked to write an e-mail to our conference registration address: ejea-reg-c@kagawa-u.ac.jp

Please write into the **email subject** line: **2021EJEA_Conf_Regist**

In your registration email please **include the following information for each person to be registered:**

1) First Name
2) Family Name
3) E-mail address
4) Affiliation
5) Affiliation postal address

Venue

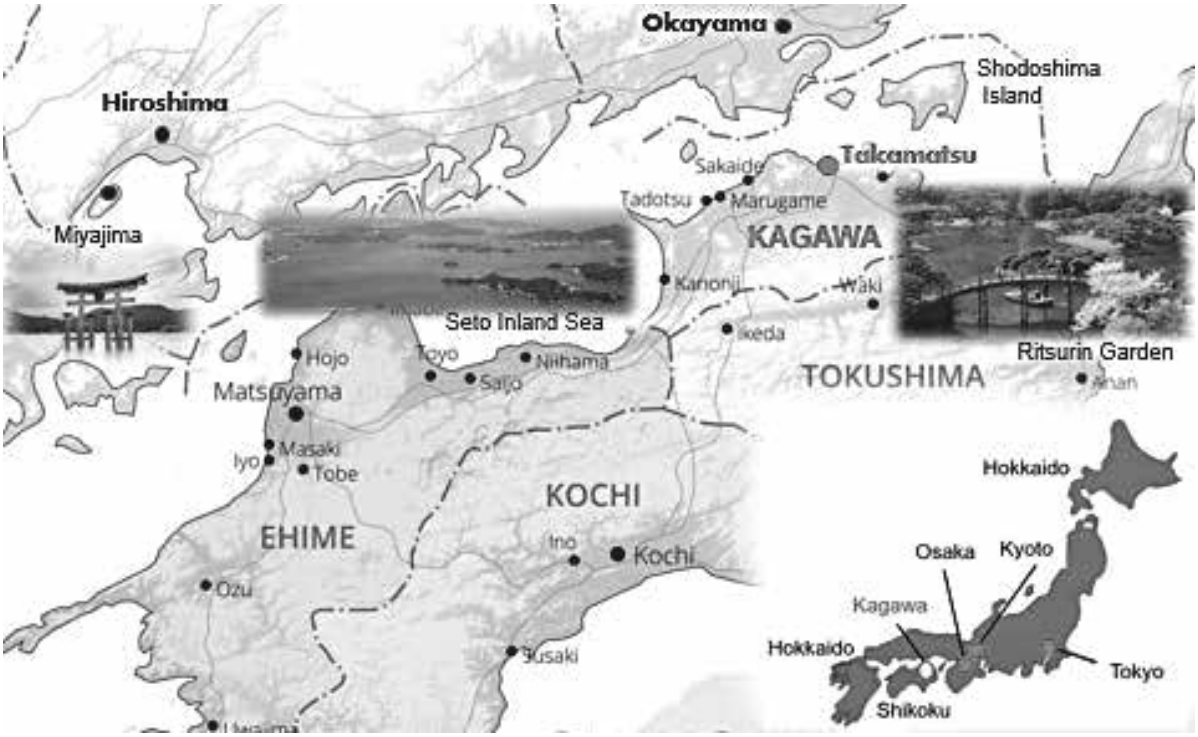
The conference will be organized as hybrid event at Kagawa University, 1-1 Saiwai-cho, Takamatsu, Kagawa (Japan). All Workshops and talks will also be made available online for registered participants.

Kagawa Prefecture is located in Shikoku Island, one of the four major islands of Japan, where no metropolitan cities exist, and beautiful nature and traditions have well preserved. Its capitol, Takamatsu-city, has been working to promote "Smart City" with human-centered policies and welcomes the conference to be held in Kagawa.

The 88-temple pilgrimage route, art-island Naoshima, Yashima Plateau, Kompira Temple, Ritsurin Garden, olive-island Shodoshima, Seto Inland Sea National Park, Sanuki Udon noodle, Marugame Uchiwa, Lacquer wares – just to mention a few **highlights of Kagawa Prefecture waiting to welcome you!**

On your way to Kagawa you might stop-over in Okayama, Hiroshima, Miyajima Shrine, Himeji Castle and enjoy Japanese culture apart from metropolitan cities.

The closest international airport is Kansai International Airport (near Osaka). Several flights from Tokyo Haneda International Airport and 2 from Narita International Airport are available to Takamatsu Airport which primarily handles domestic flights except for those from Hong Kong, Shanghai, Taipei,and Incheon.



Letter of intent（Japanese）

EJEA Conference 2021 in Kagawa開催趣意書

https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

下記のように、EJEA Conference 2021 in Kagawaを香川大学において2021年10月に開催します。新型コロナウィルス感染症の感染の蔓延状況を鑑み、学術セッションは基本オンラインでの開催とします。また参加費についても無料としての開催とします。本会の趣旨にご賛同いただき、ご参加およびご支援をよろしくお願いいたします。

1．カンファレンスのタイトル

International Conference on Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe
AI が支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介

2．日時　2021年10月22日（金）～24日（日）

3．会場　香川大学（幸町キャンパス）　香川県高松市幸町１番１号

4．開催様式　学術セッションはオンライン実施。ポスター発表は対面とオンラインで実施。

5．主催

- EJEA：ヨーロッパ日本有識者協会（ドイツ）
- 香川大学（日本）
- フラウンホーファー応用情報技術研究所（ドイツ）
- 安全保障開発政策研究所（スウェーデン）

6．協賛・後援

- 日欧産業協力センター（日本）
- JDZB：ベルリン日独センター（ドイツ）
- GRANITEプロジェクト（ドイツ・日本）
- モジュール管理グループ（スウェーデン）
- WISTA：国際女性海運・貿易協会（ルーマニア）
- 香川日独協会（日本）
- 東芝国際交流財団（日本）
- 香川県（日本）
- 高松市（日本）
- ジェトロ香川（日本）
- かがわ産業支援財団（日本）

7．目的

ヨーロッパでも日本でも、COVID-19パンデミックの発生直後の停滞の第一段階が克服された後、世界中の人々が日常生活を調整し変えようとしています。これらの変化の多くは、新しいテクノロジーとともにもたらされ、数カ月のうちに、「デジタルトランスフォーメーション」に突

入しました。それはAI（人工知能）社会の到来を加速化するものでもありました。確かにAI社会の到来は、大きなアドバンテージをもたらしますが、同時にリスクももたらします。前者としてはデジタル化により大きな情報の獲得が容易になること、距離の概念を超えて様々な活動に参加するチャンスが得られるなどがあります。後者としては、デジタル情報が尊重される反面で情緒的な要素が拾い上げられないこと、評価の均一化が進み個性の評価が難しくなること、情報依存性が起こることなどがあります。

本カンファレンスでは、エンジニアリングをはじめ様々な分野で利用される人工知能（AI）を使用する際に、如何にして「人間を中心」の展開をすることができるかを、教育および研究の分野から見て行きます。また、EU欧州連合の“Green Sustainable Societies”、さらに国連が提唱する“SDGs（sustainable development goals）”の取り組みは、行政のみならず企業や教育機関においてもますます重要性を増しています。AIを用いる我々がいかにして「人間中心の視点でAIを活用して持続可能社会とするイノベーションを興すことができるか（Human-centered Sustainability and Innovation）」について議論します。

分野としては情報工学分野のみならず医療・保健分野、人文・社会科学、都市工学、農業、環境、教育など、幅広い学際的領域において考え議論する機会を提供します。

以上のような目的で開催するカンファレンスは、EJEAの学際的で幅広いネットワークを活用するとともに、フラウンホーファー応用情報技術研究所（Fraunhofer FIT）と香川大学が牽引するGRANITEプロジェクトと合体することとし、Fraunhofer FITと香川大学が共同主催者に加わり実施します。また日独交流160周年記念イベントとしても位置付けます。

日独交流160周年
Jahre Freundschaft
Deutschland – Japan

8．主なテーマ

- Human Security and Sustainability: 人間の安全と持続可能性
- eHealth / Tele-Medicine / Medical Engineering: e-ヘルス・遠隔医療・医療テクノロジー
- GRANITE session: GRANITEセッション
- Human-Involvement in Technology Advancement: 技術進歩への人間の関与
- Environmental Humanities: Water, Air, and Land for Sustainable Living Spaces: 環境人文学：持続可能な生命空間のための水、大気そして土地
- Distributed Cognition in Learning and Behavioral Change: 学習と行動変化
- Smart City：スマートシティ

9．発表形式

- 特別講演（7）
- ワークショップ（9）
- ポスター発表（対面およびオンライン）：高校生、高等専門学校生も参加します。
- 展示（地域の企業等）

10. 会費

無料です。

11. 参加対象者と参加者数

日本、ヨーロッパを中心に、すべての年齢層の個々の専門家と市民、企業、大学、研究機関、国際機関、行政機関等のステークホルダーやオピニオンリーダー。学生の参加も促す。150人～

200人程度の参加を予想しています。

12. プログラム委員会

- Prof. Dr. Dietrich Albert, University of Graz（Austria）
- Prof. Dr. Yoshiro Imai, Kagawa University（Japan）
- Prof. Dr. Tomoko Kojiri, Kansai University（Japan）（tbc）
- Dr. Anja Linnemann, Fraunhofer Institute for Applied Information Technology FIT（Germany）
- Prof. Dr. Anders Törnvall, Linköping University（Sweden）
- Prof. Dr. Masaaki Tokuda, Kagawa University（Japan）
- Dr. Lars Vargö, Institute for Security and Development Policy（Sweden）

13. 開催事務局

香川大学インターナショナルオフィス
〒760-8521　香川県高松市幸町１番１号
電話：087-832-1318　e-mail: soryucet@kagawa-u.ac.jp

以上

2021年８月12日
EJEAカンファレンス実行委員長
香川大学 副学長（国際戦略・グローバル環境整備担当）
徳田　雅明

EJEA and GRANITE（Japanese）
1）EJEA: European Japan Experts Associationについて

1　設立

ヨーロッパ11カ国の日本に関する専門家と日独センターベルリンの欧州委員会によって1995年に設立したNPO法人。ディートリッヒ・アルバート博士（オーストリア・グラーツ大学名誉教授、実験心理学）が会長。

2　ミッション

EJEAは、20年の歴史を経て、日欧関係の信頼できる基盤を提供するために、持続可能な学際的なネットワークを確立するための新しい機会を提供する。

3　ビジョン

- EJEAは、それ自体で研究を行わないが、ヨーロッパと日本の間のR&Dを促進するため新しいパートナーシップと協力を生み出すという観点から、人々が出会い、話し合い、知を交換するためのフォーラム等の機会の提供に寄与する。
- EJEAは、フォーラム等で扱うトピックスを提案し、ネットワークを活用して、関心や関連のある組織・機関から人々の参加を促す役割を果たす。
- EJEAは、フォーラム等の開催に賛同する組織・機関に対して協力するが、自由かつ柔軟な運営を妨げない。
- EJEAは、以下のような活動を行う。
  - 既存の組織・機関にサービスを提供するための「傘」になる
  - 幅広い分野からのヨーロッパの「声」を繋ぎ合わせる
  - 日欧関連のトピックについて議論するためのプラットフォームとなる
  - 多文化共生を推進する

4　EJEAが関連する組織

A）日本と連携をしている各国の主な組織

Austria

- Austrian Academy of Sciences（OeAW）
  APART-Fellowship, DOC-Fellowship, OeAW Scholorship Information（in German）
- Austrian Science Fund（FWF）
- Erwin Schrödinger Fellowship, FWF Joint Research Projects
- OeAD, Centre for International Cooperation and Mobility
  several funding programs for students, pre/post-docs and scientists

Europe

- EU-Japan Centre for Industrial Cooperation
  6 month in-house fellowship at the EU-Japan Centre in Japan.
  Minerva Fellowship Programme
- European Commission
  Marie Sklodowska-Curie Innovative Training Networks（ITN）
- European Science Foundation
  ESF-JSPS Frontier Science Conference Series for Young Researchers

France

- École Française d'Extrême-Orient
  EFEO Field Scholarships
- French Foreign Affairs (MAEDI)
  France-Japan cooperation programme for S&T
  PHC-Sakura Programme (in French)

Germany

- German Academic Exchange Service (DAAD)
  several scholarships for students, pre-/post-docs and scientists
  exchange and research projects
- German Research Foundation (DFG)
  Initiation and intensification of bilateral collaborations
  www.dfg.de/en/dfg_profile/head_office/dfg_abroad/japan/index.html
- Japanese-German Center Berlin (JDZB)
  several exchange programs for high-school students, young professionals, welfare specialists etc.
  www.jdzb.de/en/exchange-programs/overview/

Italy

- Italien Ministry of Foreign Affairs
  program for S&T collaboration

Japan

- German Institute for Japanese Studies (DIJ)
  DIJ Visiting Scholar Program
- Japan Science and Technology Agency
  Strategic International Collaborative Research Program
- Japan Science and Technology Agency
  Strategic International Research Cooperative Program
- Japan Society for the Promotion of Science (JSPS)
  several funding programs for post-docs (few exceptions for pre-docs) to senior scientists, exchange and joint research projects
- Japan Student Services Organization (JASSO)
  Student Exchange Support Program (Scholarship for Short-term Study in Japan)
  Follow-up Research Fellowship
- Japanese Government (Monbukagakusho) Scholarship Student
  comprehensive site for scholarship programs for students funded by MEXT
  www.studyinjapan.go.jp
- Japanese Ministry of Foreign Affairs
  Japan Exchange and Teaching (JET) Programme
- The Japan Foundation

several funding programs in the fields of arts, culture, Japanese language, Japanese studies

www.jpf.go.jp/e/program/index.html

Sweden

- Royal Swedish Academy of Sciences

  Scholarships, grants, scientific exchange and research fellow positions
- Scandinavia-Japan Sasakawa Foundation

B）科学や経済の分野で日本関連する各国の主な組織

Europe

- European Association of Japanese Studies
- Nordic Association of Japanese and Korean Studies

France

- Maison Universitaire France-Japon

Germany

- German Association for Social Science Research on Japan（VSJF）
- German-Japanese Association of Jurists（DJJV）
- German-Japanese Society for Social Sciences（GJSSS）
- Japanese-German Business Association（DJW）
- Japanese-German Center Berlin（JDZB）

Sweden

- European Institute of Japanese Studies（EIJS）（in English）European Institute of Japanese Studies（EIJS）（in Japanese）

Japan

- Deutsche Gesellschaft für Natur- und Völkerkunde Ostasiens（OAG）（in German）
- German Institute for Japanese Studies（DIJ）
- German Chamber of Commerce and Industry in Japan（AHK）

5．EJEAの委員会

A）Full Executive Committee:

- Chairperson: Prof. Dr. Dietrich Albert
- Executive Manager: Sabine Ganter-Richter
- Executive Committee Member: Prof. Dr. Anders Törnvall

B）Members' Meeting:

11カ国を代表する約30名のエクスパートメンバーから構成される。

C）Advisory Board:

- Dr. Lars Vargö, Jörn Keck

2）GRANITEについて

THE FUTURE OF WORK

GRANITE グラニット　German Research Ambassadors Network for Industrial Technology Endeavors

GRANITEプロジェクトとは：

ドイツ連邦教育研究省(BMBF)は、日本、フランス、アメリカを対象として、2019年6月から研究マーケティングキャンペーン“The Future of Work”を開始し、10のプロジェクトを立ち上げました。このうち、GRANITE (German Research Ambassadors Network for Industrial Technology Endeavors) は、ドイツと日本の企業・研究者・自治体等のネットワーク形成を通して、主としてIoT分野における応用研究や技術活用の持続可能な日独のネットワークを創り、共同研究・開発や技術移転の促進をすることを目的としている。

German Research Ambassadors Network for Industrial Technology Endeavors

GRANITE aims to initiate active dialogue between companies and research institutes and local administration and government in Japan and Germany. Establishing an innovative and sustainable network for applied research and technology will facilitate a joint effort for the exchange and transfer of knowledge between the two countries.

Keywords: プロジェクトの重点項目

- Industry 4.0 and digitalization　インダストリー4.0とデジタル化
- Identifying SME potential　中小企業のポテンシャル
- User-centered design　利用者中心設計
- Change and system design　変革とシステムのデザイン

Institution 中心となる研究所

Fraunhofer Institute for Applied Information Technology FIT
フラウンホーファー研究所応用情報技術研究所

Headquarters プロジェクト所在地

Sankt Augustin, Germany　上記FITの所在地

Partners パートナーグループ・企業

- Clover Design
- Lyogroup International
- Mittelstand 4.0 - Kompetenzzentrum eStandards
- Plastcontrol GmbH
- Takashima Sangyo Co., Ltd.　日本の高嶋産業（長野）もパートナー
  http://www.takashima.co.jp/

Target country ターゲット国

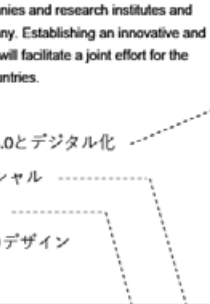
Japan

Contact 連絡先

Fraunhofer Institute for Applied Information Technology FIT

User-Centered Ubiquitous Computing
Dr. René Reiners
Schloss Birlinghoven
53754 Sankt Augustin
Germany
+49 2241 – 14 3715

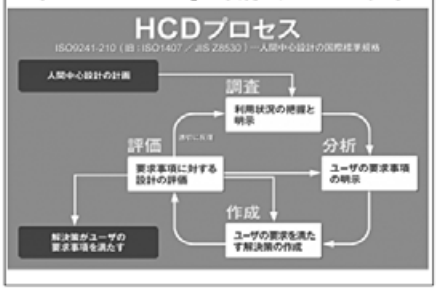
rene.reiners@fit.fraunhofer.de
www.fit.fraunhofer.de/en.html



インダストリー4.0は、ドイツ政府が主導し、産官学共同で進めている国家プロジェクトです。人類史上4回目の産業革命、つまり「第4次産業革命」を起こす取り組みとしており、そのコンセプトは「スマートファクトリー」（考える工場）です。日本の▼Society 5.0に相当する概念です。

デジタル化やIoT（Internet of Things:もののインターネット）により中小企業Small and Medium-sized Enterprise: SMEのポテンシャルの向上を図る。IoTにより、あらゆるモノや情報がインターネットを通じて繋がり、それらが互いにリアルタイムで情報をやり取りしつつ（相互協調）、人の指示を逐一受けずに判断・機能し（自律化）、システム全体の効率を高めるとともに新たな製品・サービスを創出する。（高度化）

User-centered design（利用者中心設計）はHuman-centered design（人間中心設計）とも言われる。
モノや技術中心ではなく、使う人間を中心に据えて、人の要求に合わせたモノ作りをするためのプロセスを体系化したもの。分かりやすく「モノのデザインからコトのデザインへ」と表現されることもある。



2018年開始。日本からは香川大学や信州大学等が参加してプロジェクトを実施している。2019年10月には、香川大学創造工学部を会場にGRANITEミーティングを開催し、中心となるフラウンホーファー応用情報技術研究所や香川大学および香川県の技術について紹介した。

European Japan Experts Association | Fraunhofer FIT | Institute for Security & Development Policy | Kagawa University

ONLINE Zoom Conference

EJEA Conference 2021 in Kagawa

Human-centered Sustainability and Innovation for an AI-assisted Future:
New Interdisciplinary Education & Research for the Next Stages in Japan and Europe

AIが支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：
新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介

Free

October 22nd - 24th, 2021, 15:00-20:00 JST
Kagawa University, Kagawa, Japan
https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

7 KEYNOTE LECTURES

1. **Dr. Yuko Harayama** (Japan)
   Executive Director RIKEN, Former Executive Member of Council for Science, Technology and Innovation
2. **Prof. Dr. Fredrik Heintz** (Sweden)
   Linköping University, Dept. of Computer and Information Science EU Commission High-Level Expert Group on AI
3. **Prof. Dr. Satoshi Murayama** (Japan)
   Professor Emeritus, Co-convener of the International Consortium for Earth and Development Sciences, Kagawa University
4. **Dr. Lucas Paletta** (Austria)
   Human Factors Lab at Joanneum Research Forschungsgesellschaft mbH
   DIGITAL – Institute for Information and Communication Technologies
5. **Prof. Dr. Hiroshi Tsuji** (Japan)
   Executive Director, University Public Corporation Osaka, Former President of Osaka Prefecture University
6. **Dr. René Reiners** (Germany)
   Head of Human-centered Engineering and Design at Fraunhofer Institute for Applied Information Technology FIT Coordinator of GRANITE
7. **Mr. Colin de Kwant** (Sweden)
   Vice President, Modular Management Group®

8 WORKSHOPS

Workshop 1: eHealth and Medical Engineering
Workshop 2: Smart City
Workshop 3: Innovative Technologies for New Industry Creation
Workshop 4: Environmental Humanities: Water, Air, and Land for Sustainable Living Spaces
Workshop 5: Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence
Workshop 6: GRANITE- Human-Centered Research and Transfer to Application
Workshop 7: Human Security and Sustainability
Workshop 8: Educational Change: New Models and New Thinking in Intercultural Concepts

Poster presentation

Date: October 23, 13:00-14:30 JST
Venue: Olive Square, Kagawa University

Please register by sending an email to **ejea-reg-c@kagawa-u.ac.jp** with the subject "**2021EJEA_Conf_Regist**." Please provide the following information;
(1) First Name, (2) Family Name, (3) E-mail address, (4) Affiliation, (5) Affiliation postal address

Agenda of the EJEA Conference 2021 in Kagawa

Day 1: Friday October 22, 2021			Day2: Saturday October 23, 2021			Day 3: Sunday October 24, 2021		
CEST	**JST**		**CEST**	**JST**		**CEST**	**JST**	
				11:30 – 14:30	Poster Session (Face-to-face) Olive Square @ Kagawa University			
8:00 – 8:30	15:00 – 15:30	Opening ceremony Mr. Takuya Hirai, 1st Minister of Digital Agency, Japan Mr. Hideto Ônishi, Mayor of Takamatsu City Prof. Dr. Yoshiyuki Kakehi, President of Kagawa Univ. Dr. Julia Münch, Secretary General JDZB Prof. Dr. Dietrich Albert, Chairperson of EJEA	8:00 – 8:15	15:00 – 15:15	Welcome and Introduction Dr. Lars Vargö, Director, ISDP	8:00 – 8:15	15:00 – 15:15	Welcome and Introduction Dr. René Reiners, Fraunhofer FIT
8:30 – 8:35	15:30 – 15:35	Technical announcements Photo session (Screenshots)	8:15 – 8:35	15:15 – 15:35	Keynote 3: Prof. Dr. Satoshi Murayama	8:15 – 8:35	15:15 – 15:35	Keynote 5: Prof. Dr. Hiroshi Tsuji
8:35 – 8:55	15:35 – 15:55	Keynote 1: Dr. Yuko Harayama	8:35 – 8:55	15:35 – 15:55	Keynote 4: Dr. Lucas Paletta	8:35 – 8:55	15:35 – 15:55	Keynote 6: Dr. René Reiners
8:55 – 9:15	15:55 – 16:15	Keynote 2: Prof. Dr. Fredrik Heintz	8:55 – 9:15	15:55 – 16:15	Presentation: EU-Japan Centre for Industrial Cooperation	8:55 – 9:15	15:55 – 16:15	Keynote 7: Mr. Colin de Kwant
9:15 – 9:30	16:15 – 16:30	Break Poster session (SpatialChat)	9:15 – 9:30	16:15 – 16:30	Break Poster session (SpatialChat)	9:15 – 9:30	16:15 – 16:30	Break Poster session (SpatialChat)
9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Workshop 1: eHealth and Medical Engineering Workshop 2: Smart City	9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Workshop 3: Innovative Technologies for New Industry Creation Workshop 4: Environmental Humanities: Water, Air and Land for Sustainable Living Spaces Workshop 5: Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence	9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Workshop 6: GRANITE - Human-Centered Research and Transfer to Application Workshop 7: Human Security and Sustainability Workshop 8: Educational Change: New Models and New Thinking in Intercultural Concepts
12:00 - 12:15	19:00 – 19:15	Break Poster session (SpatialChat)	12:00 - 12:15	19:00 – 19:15	Break Poster session (SpatialChat)	12:00 – 12:15	19:00 – 19:15	Break Poster session (SpatialChat)
12:15 – 12:45	19:15 – 19:45	Sharing of experience: "What I learned today"	12:15 – 12:45	19:15 – 19:45	Sharing of experience: "What I learned today"	12:15 – 12:45	19:15 – 19:45	Sharing of experience: "What I learned today"
12:45 – 13:00	19:45 – 20:00	Closing Japanese-German Center Berlin (JDZB)	12:45 – 13:00	19:45 – 20:00	Closing Japan-German Society Kagawa	12:45 – 13:00	19:45 – 20:00	Closing ceremony Kagawa University European Japan Experts Association (EJEA)

Thank you very much for the support from the following institutes

Call for poster

EJEA Conference in Kagawa 2021

Human-centered Sustainability and Innovation for an AI-assisted Future:
New Interdisciplinary Education & Research for the Next Stages
in Japan and Europe

October 22nd - 24th, 2021
at Kagawa University in Takamatsu, Japan and Online
with Online and/or On-site Poster Presentations Session

jointly organized by

the European Japan Experts Association (EJEA), Kagawa University, Fraunhofer Institute for Applied Information Technology (FIT) and the Institute for Security and Development Policy (ISDP)

supported by

Japanese German Center Berlin (JDZB), EU-Japan Centre for Industrial Cooperation, the German Research Ambassadors Network for Industrial Technology Endeavors (GRANITE), Japan-German Society Kagawa (Japan), Kagawa Prefecture (Japan), JETRO Kagawa (Japan), Modular Management Group (Sweden), Takamatsu City (Japan), Women's International Shipping & Trading Association (WISTA Romania)

sponsored by

Kagawa Industry Support Foundation (Japan), Toshiba International Foundation (TIFO), Frontiers in Artificial Intelligence

Conference Website:

https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

EJEA Conference in Kagawa 2021 is calling for poster presentations and inviting you to participate in discussions about developing new advanced applications of AI with the aim to foster:

- ✓ new concrete interdisciplinary methods and models to achieve sustainable and resilient societies
- ✓ new areas of research and education as well as innovation and industrial application for the benefit of all generations
- ✓ new opportunities for and forms of cooperation and partnerships on a local, international and global level

Poster presentations by high schools and technical colleges students are also welcome.

Important Dates

- ✓ Submission deadline: September 15th 2021
- ✓ Notification of acceptance: September 30th 2021
- ✓ Early registration: September 30th 2021

Poster Session: Participants are encouraged to join both online and on-site poster presentations session, while the remote participants may join only the online poster session.

◆ Online (on-demand, not live) poster presentations for all participants:

- ✓ Participants are required to submit the files of their posters before the conference.
- ✓ Submitted posters will be opened for view of the registered participants during the conference period.
- ✓ Discussions (Q&A) will be done through the chat function.
- ✓ Further details will be announced soon.

◆ On-site poster presentations for participants in Kagawa only:

- ✓ The on-site, face-to-face poster presentations session will be held from 10:30 am to 2:30 pm JST, October 23rd (Sat) 2021 (Main discussion: from 1:00 pm to 2:30 pm JST)
- ✓ The contents of on-site posters should be the same as the online posters.
- ✓ Poster size: Portrait, W 800 mm x H 1200 mm or smaller, 1 page
- ✓ Please print out your posters, bring them to the venue, and remove them after the session.
  - ※ Should you have any difficulties in printing the posters, please contact the organizer for printing assistance.

Official Language: English

Conference Fee

- ✓ Free

Restriction

- ✓ Please be reminded that all the participants are prohibited from taking photos, screenshots, or video recording etc. during the poster presentations session.

Awards

- ✓ Awards will be presented to selected excellent poster presentations.
- ✓ Participation certificate will be issued upon request.

Submission

- ✓ Please visit the conference website and follow the instructions stated on the website.
- ✓ Please submit a one-page abstract. The template of abstract can be found at the following site.

  https://www.kagawa-u.ac.jp/files/7616/1586/1524/Template.docx
- ✓ Submission deadline: September 15th 2021.

✓ Notification date of acceptance or rejection: September 30th 2021

Registration

✓ All poster presenters are required to register before September 30th 2021 in order to secure a placement for the presentation. Please find information regarding the registration fee on the conference website.

✓ For more details, please visit the conference website.

Correspondence:

Secretary Office of the EJEA Conference in Kagawa 2021
ejea2021conf-c@kagawa-u.ac.jp
Administrative Group, International Office
National University Corporation Kagawa University
1-1 Saiwai-cho, Takamatsu, Kagawa, 760-8521 JAPAN

EJEA Conference in Kagawa 2021
ポスターセッション発表者募集のご案内

香川大学は、The European Japan Experts Association（EJEA), Fraunhofer Institute for Applied Information Technology（FIT)、The Institute for Security and Development Policy（ISDP）と共催で、AI が支援する未来に向けた人間中心のサステイナビリティとイノベーションを論議し、新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介を行うため、EJEA Conference in Kagawa 2021を開催します。本国際カンファレンスでは、以下の要領でポスターセッションを開催しますので、皆様には奮ってご発表、ご参加くださいますよう、お願いいたします。

皆様の積極的な発表応募をお待ちしております（応募登録締切：令和３年９月15日（木))。

日　　時　令和３年10月22日（金）～24日（日）
対面ポスターセッションは10月23日（土）に開催予定

会　　場　香川大学幸町キャンパス（高松市幸町1-1）　多目的ホール（対面セッション：予定）

対象分野　「AIが支援する未来に向けた人間中心のサステイナビリティとイノベーション」がテーマですので、関連する成果発表となります。
また上記テーマ以外でも、Sustainable Development Goals（持続可能な開発目標）や環境、人文科学など、幅広い分野に関する研究に加えて、教育等の取り組みに関する成果発表についても歓迎しますので、積極的な参加をお願いします。

実施形態　ポスターセッションは、対面セッションと、オンラインセッションから構成されます。
原則として対面・オンラインの双方への参加を前提としておりますが、遠隔地からの参加といった事情がある場合には、オンラインセッションのみへの参加も可能です。
なお、COVID-19の状況等によって、会場や実施形態が変更される場合があります。

◆　対面セッション

・10月23日（土）　午前10時30分～午後２時30分
・午前９時30分から10時30分の間にポスターを掲示してください。
・午後１時～午後２時30分　討議コアタイム（予定）
・高校生、高等専門学校生等については、複数名を発表者とすることが可能です。
・ポスターサイズ　800㎜×1200㎜以下　１枚
原則として、ポスターは発表者が印刷して当日持参してください。
持参が困難な場合は事務局で印刷することも可能ですので問い合わせ先に連絡をください。

◆　オンラインセッション

・10月22日（金）午前９時30分～10月24日（日）午後７時
・ライブではなく、オンデマンドのセッションを予定しています。
・発表者は、所定の期日までにポスターのファイル（pdf等、できれば音声付き）の提出をお願いします。

・ファイルの作成および提出方法については別途お知らせします。
・会議期間中、会議参加者はウェブサイトにてポスターが閲覧可能となります。
・質疑はウェブ上のチャット機能によって、文章のやり取りにて行われます。発表者は随時ウェブサイトを確認し、質問に適切に回答してください。
・ウェブサイトに接続可能な機器（スマートフォン、ノートPC等）が必要です。また、指定したアプリやソフトウェアの導入が必要である場合があります。オンラインセッションの詳細については追ってご連絡いたします。

応募資格　国内外の高校生、高等専門学校生、大学生、大学院生、および大学や研究機関、企業等に所属する研究者

使用言語　英語

禁止事項　ポスターの複写や録画、録音、撮影は一切お断り致します。講演資料の著作権は作成者または作成者の所属する組織が所有し、著作権法によって保護されています。著作権所有者の許可なく複製、二次利用することはできません。

表　　彰　高校生・高等専門学校生、大学生以上をそれぞれ対象として、優秀ポスターの表彰を予定しています。また、ポスター発表者の方には全員に参加証を発行いたします。

参加費用　高校生、高等専門学校生の発表者、共著者、指導教員は無料です。
それ以外の場合は所定の参加費の支払いが必要です。詳細は以下掲載のウェブサイトをご参照ください。

応募方法　・以下のウェブサイトを参照してください。なお、「アブストラクト」の提出が必要です。また、高校生、高等専門学校生は、所属機関を通じて申し込んでください
（所属機関の先生方へ：下記ウェブサイト上のEasyChairシステムから申し込んでください）。
・ご発表の採否については、実行委員会にご一任ください。採択された場合には、スケジュール記載の期日までに代表者宛にご連絡いたします。期日を過ぎても連絡が届かない場合には、以下の連絡先にお問い合わせください。
・EasyChairシステム入力の際にアカウントを作成する必要があります。アカウント作成には代表の方の氏名・有効な電子メールアドレスの入力が必要です。操作方法等で不明の点がある場合には、以下の連絡先に電子メールでお問い合わせください（電話連絡での質問はご遠慮ください）。

カンファレンスウェブサイト
https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/
「アブストラクト」テンプレート（A4版１ページ）
https://www.kagawa-u.ac.jp/files/7616/1586/1524/Template.docx

参加登録　本会議に参加される方は、参加費が無料の場合も含めて別途参加登録が必要です。以下のウェブサイトを参照して期日までに参加登録し、参加費のお支払い手続きをお済ませください。原則として９月30日（木）までに事前参加登録を終えてください
なお、高等学校、高等専門学校からご参加の場合には、学校単位で参加登録いただきます。９月30日（プログラム採否決定）の連絡と共に、登録フォームをお送りしますので、できるだけ速やかに参加登録を終えてください。

スケジュール

応募登録締切	令和３年９月15日（水）
採否決定連絡	令和３年９月30日（木）
事前参加登録期限	令和３年９月30日（木）
当日参加登録も承りますが、できる限り事前に参加登録をお願いします。	
会議開催	令和３年10月22日（金）～24日（日）
対面ポスターセッション	令和３年10月23日（土）

事務局（問い合わせ先）

EJEA Conference in Kagawa 2021事務局　ejea2021conf-c@kagawa-u.ac.jp
（担当）国立大学法人香川大学国際グループ
〒760-8521　香川県高松市幸町１番１号　Tel: 087-832-1318

EJEA Conference 2021 in Kagawaポスターセッション発表者募集のご案内

高等学校、高等専門学校向け

香川大学は、The European Japan Experts Association（EJEA), Fraunhofer Institute for Applied Information Technology（FIT)、The Institute for Security and Development Policy（ISDP）と共催で、AI が支援する未来に向けた人間中心のサステイナビリティとイノベーションを論議し、新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介を行うため、EJEA Conference in Kagawa 2021を開催します。本国際カンファレンスでは、以下の要領でポスターセッションを開催しますので、皆様には奮って発表、参加くださるよう、お願いします。

このたび実行委員会では、以下のように高校生や高等専門学校生の皆様に、ポスター発表の機会を提供させていただくことになりましたので、積極的な発表応募をお待ちしています。

日　　時　令和３年10月22日（金）～24日（日）
ポスターセッション（対面）は10月23日（土）に開催予定

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高校生、高等専門学校生については、日頃の活動等で行っている研究であれば、分野を問いません。

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◆　対面セッション（高校生、高等専門学校生はこちらが基本です）

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◆　オンラインセッション　（国内の遠隔地や海外からの発表を対象）

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応募資格　国内外の高校生、高等専門学校生

使用言語　英語とします。
ポスターおよび討論コアタイムでの最初の説明は英語でお願いします。
その後の質疑応答については、英語での会話が難しければ日本語でも構いません。

作成協力　英語でのポスター作成について、香川大学の協力が必要な場合には、教員が適切な範囲で協力させていただきます。必要な場合には、ご連絡ください。

禁止事項　ポスターの複写や録画、録音、撮影は一切お断り致します。講演資料の著作権は作成者または作成者の所属する組織が所有し、著作権法によって保護されています。著作権所有者の許可なく複製、二次利用することはできません。

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カンファレンスウェブサイト
https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/
「アブストラクト」テンプレート（A4版１ページ）
https://www.kagawa-u.ac.jp/files/7616/1586/1524/Template.docx

参加登録　本会議に参加される方は、別途参加登録が必要です。

高等学校、高等専門学校から参加の場合には、学校単位で参加登録いただきます。登録フォームをお送りしますので、できるだけ速やかに参加登録を終えてください。原則として９月30日（木）までに事前参加登録を終えてください。

スケジュール

応募の連絡締切	９月15日（水）までに、以下にメールで参加の意思をお知らせください。その際に、発表されるポスターの「タイトル名（日本語でも可）」をお知らせください。 原則参加を希望する皆様に発表いただきます。
事前参加登録期限	令和３年９月30日（木） 学校単位での参加登録をお願いします。
会議開催	令和３年10月22日（金）～24日（日）
対面ポスターセッション	令和３年10月23日（土）

事務局（問い合わせ先）

EJEA Conference in Kagawa 2021事務局　ejea2021conf-c@kagawa-u.ac.jp
（担当）国立大学法人香川大学国際グループ
〒760-8521　香川県高松市幸町１番１号　Tel: 087-832-1318

Call for company exibition（Japanese）

EJEA Conference 2021 in Kagawa
展示開催要項

EJEA Conference 2021 in Kagawaを、香川大学がEJEA（ヨーロッパ日本有識者協会）と共同主催して、2021年10月22日～24日に、対面とオンラインのハイブリッド形式で開催することとなりました。

エンジニアリングをはじめ様々な分野で利用される人工知能（AI）を使用する際に、如何にして「人間を中心」の展開をすることができるかを、教育および研究の分野とともに、イノベーションの観点から議論して行きます。日本、ヨーロッパを中心に、専門家と市民、企業、大学、研究機関、国際機関、行政機関等のステークホルダーやオピニオンリーダーおよび学生が参加する予定です。

新型コロナウィルス感染症の状況によっては発表形式などが変更になる可能性もあります。そのため、「パネル展示」および「ビデオ展示」の両方をご準備ください。よろしくお願いします。

以上の趣旨にご賛同いただき、御社や御機関のご活動について展示をお願い申し上げます。

⑴ パネル展示

1．展示日時

2021年10月23日（土） 10時30分～14時30分

2．展示場所

香川大学　グローバル・カフェ（仮）（幸町キャンパス　OLIVE SQUARE 2 階）

3．搬入・設営期間

2021年10月22日（金） 9 時～13時

2021年10月23日（土） 9 時～10時

（上記期間が困難な場合はご相談ください。）

4．撤収・搬出期間

2021年10月23日（土） 展示終了後

5．展示スペース

机（幅1800㍉×奥行4500㍉×高さ700㍉）１台、及び、バックパネル（横128㎝×縦170㎝）を１枚ご用意します。

パソコンをご使用になる場合は電源をお使いになれます。スペースと電源の関係で、大きな機器や100V以上の電源を必要とする機器の展示はご遠慮ください。

6．使用言語

英語でお願いします。

⑵ **ビデオ展示**

1．展示日時

2021年10月22日（金）～24日（日） カンファレンス開催中随時

2．展示方法

カンファレンスの開催中に、セッションの間等に上映します。

３分以内の動画としてご提供をお願いします。

3．動画ファイル形式等

動画ファイル形式、画像の解像度、画面縦横比は自由とします。ただし、主催者側で再生できないときは、修正をお願する場合がありますので予めご了承ください。

4．使用言語

英語でお願いします。

⑶ **その他申し込み要領**

1．出展料

無料

2．申込締切日

2021年８月31日（火）

スペースの関係上、先着順となりますのでお早目にお申込みください。

3．お申込み方法

メール件名を『EJEA展示』とご記載のうえ，下記のお申込み先までe-mailにて、⑴～⑵をご連絡ください。後ほど当方より、車両の入場・駐車場所・搬入経路及びビデオの受け渡し方法等につきましてご案内をいたします。

⑴ 機関・企業名

⑵ 担当者様の連絡先（氏名，住所，電話番号，e-mail）

〈お申込み・お問合わせ先〉

EJEA Conference in Kagawa 2021 事務局

e-mail: ejea2021conf-c@kagawa-u.ac.jp

（担当）国立大学法人香川大学国際グループ

〒760-8521 香川県高松市幸町１番１号　Tel: 087-832-1318

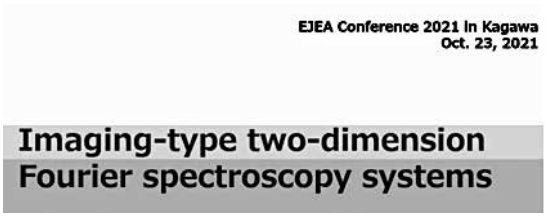
Introductory videos of institutes and companies
企業等紹介ビデオ

Since the exhibition session was cancelled due to COVID-19 outbreak, the introductory videos of the following 4 institutes and companies were shown repeatedly during the intervals of the sessions.

新型コロナウィルス感染症の蔓延のため、対面での展示を実施できなかったため、セッション間のインターバル等で、以下の４機関・企業の紹介ビデオを上映した。

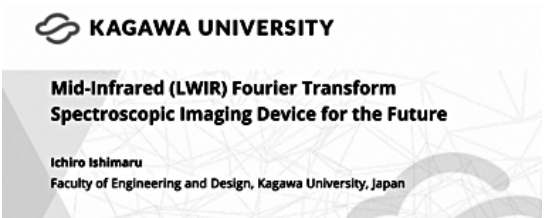
１．JETRO（Japan External Trade Organization）Kagawa
日本貿易振興機構（ジェトロ香川）

２．Nissin Kikai Co., Ltd.
株式会社日進機械



３．Melody International Ltd.
メロディ・インターナショナル株式会社

４．Innovation Design Institute, Kagawa University
香川大学イノベーションデザイン研究所



KAGAWA UNIVERSITY

Letter to partner universities

EUROPEAN JAPAN EXPERTS ASSOCIATION

8 July 2021

Dear partners and colleagues,

Greetings from Kagawa University, Japan.

We cordially invite you to participate in EJEA International Conference in Kagawa 2021. The conference is co-organized by Kagawa University and the theme is "Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe". We welcome participations not only from Japan and Europe but also from all the areas of the world.

The COVID-19 pandemic has changed our lifestyles and we tend to rely more on technologies to accommodate the New Normal. Due to the pandemic, we were rushed into the tide of "Digital Transformation", a process that we have been discussing for years, but now this long-term process that we thought has become reality within a short period of time.

This conference seeks to discuss how we can use AI in "human-centered" manner. In addition, this conference also aims to investigate the new models and methods in developing and realizing green / sustainable / secure and resilient initiatives to support local and global communities.

We plan to have 9 workshops with the following themes:

1. Educational Change: New Models and New Thinking in Intercultural Concepts
2. e-Health / Tele-Medicine / Medical Engineering
3. Smart City
4. GRANITE workshop
5. Environmental Humanities: Water, Air and Land for Sustainable Living Spaces
6. Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence
7. Human-Involvement in Technology Advancement
8. Human Security and Sustainability
9. Other topics

For Poster Presentation:

Please see the attachment of "CALL FOR POSTERS!".

Please encourage your undergraduate and graduate students to make presentations. Awards will be presented to selected poster presentation and participation certificates will be provided to all the participants.

For Oral Presentation:

We welcome any presentations which deal with the theme of the conference as well as the themes of the 9 workshops.

Sincerely yours,

Masaaki Tokuda, M.D. Ph.D.
Organizer of the EJEA Conference in Kagawa 2021
Vice-President for International Affairs, Kagawa University
Secretary Office of the EJEA Conference in Kagawa 2021
ejea2021conf-c@kagawa-u.ac.jp
Administrative Group, International Office
National University Corporation Kagawa University
1-1 Saiwai-cho, Takamatsu, Kagawa, 760-8521 JAPAN

Agenda

EJEA Conference 2021 in Kagawa on
Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe
22nd – 24th October 2021

Agenda of EJEA Conference 2021 in Kagawa

Day 1: Friday October 22, 2021			Day2: Saturday October 23, 2021			Day 3: Sunday October 24, 2021		
CEST	JST		CEST	JST		CEST	JST	
				11:30 – 14:30	Poster Session (Face-to-face) Olive Square@Kagawa University			
8:00 – 8:30	15:00 – 15:30	Opening ceremony Room A Mr. Takuya Hirai, The 1st Minister of Digital Agency, Japan Mr. Hideto Ônishi, Mayor of Takamatsu City Prof. Dr. Yoshiyuki Kakehi, President of Kagawa University Dr. Julia Münch, Secretary General JDZB Prof. Dr. Dietrich Albert, Chairperson of EJEA	8:00 – 8:15	15:00 – 15:15	Welcome and Introduction: Room A Dr. Lars Vargö, Director, ISDP Japan Center (Sweden)	8:00 – 8:15	15:00 – 15:15	Welcome and Introduction: Room A Dr. René Reiners, Fraunhofer FIT
8:30 – 8:35	15:30 – 15:35	Technical announcements: Room A	8:15 – 8:35	15:15 – 15:35	Keynote 3: Room A Prof. Dr. Satoshi Murayama	8:15 – 8:35	15:15 – 15:35	Keynote 5: Room A Prof. Dr. Hiroshi Tsuji
8:35 – 9:55	15:35 – 15:55	Keynote 1: Room A Dr. Yuko Harayama	8:35 – 8:55	15:35 – 15:55	Keynote 4: Room A Dr. Lucas Paletta	8:35 – 8:55	15:35 – 15:55	Keynote 6: Room A Dr. René Reiners
9:55 – 9:15	15:55 – 16:15	Keynote 2: Room A Prof. Dr. Fredrik Heintz	8:55 – 9:15	15:55 – 16:15	Presentation: Room A EU-Japan Centre for Industrial Cooperation	8:55 – 9:15	15:55 – 16:15	Keynote 7: Room A Mr. Colin de Kwant
9:15 – 9:30	16:15 – 16:30	Break Poster session (SpatialChat)	9:15 – 9:30	16:15 – 16:30	Break Poster session (SpatialChat)	9:15 – 9:30	16:15 – 16:30	Break Poster session (SpatialChat)
9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Workshop 1: eHealth and Medical Engineering Room B Workshop 2: Smart City Room A	9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Workshop 3: Innovative Technologies for New Industry Creation Room A Workshop 4: Environmental Humanities: Water, Air and Land for Sustainable Living Spaces Room B Workshop 5: Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence Room C	9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Workshop 6: GRANITE - Human-Centered Research and Transfer to Application Room C Workshop 7: Human Security and Sustainability Room A Workshop 8: Educational Change: New Models and New Thinking in Intercultural Concepts Room B
12:00 – 12:15	19:00 – 19:15	Break Poster session (SpatialChat)	12:00 - 12:15	19:00 – 19:15	Break Poster session (SpatialChat)	12:00 – 12:15	19:00 – 19:15	Break Poster session (SpatialChat)
12:15 – 12:45	19:15 – 19:45	Sharing of experience: Room A "What I learned today"	12:15 – 12:45	19:15 – 19:45	Sharing of experience: Room A "What I learned today"	12:15 – 12:45	19:15 – 19:45	Sharing of experience: Room A "What I learned today"
12:45 – 13:00	19:45 – 20:00	Closing Room A Japanese-German Center Berlin (JDZB)	12:45 – 13:00	19:45 – 20:00	Closing Room A Japan-German Society Kagawa	12:45 – 13:00	19:45 – 20:00	Closing ceremony Room A Poster Awarding Ceremony Kagawa University European Japan Experts Association

URLs for Room A, B and C will be provided after your registration. For more information visit the conference web site: https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

Program

EJEA Conference 2021 in Kagawa on
Human-centered Sustainability and Innovation for an AI-assisted Future:
New Interdisciplinary Education & Research for the Next Stages in Japan and Europe
AIが支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：
新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介
October 22nd - 24th, 2021 hosted by Kagawa University, Kagawa（Japan）
The conference is managed online on Zoom

Program

Day 1: Friday October 22, 2021		
CEST	JST	
8:00 – 8:30	15:00 – 15:30	Room A Opening Ceremony Mr. Takuya Hirai, The 1st Minister of Digital Agency（video message） Mr. Hideto Ônishi, Mayor of Takamatsu City Prof. Dr. Yoshiyuki Kakehi, President of Kagawa University（video message） Dr. Julia Münch, Secretary General, Japanese-German Centre Berlin, JDZB（video message） Prof. Dr. Dietrich Albert, Chairperson European Japan Experts Association, EJEA
		Moderation: Kagawa University Prof. Dr. Masaaki Tokuda, Kagawa University
8:30 – 8:35	15:30 – 15:35	Room A Technical announcements Photo session（Screenshots）
8:35 – 8:55	15:35 – 15:55	Room A Keynote 1: Dr. Yuko Harayama, Executive Director RIKEN（Japan） former Executive Member of Council for Science, Technology and Innovation “Human in the Loop or Human-centered”
8:55 – 9:15	15:55 – 16:15	Room A Keynote 2: Prof. Dr. Fredrik Heintz, Linköping University, Dept. of Computer and Information Science（Sweden）; EU Commission High-Level Expert Group on AI “Education for an AI-assisted Future - From Primary Education to Life-Long Learning”
9:15 – 9:30	16:15 – 16:30	SpatialChat Poster session / Break
9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Room B Workshop 1: eHealth and Medical Engineering chaired by Prof. Dr. Kazuhiro Hara and Prof. Dr. Ichiro Ishimaru, Kagawa University（Japan） • Ichiro Ishimaru, Kagawa University（Japan） “Mid-infrared（LWIR）passive-active spectroscopic imaging for non-invasive blood glucose sensors” • Lorenz Granrath, Tohoku University（Japan） “EU-Japan Project E-VITA - a Virtual Coach for Smart Aging”

9:30 – 12:00	16:30 – 19:00	• Hirotsugu Yamamoto, Utsunomiya University, (Japan) "Fundamentals and Applications of Aerial Display" • Lingbing Kong, Kagawa University (Japan) "Multidisciplinary Approaches and AIs" • Kazuhiro Hara, Kagawa University (Japan) "Development of ultra-small mobile CTG and its effectiveness on remote monitoring of the expecting mothers, as well as its global expansion" • Yhuko Ogata, CEO, Melody International Co. Ltd. (Japan) "Developing medical devices for e-health to work towards the overseas" • Tetsuo Minamino, Kagawa University, (Japan) "Development of a Novel Program to Detect Atrial Fibrillation Using Pulse Wave from Automated Blood Pressure Monitor" Room A Workshop 2: Smart City chaired by Mr. Orfeas Voutyras, National Technical University of Athens (NTUA) (Greece) • Orfeas Voutyras, National Technical University of Athens (NTUA) (Greece) "The rise of Smart Cities" • Lars Vikinge, Jakob Algulin, City of Linköping (Sweden) "City of Linköping – a Smart City!" • Takahiro Ozawa, Takamatsu City (Japan) "Smart City Takamatsu: Solutions for Disaster Prevention/Management" • City of Santander (Spain) • Tatsuo Fukuda, Fujisawa City (Japan), Jin Nakazawa, Keio University (Japan) "Secure and Trustworthy Mobile Participatory Sensing over M-Sec Platform" • City of Malmö (Sweden)
12:00 – 12:15	19:00 – 19:15	SpatialChat Poster session / Break
12:15 – 12:45	19:15 – 19:45	Room A Sharing of experience: "What I learned today" By co-chairs of workshops 1 and 2
12:45 – 13:00	19:45 – 20:00	Room A Closing Dr. Phoebe Stella Holdgrün Head of Project Management, Japanese-German Center Berlin (JDZB)

Day2: Saturday October 23, 2021		
CEST	JST	
	11:30 – 14:30	Poster Session (Face to Face) Olive Square @ Kagawa University
8:00 – 8:15	15:00 – 15:15	Room A Welcome and Introduction Institute for Security and Development Policy (ISDP) Dr. Lars Vargö, Director, ISDP Japan Center (Sweden)
		Moderation: European Japan Experts Association (EJEA) Prof. Dr. Anders Törnvall, EJEA Executive Committee, Linköping University (Sweden)
8:15 – 8:35	15:15 – 15:35	Room A Keynote 3: Prof. Dr. Satoshi Murayama, Co-convener of the International Consortium for Earth and Development Sciences, Kagawa University (Japan)

8:15 – 8:35	15:15 – 15:35	"Environmental humanities: a long-term local history approach to living spaces to be sustained"
8:35 – 8:55	15:35 – 15:55	Room A Keynote 4: Dr. Lucas Paletta, Human Factors Lab at Joanneum Research Forschungsgesellschaft mbH, DIGITAL – Institute for Information and Communication Technologies (Austria) "Cognitive Sensing for Future Smart Health and Care"
8:55 – 9:15	15:55 – 16:15	Room A Presentation: Dr. Philippe de Taxis du Poët Managing Director, EU-Japan Centre for Industrial Cooperation (video message)
9:15 – 9:30	16:15 – 16:30	SpatialChat Poster session / Break
9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Room A Workshop 3: Innovative Technologies for New Industry Creation chaired by Prof. Dr. Kiyoshi Tanaka, Shinshu University (Japan) and Prof. Dr. Tomohiko Ishii, Kagawa University (Japan) • Xing Wang, Kagawa University (Japan) "Lithium-ion Battery Anode of Mesocrystalline CoTiO3/TiO2 Nanocomposite with Extremely Enhanced Capacity" • Kaisei Harada, Kagawa University (Japan) "Development of Air Supply System for Wearable Robot-Effectiveness of Hollow Cylindrical-shaped Variable Volume Tank" • Tomoya Kitazaki, Kagawa University (Japan) "Mid-infrared Passive Spectroscopic Imaging of Microplastics Using Imaging-type 2-D Fourier Spectrometer for Wide-field Measurements" • Haruto Adachi, Kagawa University (Japan) "Real-Time Infrared Spectroscopic Monitoring of Fermentation Process to Support Sensory Evaluation" • Endi Kazuto Takeda, Kyushu University (Japan) "Modelling and Simulation of Introduction of RFID in Warehousing of a Supply Chain" • Takaki Nishimura, Kagawa University and others (Japan) "Theoretical Research Aiming at High-efficiency Hydrogen Production Using Solar Thermochemical Energy for the Goal of Sustainable Energy Supply" • Takuya Mitani, Kagawa University (Japan) "Relationship Between the Joint Angle and the Contact Force at the Knee During Walking" Room B Workshop 4: Environmental Humanities: Water, Air and Land for Sustainable Living Spaces chaired by Prof. Dr. Satoshi Murayama and Prof. Dr. Toru Terao, Kagawa University (Japan) • Lrong Lim, Kagawa University (Japan) "Contributing Towards Sustainable Living via Environmental Cleaning - a Community-based Movement in Action -" • Kazuhiko Ichimi, Kagawa University (Japan) "Global warming as one of the causes of decrease in fisheries resources; the case of Manila clam" • Kuninao Tada, Kagawa University (Japan) "Environmental Conservation and Fishery of the Seto Inland Sea, Japan" • Hirotoshi Tamura, Kagawa University (Japan)

		"Green Chemistry for the Investigation of Agricultural Products and Functional Foods: Statistical Approach" • Takahiro Yamamoto, Kagawa University (Japan) "A Study on Estimation of Air Conditioning Load from Human Body and Equipment Using Image Analysis" • Masahito Katoh, Shinshu University (Japan) "The Practical Application of Smart Precision Forestry Project Using Laser Scanning for an AI-assisted in Japan" • Gaurav Vikash Bhuyan, Gauhati University (India) "Community Response to Local Environment: Reflection in Certain Micro-Landscapes of the Brahmaputra River Valley in Assam, India" • Anjaneyulu Akkimi, Indian Inst. of Technology Guwahati (India) "Modeling for Prediction of Extreme Floods in Urban Landscapes: Developing Land for Sustainable Living Spaces during Floods" • Soumya Guchhait, Indian Inst. of Technology Guwahati (India) "Socio-hydrological aspects of event-based flood hazard in Assam, India" • Nazmul Huda, Kagawa University (Japan) "Influence of Natural Disasters on Surface Water: A Spatiotemporal Study in A Disaster-Prone Area from 1988 to 2021" • A.T.M. Shakhawat Hossain, Jahangirnagar University (Bangladesh) "Risk Associated with Rohingya Refugee Settlements at Ukhia Camp, Cox's bazar, Bangladesh - A Threat for Sustainable Development"
9:30 – 12:00	16:30 – 19:00	Room C Workshop 5: Distributed Cognition in Learning and Behavioral Change - Based on Human and Artificial Intelligence chaired by Prof. Dr. Dietrich Albert, University of Graz (Austria), Prof. Dr. Xiangen Hu, The University of Memphis (USA) & Central China Normal University (China), Prof. Dr. Tomoko Kojiri, Kansai University (Japan), and Dr. Paul C. Seitlinger, University of Vienna (Austria) • Dietrich Albert, University of Graz (Austria) "Do We Need a Holistic Interpretation of 'Distributed Cognition'? Past and Future Research Questions with respect to AI" • Daniel Wolferts, Fraunhofer FIT (Germany) "Remote Design Thinking for Sustainability - Investigating the Role of Distributed Cognition" • Toshihiro Hayashi, Kagawa University (Japan) "Conceptual Structure of an Intelligent Educational Support System Using Various Kinds of Cognitive Characteristic Information" • Xiangen Hu, The University of Memphis (USA), Central China Normal University (China) "Self-Improvable Adaptive Instructional Systems (SIAIS)" • Vasile Rus, The University of Memphis (USA) "Models of Learner-Teacher-EdTech Partnerships in the Future Learning" • Tomoko Kojiri, Kansai University (Japan) "Visualization System of Nonverbal Information in Medical Interviews for Training Doctors' Credible Attitude" • Michael Öllinger, Parmenides Center for the Study of Thinking & Cognostics AG (Austria) "Distributed Cognition in Innovative Problem Solving" • Paul Seitlinger, University of Vienna (Austria) "Distributed Cognition in Modeling Cross-Modal Short-Term Memory for the Design of Smart Sensory Prostheses" • Yulia Zhiglova, Tallinn University (Estonia) "BeMe Jacket - Using Vibrotactile Body-Centric Displays for Distributed Emotion Regulation"

9:30 – 12:00	16:30 – 19:00	• Gerald Steinbauer-Wagner, TU Graz (Austria) "Robust Joint Plan Execution in Teams of Mobile Robots"
12:00 – 12:15	19:00 – 19:15	SpatialChat Poster session / Break
12:15 – 12:45	19:15 – 19:45	Room A Sharing of experience: "What I learned today" By co-chairs of workshops 3, 4 and 5
12:45 – 13:00	19:45 – 20:00	Room A Closing Prof. Dr. Takahiro Shinyo (video message) Senior Advisor for the Japan-German Society Kagawa

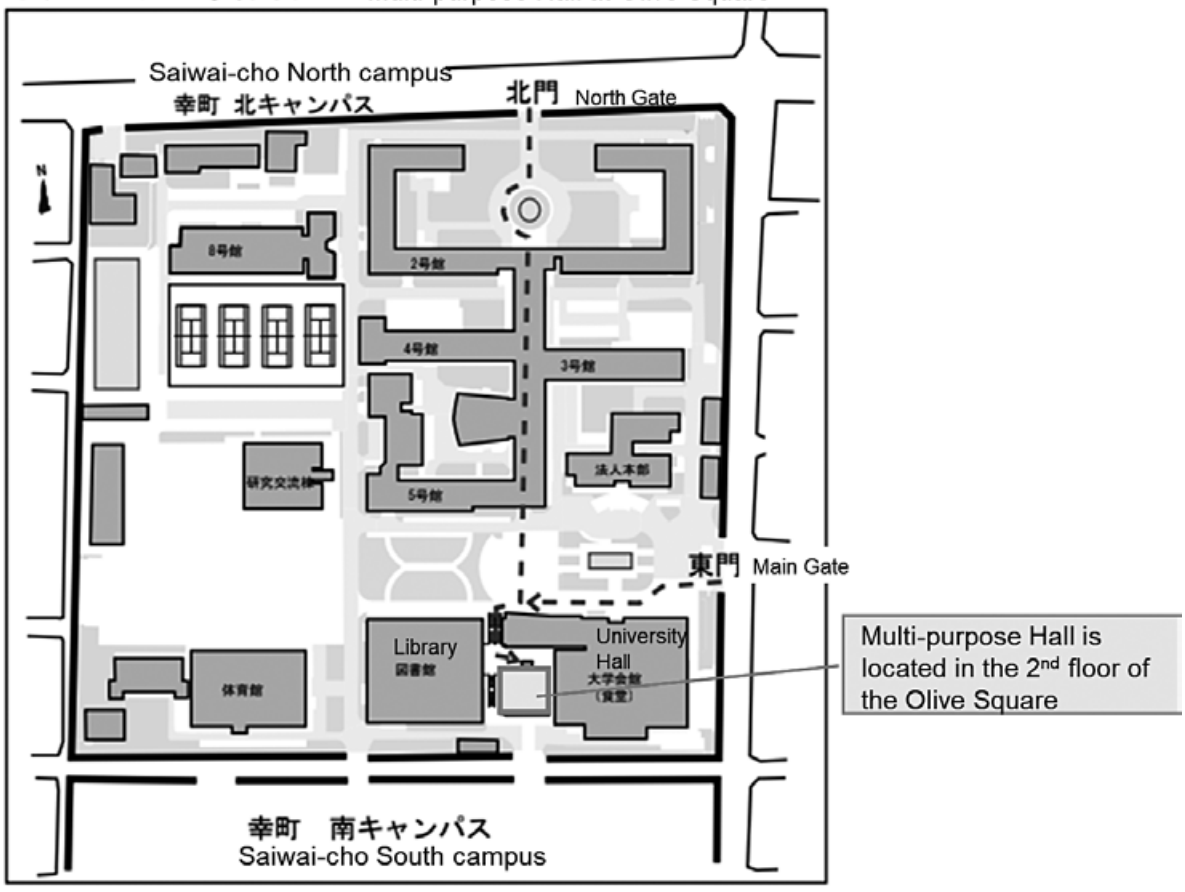
Day 3: Sunday October 24, 2021		
CEST	JST	
8:00 – 8:15	15:00 – 15:15	Room A Welcome and Introduction Fraunhofer Institute for Applied Information Technology (FIT) Dr. René Reiners, Head of Human-centered Engineering and Design
		Moderation: Fraunhofer Institute for Applied Information Technology (FIT) Elisabeth Stein and Daniel Wolferts
8:15 – 8:35	15:15 – 15:35	Room A Keynote 5: Prof. Dr. Hiroshi Tsuji, Executive Director, University Public Corporation Osaka (Japan), former President of Osaka Prefecture University (Japan) "From 45 Years' Experience on R&D and Education of Systems Sciences"
8:35 – 8:55	15:35 – 15:55	Room A Keynote 6: Dr. René Reiners Head of Human-centered Engineering and Design at Fraunhofer Institute for Applied Information Technology FIT (Germany), Coordinator of GRANITE "Human-Centered System Design for Successful Digital Transformation"
8:55 – 9:15	15:55 – 16:15	Room A Keynote 7: Mr. Colin de Kwant, Vice President Modular Management®; Lecturer at Royal Institute of Technology (Sweden) "Sustainable Mobility Scenario Modeling: Evaluating Future Resilience of Modular Concepts for Electrified Trucks"
9:15 – 9:30	16:15 – 16:30	SpatialChat Poster session / Break
9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Room C Workshop 6: GRANITE - Human-Centered Research and Transfer to Application chaired by Dr. René Reiners, Fraunhofer FIT (Germany) and Prof. Dr. Satoru Takahashi, Kagawa University (Japan) • Lena Brüch, Fraunhofer FIT (Germany) "A Practical Approach of Integrating Sustainability Goals in the Human-Centered-Design-Process" • Takefumi Mokudai, Kyushu University (Japan)

9:30 – 12:00	16:30 – 19:00	"Digital Technologies as Lean Augmentation: A Preliminary Study of Japanese Automotive Manufacturers" • Satoru Adachi, Kagawa University (Japan) "Planck's Law Base Function for Background Correction of Remote Sensing with Compact and High-Sensitivity Mid-Infrared Spectrometer" • Anika Isabelle Rieth, Fraunhofer FIT (Germany) "Service Design for Beneficial Technology Integration: Looking into the Case Study of Renova" • Minoru Inadama, Nagano Prefectural Government (Japan) "Disaster-Resistant Hydropower Microgrid Construction and Smart Conservation Initiatives in Nagano Prefecture" • Mai Murabayashi, Kagawa University (Japan) "Functional Verification and Structural Evaluation of Transfemoral Prosthetic Knee Mechanism for Running" • Tatsuya Usui, Osaka University (Japan) "Soft Capacitive Tri-axis Tactile Sensor Based on Level Sensing" • Dominik Pins, Fraunhofer FIT (Germany) "Challenges and Concepts for the Evaluation of Usable and Satisfying VAs According to DIN EN ISO 9241-11 and -110" Room A Workshop 7: Human Security and Sustainability chaired by Dr. Lars Vargö, Director Japan Center, Institute for Security and Development Policy (Sweden) • Renée Schulz, JRCS. Co. Ltd. (Japan) "AI and HCI come together for the Digitalization of the Maritime Industry to Foster a Sustainable, Innovative and Safe Work Environment" • Colin de Kwant, Modular Management (Sweden) "Sustainable Mobility Scenario Modeling, Evaluating Future Resilience of Modular Concepts for Electrified Trucks" • Sudha Jamthe, Stanford University (USA) "Character Development for Artificial Intelligence" • Kazuya Ishii, Kagawa University (Japan) "SDGs in the Anthropocene: A Gandhian Critique" • Masatoshi Imai, Kagawa Junior College (Japan) "A Proposal of Numerical Approach of Quantitative Verification of Check List to Support Human Digital Security through Kansei Engineering" Room B Workshop 8: Educational Change: New Models and New Thinking in Intercultural Concepts chaired by Prof. Dr. Toshihiro Hayashi, Kagawa University (Japan) and Prof. Dr. Anders Törnvall, Linköping University (Sweden) • Michal Cerný, Masaryk University (Czech Republic) "Extended Mind as a Way for Education in the Networked World" • Khalifa Sy, Kagawa University (Japan) "Extracting Learning Path Data from Learning History" • Toru Takamizu, Kagawa University (Japan) "Online Japanese Language Education for Elementary Level Learners" • Nik Anni Afiqah bitni Haji Mohammad Tuah, Brunei Darussalam University (Brunei) "The Transition from Traditional to Online Learning: what are the new approaches and challenges for higher education during the pandemic?"
12:00 – 12:15	19:00 – 19:15	SpatialChat Poster session / Break

12:15 – 12:45	19:15 – 19:45	Room A Sharing of experience: “What I learned today” By co-chairs of workshops 6, 7, and 8
12:45 – 13:00	19:45 – 20:00	Room A Closing Ceremony Poster Awarding Ceremony, Prof. Dr. Kenji Wada, Kagawa University　Kagawa University, Prof. Dr. Masaaki Tokuda European Japan Experts Association (EJEA), Sabine Ganter-Richter, Executive Manager

Venue of the Poster Session (Face-to-face)

オリーブスクエア多目的ホール Multi-purpose Hall at Olive Square



https://www.kagawa-u.ac.jp/files/6715/1175/5632/Olive_Square.pdf

Poster Presentation

October 22, 23, 24, 2021		
CEST	JST	
	October 23 11:30 – 14:30	Poster Session (Face to Face) Olive Square @ Kagawa University
October 22, 23, 24 9:15 – 9:30 12:00 – 12:15	October 22, 23, 24 16:15 – 16:30 19:00 – 19:15	Poster Session (Online, P01 – P04) SpatialChat @ http://spatial.chat/s/ejea-kagawa

P01 Sachiko Somaki (Osaka Medical and Pharmaceutical University, Japan), Yukie Majima, Seiko Masuda and Yumiko Nakamura (Osaka Prefecture University, Japan)
"Education Support System for Newcomer Nurses at Visiting Nursing Stations" (online discussions only)

P02 Koji Mikami, Yukie Majima and Seiko Masuda (Osaka Prefecture University, Japan)
"Proposal of a System Enhancing Self-affirmation Using LINE Chatbots for Elementary School Students"
(online discussions only)

P03 Naoki Yaemoto and Shoichi Maeyama (Kagawa University, Japan)
"Development of the second prototype of a half drone inverted pendulum transportation robot to improve the safety and the controllability"

P04 Masataka Yatsuzuka, Masahide Ishizuka, Satoshi Murayama and Toru Terao (Kagawa University, Japan)
"Location of wells and groundwater distribution in Teshima Island, Japan. Environmental humanities approach and hydrological simulation"

P05 Takeshi Kasai and Atsuko Nonomura (Kagawa University, Japan)
"Verification of human resources development methods for continuous disaster prevention and crisis management unique to local governments"

P06 Naoya Matsuda, Tomohiro Tsubata and Yukihiko Okumura (Kagawa University, Japan)
"NOx reaction analysis of ammonia flame burner with hydrogen stabilizer"

P07 Tomohiro Tsubata, Naoya Matsuda and Yukihiko Okumura (Kagawa University, Japan)
"Effect of reaction scheme on the structure of ammonia turbulent flame"

P08 Kosuke Hoshika, Kira Kagawa and Yukihiko Okumura (Kagawa University, Japan)
"Combustion characteristics of NH3/H2 premixed flames and mechanism of NOx formation"

P09 Izumi Funahashi (Kagawa Prefectural Marugame High School, Japan)
"Study about relationship between walking habit and lack of exercise"

P10 Anna Mimuro (Kagawa Prefectural Marugame High School, Japan)
"To increase the recycling rate of Marugame city"

P11 Kokoa Shirakawa, Yuna Tao and Sora Kondo (Kagawa Prefectural Kan-onji Daiichi High School, Japan)
"Investigating the Mechanism of the Marsilea Mutica's Nyctinastic Movements"

P12 Haruchika Onishi, Natsuki Koyama and Airi Toyoura (Kagawa Prefectural Kan-onji Daiichi High School, Japan)
"The Relationship Between the Crystalline Lens and Vitreous Humour's Quality in Fish Freshness"

Day 3: Sunday October 24, 2021		
12:45 – 13:00	19:45 – 20:00	Room A in Closing Poster awarding by Kagawa University and EJEA

Note:
1) Red-color numbered posters will be mainly discussed at the online poster session.
2) Face-to-face poster presentation will be held at Multi-purpose room in Olive Square, Kagawa University on October 23 (Sat) 11:30-14:30.
3) Online poster presentation using "SpatialChat" will be held 16:15-16:30 and 19:00-19:15 every day.

Message from the President of Kagawa University

Mr. Takuya Hirai, the Former Minister for Digital Transformation, Mr. Hideto Onishi, Mayor of Takamatsu City, Dr. Julia Münch, Secretary General, Japanese German Center Berlin, Professor Dr. Dietrich Albert, chairperson of the European Japan Experts Association (EJEA), Dr. Yuko Harayama, Executive Director of RIKEN, Professor Dr. Fredrik Heintz, Linköping University, distinguished guests, researchers, ladies, and gentlemen.

I am Kakehi Yoshiyuki, President of Kagawa University. It is a great honor for Kagawa University to co-organize the EJEA International Conference for the first time in Japan.

This International Conference, titled "Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe", was initially planned to be held physically in Kagawa University.

However, due to COVID-19 outbreak, it turned out to be an online conference. I regret that we are unable to welcome delegates from all over the world to Kagawa, which is in Shikoku Island, one of the four major islands of Japan, where beautiful nature and traditions are well preserved.

The COVID-19 pandemic put a sudden stop on our daily activities, and forced us to change our lifestyles. People all over the globe tried to adjust and modify the daily routines with new digital technologies, making a rush into the era of "digital transformation".

Universities have been struggling to upkeep education and research activities, and Kagawa University has fortunately been successful to rapidly build up the digital environment based on our "Digital Campus Strategy".

Personally, I am aware of the big advantages which can be brought about by digitalization, such as Internet of Things and artificial intelligence. As the leader of the university, I have tried to take advantage of these technologies as effectively as possible. However, I also know that it is very important for us not to fully depend upon digitalization. Especially in education, students must learn a lot from the real world. In other words, they are influenced, enlightened and encouraged by various encounters in the real world.

The theme of this conference allows participants to discuss how we use the digital technologies in a human-centered manner and how we develop innovation through such approaches. Over 80 presentations, with speakers from 11 countries are planned, including 7 keynote lectures and 60 oral presentations in 8 workshops. We also have 12 poster presentations including 4 ones by high school students from Kagawa Prefecture.

I would like to thank everyone involved in this conference, dignitaries, speakers, participants, and organizers, for your efforts to make this conference a big success. Last, but not least, I would like to convey my hopes that your participation in this conference will offer new information, knowledge, skills and network building through mutual discussion and sharing of expertise.

Please enjoy EJEA International Conference 2021 in Kagawa Prefecture.

Thank you very much.

Prof. Dr. Kakehi Yoshiyuki

President of Kagawa University

Information for participants

EJEA Conference 2021 in Kagawa
Important Information for the Participants

After your registration, all important information such as links and passwords has been delivered to you by the organizing committee.

1. Zoom links for the parallel workshop sessions:

Zoom link for REGISTRATION	
Room A	https://kagawa u ac jp.zoom.us/meeting/register/tZItfuirqz4pGdzhGs7dsgmk5EiqY5YXRJ93
Room B	https://kagawa u ac jp.zoom.us/meeting/register/tZYsceupqT8qHNBa3jNefZj6rTRy8xn2wJCw
Room C	https://kagawa u ac jp.zoom.us/meeting/register/tZAscuGhqTMsHNLkeX3nE5KqZQmotyiqE7lS

2. SpatialChat links
   Live website https://spatial.chat/s/ejea kagawa
   Effective from 8:00 (CEST) 15:00 (JST) 22nd Oct to 13:00 (CEST) 20:00 (JST) 24th Oct.
3. Abstract Book is uploaded in the webpage and will be distributed as a non printable, non editable pdf file and are protected by the password.
4. We record all sessions for our internal purposes and the recordings of the keynotes will be published later.
5. We take screenshots in all sessions for our internal purposes.
   A screenshot at the opening ceremony will be published so those who don't wish to be shot please make your camera off.
6. Please be sure to mute yourself (microphone off) and camera off during the session unless you are currently talking.
7. Please make questions to the presenter using the built in CHAT box.

EJEA Conference 2021 in Kagawa
Room A Please wait a moment until the starting time.

日独交流160周年
Jahre Freundschaft
Deutschland–Japan

	CEST	JST	Programme
Oct. 22	8:00 – 8:30	15:00 – 15:30	Opening ceremony
	8:30 – 8:35	15:30 – 15:35	Conference introduction
	8:35 – 8:55	15:35 – 15:55	Keynote 1: Dr. Yuko Harayama
	8:55 – 9:15	15:55 – 16:15	Keynote 2: Prof. Dr. Fredrik Heintz
	9:15 – 9:30	16:15 – 16:30	Break / Poster Session (Spatial Chat)
	9:30 – 12:00	16:30 – 19:00	Parallel Sessions: Workshop 2: Smart City
	12:00 – 12:15	19:00 – 19:15	Break / Poster Session (Spatial Chat)
	12:15 – 12:45	19:15 – 19:45	Sharing of experience:"What I learned today"
	12:45 – 13:00	19:45 – 20:00	Closing

Thank you very much for the support from the following institutes

Confidential

Dear participants,

Thank you for the registration.
It is our honor and pleasure to welcome you to EJEA Conference 2021 in Kagawa.
Various information such as Program, Brochure, Abstracts of Keynote Speakers, Instruction for Poster Presentation and Registration method has been updated and is available in EJEA Conference homepage.
https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

◆ Abstract book will be uploaded later.
You need a password to open Abstract Book.

◆ All oral presentations will be carried out as Online ZOOM sessions.
The main events will be performed in Room A.
For the parallel workshops, Room B and Room C will also be used in addition to Room A.
To make an access to Room A, B and C, please use the following URLs.
Room A: https://kagawa-u-ac-jp.zoom.us/meeting/register/tZItfuirqz4pGdzhGs7dsgmk5EiqY5YXRJ93
Room B: https://kagawa-u-ac-jp.zoom.us/meeting/register/tZYsceupqT8qHNBa3jNefZj6rTRy8xn2wJCw
Room C: https://kagawa-u-ac-jp.zoom.us/meeting/register/tZAscuGhqTMsHNLkeX3nE5KqZQmotyiqE7lS
These URLs will be the same throughout 3 days of the EJEA Conference.

◆ Face to face poster session
Face to face participants are restricted to those from Kagawa Prefecture, Japan.
- The venue : Olive Square at Kagawa University.
  See the map
  https://www.kagawa-u.ac.jp/files/6715/1175/5632/Olive_Square.pdf
- Posters should be mounted during 11:30 -12:30（JST）on Oct.23rd.
- Core time is 13:00-14:30（JST）. Presenters are required to be near the poster during the core time.

◆ Online poster session
Posters P01 to P04 can be seen on-line and all participants can discuss about the topics via “SpatialChat“ system.
SpatialChat time is scheduled every day during the conference before and after the workshop. Poster presenters are strongly recommended to join the system and discuss with the virtual visitors. Please use URL shown below to enter the virtual poster session room（during the scheduled time）
SpatialChat link: http://spatial.chat/s/ejea-kagawa

This link and Password are effective from 8:00 (CEST) 22 Oct to 13:00 (CEST) 24 Oct.
The instruction of the poster session is also provided in our home page.

◆ Naming rules: Please follow the naming rules below at Zoom and SpatialChat.

- ✓ Chair: [Chair] SURNAME Middle and given name (Affiliation in short)
  ex. [Chair] TOKUDA Masa-aki (Kagawa U)
- ✓ Keynote lecturer: [KL] SURNAME Middle and given name (Affiliation in short)
  ex. [KL] SANUKI Taro (Kagawa U)
- ✓ Oral presenter: [WS No] SURNAME Middle and given name (Affiliation in short)
  ex. [WS3] SAIWAI Hanako (Kagawa U)
- ✓ Poster presenter: [poster No] SURNAME Middle and given name (Affiliation in short)
  ex. [P05] SETOUCHI Kaito (Shikoku U)
- ✓ Other participants: SURNAME Middle and given name (Affiliation in short)
  ex. NAOSIMA Lemon (Umi Corp)

If you have any questions or problems, please contact us via E-mail.
We hope you can enjoy this conference.
All the best,

Organizing Committee
EJEA Conference in Kagawa 2021
E-mail: ejea-reg-c@kagawa-u.ac.jp
Webpage: https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf

取り扱い注意

参加者各位

ご登録ありがとうございます。
EJEA Conference 2021 に皆様をお迎えできることを光栄に思います。
プログラム、パンフレット、基調講演者の抄録、ポスター発表の説明、登録方法など、さまざまな情報が更新され、EJEA カンファレンスのホームページで入手できます。
https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

◆ Abstract 集は後日ホームページにアップしますのでダウンロードしてください。
開けるにはPasswordが必要になります。

◆ すべての口頭発表は、オンラインZOOM セッションとして実施されます。
主なイベントはRoom A で行われます。
ワークショップでは、Room A に加えてRoom B とRoom C も使用されます。
Room A、Room B、C にアクセスするには、次のURL を使用してください。
Room A：https：//kagawa-u-ac-jp.zoom.us/meeting/register/tZItfuirqz4pGdzhGs7dsgmk5EiqY5YXRJ93
Room B：https：//kagawa-u-ac-jp.zoom.us/meeting/register/tZYsceupqT8qHNBa3jNefZj6rTRy8xn2wJCw
Room C：https：//kagawa-u-ac-jp.zoom.us/meeting/register/tZAscuGhqTMsHNLkeX3nE5KqZQmotyiqE7lS
これらのURL は、EJEA カンファレンスの 3 日間を通じて同じになります。

◆ 対面ポスターセッション
ポスターセッションは、オンラインと対面の両方で開催されます。
対面の参加者は、香川県からの参加者に限定されていますのでご注意ください。
- 会場：香川大学オリーブスクエア（高松市幸町 1 － 1 ）
  地図　https://www.kagawa-u.ac.jp/files/6715/1175/5632/Olive_Square.pdf
- ポスターは10月23 日（土）11：30〜12：30（日本時間）に設置してください。
- コアタイムは13：00-14：30（日本時間）です。発表者は、ポスターの近くに居て説明をお願いします。

◆ オンラインポスターセッション
P01からP04のポスターは「SpatialChat」システムを介してオンラインで見ることができ、ディスカッションすることができます。
SpatialChat の時間は、ワークショップの前後の時間帯（それぞれ15分ずつ）にセットされています。下記のURL でバーチャルポスターセッションルームにご入場ください。
SpatialChat：http://spatial.chat/s/ejea-kagawa
ここに入るにはパスワードが必要です。
このリンクおよびPassword は、日本時間の10月22日15：00から10月24日20：00のみ有効です。
ポスターセッションの実施要領は、ホームページに掲載されています。

◆ ZoomやSpatialChat で参加される時の名前の表記については以下のようにお願いします。

- ✓ Chair: [Chair] SURNAME Middle and given name (Affiliation in short)
  例 [Chair] TOKUDA Masa-aki (Kagawa U)
- ✓ Keynote lecturer: [KL] SURNAME Middle and given name (Affiliation in short)
  例 [KL] SANUKI Taro (Kagawa U)
- ✓ Oral presenter: [WS No] SURNAME Middle and given name (Affiliation in short)
  例 [WS3] SAIWAI Hanako (Kagawa U)
- ✓ Poster presenter: [poster No] SURNAME Middle and given name (Affiliation in short)
  例 [P05] SETOUCHI Kaito (Shikoku U)
- ✓ Other participants: SURNAME Middle and given name (Affiliation in short)
  例 NAOSIMA Lemon (Umi Corp)

ご不明な点や問題がございましたら、メールにてお問い合わせください。
この会議を楽しんでいただければ幸いです。

EJEA Conference in Kagawa 2021実行委員会
E-mail: ejea-reg-c@kagawa-u.ac.jp
https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

Poster session instruction

EJEA Conference 2021 in Kagawa
Instructions for the Online Poster Session

1. Please check the accessibility to the SpatialChat website (the testing site will be effective until October 20th)

Recommended browsers for the SpatialChat websites. Difficulties may arise if using a smartphone.

・Google Chrome
・Firefox
・Microsoft Edge
・Safari
・Opera

For further information, please also visit the following website:

https://help.spatial.chat/hc/ja/articles/360017769780

URL of the testing SpatialChat website: https://spatial.chat/s/wadaken

If you find any difficulties in accessing the SpatialChat test website, please consult your system administrator.

2. Access to the live SpatialChat website of the Poster Session

URL of the live SpatialChat website: https://spatial.chat/s/ejea-kagawa

Password will be announced separately.

Live Session Schedule

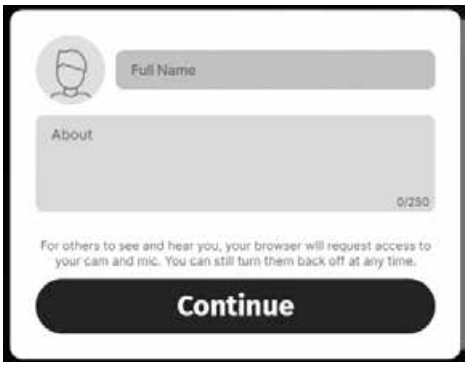
22 Oct 2021 9:15-9:30 (CEST), 12:00-12:15 (CEST)

23 Oct 2021 9:15-9:30 (CEST), 12:00-12:15 (CEST),

24 Oct 2021 9:15-9:30 (CEST), 12:00-12:15 (CEST),

The availability of the presenters will be announced in the chat box of the SpatialChat rooms.

3. Logging in to the SpatialChat website



You will be first prompted on how you would like to be called. You can set your "Full Name" (include titles if you wish to be addressed that way) and your affiliation in the "About" box. Please follow the naming rules below.

Poster presenter: [PPoster No] SURNAME Middle and given name (Affiliation in short)

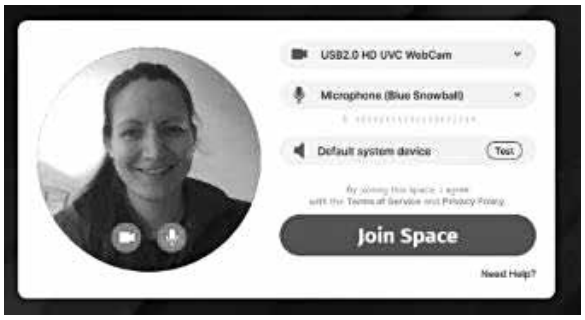
ex. [P11] SETOUCHI Kaito (Shikoku U)

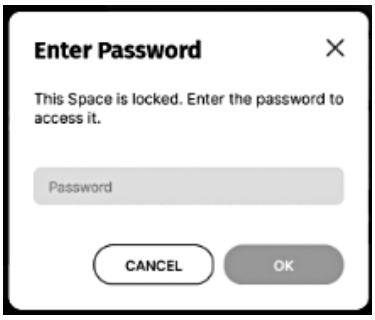
Other participants: SURNAME Middle and given name (Affiliation in short)

ex. NAOSIMA Lemon (Umi Corp)

By clicking on the avatar area, you can choose a picture from your computer.

The next screen prompts you about access to your microphone and webcam settings. These can also be changed when you are inside the Spatial Chat room. When settings are ready, click “Join Space”. The system may ask you to enter the password.



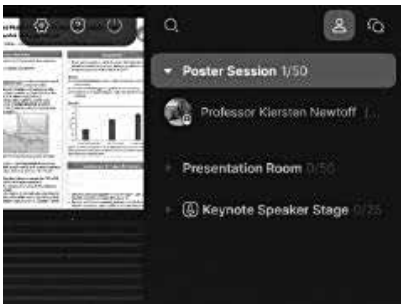


4. Moving around the SpatialChat space (in a room and between rooms)

There are two ways moving around in this space: moving within a room and moving between rooms. To move within a room, click on your circle in the space and drag it to a new space. Please do not place your avatar on the poster images.

To zoom in and out, you can use the scroll wheel on your mouse to instantly change the zoom level. If you are not using a mouse, you can manually change your zoom level by clicking on the zoom bar in the lower right-hand corner.

There will be multiple rooms at the conference for those presenting posters. To move between rooms, click on the room name in the list on the right-hand side. If you do not see a list of rooms, click on the person icon in the top right corner of your screen.



5. Talking to others using the platform

Much like spaces in real life, you hear people who are closest to you and as you move further from them, you hear them less until you are out of earshot. SpatialChat replicates this as you move your circle closer and further away from others.

6. Using the chat feature

Please use the chat function by clicking the message icon at the bottom tools panel. You can also use emojis. The messages in the chat panel on the right will remain throughout the session.

7. Leaving the room

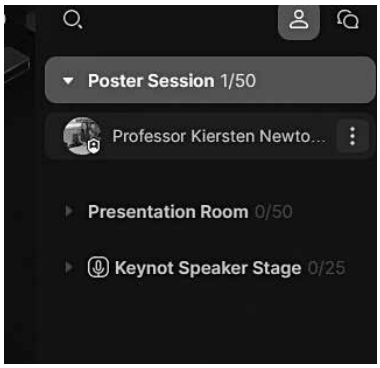
When leaving the room, be sure to press the leave space button ⏻ at the top right before closing the window.

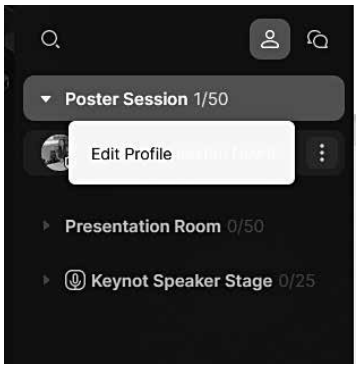
Appendix I. What to do when a problem occurs

Please close the window of the browser and re-access the SpatialChat website. If it does not work, please restart your PC or directly contact the webmaster.

Appendix II. Changing settings inside the SpatialChat rooms

If you would like to edit your profile details or change your profile picture, you can make changes after entering the Spatial Chat space. To change your profile details, move your cursor to your name in the participant's panel on the right. When you highlight your name, three vertical dots appear to the right of your name. Click on these dots and select "Edit Profile". The page of editing profile will be popped up.





Camera and microphone settings can also be accessed by moving cursor over those symbols at the bottom toolbar and selecting the three vertical dots that appear. After clicking the three dots, a pop-up page similar to the one when you first logged in will appear, allowing you to configure your devices.

EJEA Conference 2021 in Kagawa ポスターセッション参加者向け SpatialChat の使い方

本資料では、EJEA Conference 2021 in Kagawaにおいて、講演者と聴講者がオンライン会議ツール SpatialChat を使用して、オンライン上に掲示された発表資料を閲覧しながら、相互に会話することによりバーチャルなポスターセッションを実施するための方法を記載します。

なお、セッションルームのデザイン等は変更することがあります。また、安全に運用するため、マニュアルで説明していない機能の一部を使えないように設定していますので、ご了承ください。

1．SpatialChat へのアクセス（事前確認、10月20日までOpen）

SpatialChat にアクセスする際は、下記のブラウザをご使用ください。タブレットやスマートフォンにも一部対応しておりますが、パソコンのご使用を推奨いたします。

・Google Chrome
・Firefox
・Microsoft Edge
・Safari・Opera

参考（SpatialChat がサポートしているブラウザのリスト）
https://help.spatial.chat/hc/ja/articles/360017769780

事前に、インターネットに接続した状態で、下記のテスト用 URL から、SpatialChat にアクセスできるかどうかを確認してください。ご利用の環境によっては、ファイアウォールの設定やセキュリティポリシー等によりアクセスできない場合があります。その際は、別の環境からアクセスしていただくか、所属先のシステム管理者等にご相談ください。

https://spatial.chat/s/wadaken

2．当日のセッションルームの URL

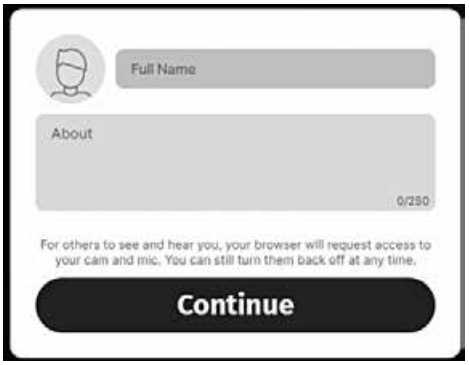
ポスターセッションの本番当日の URL は以下の通りです。パスワードは別途お送りします。参加者は開催期間中、随時入室可能です。

https://spatial.chat/s/ejea-kagawa

3．セッションルームへの入室

下図の氏名入力規則にしたがって、「Full Name」の部分に、氏名・所属等を英語（ローマ字）で入力してください。下図の入力規則にしたがって、「Full Name」の部分に、氏名・所属等を英語（ローマ字）で入力してください。

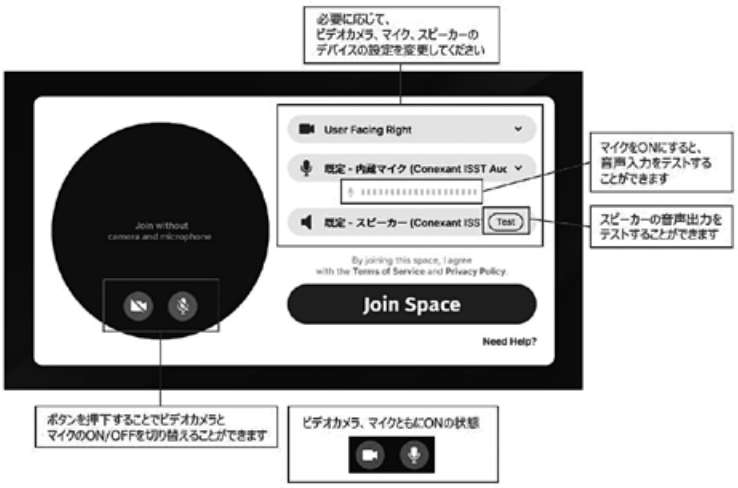
Poster presenter: [poster No] SURNAME Middle and given name (Affiliation in short)
ex. [P05] SETOUCHI Kaito (Shikoku U)
Other participants: SURNAME Middle and given name (Affiliation in short)
ex. NAOSIMA Lemon (Umi Corp)



入力後、「Continue」を押下してください。なお、コ

メント欄には特に何も入力しなくて良いです。

次に、必要に応じて、ビデオカメラ、マイク、スピーカーのデバイスを設定してください。左下のビデオカメラボタン、マイクボタンでそれぞれの ON/OFF を切り替えることができます。マイクを ON にすると、音声入力をテストすることができますが、入室する際はマイクを OFF にしてください。また、「Test」ボタンを押すと、スピーカーの音声出力をテストすることができます。設定が完了したら、「Join Space」を押下してください。



4．セッションルームの選択と移動

右側のルームリストから、興味のあるポスター番号に該当するルームを選択し、入室してください。

セッションルームに入室したら、自身のアイコン（アバター）を動かして、該当するポスター番号が記載されたスペースに移動してください。原則として「Discussion Space」と記載されたエリアで論議してください。他の方の閲覧の邪魔になりますので、Poster 画像の上にアイコン（アバター）を置かないようにご留意ください。

5．討論の際の留意点

発表者の近くにご自身のアイコン（アバター）を置いてください。音声の音量はアイコン間の相互の距離に応じて変化しますので、遠くに移動させると発表者と会話できなくなります。また、発

表者に対してChat で質問することも可能です。Chat の内容は会期中は消えません。会期終了後に消去します。

6．会場からの退出

会場からの退出時には、退出時には必ず右上の ⏻（leave space）ボタンを押してからウィンドウを閉じてください。

7．問題発生時の対応

講演中に SpatialChat の画面がフリーズする等、使えなくなった場合、ブラウザを開き直して再度プログラムの日程表に記載の URL にアクセスし、SpatialChat を起動してください。それでも正しく動作しなかった場合は、担当者に連絡ください。

Poster award winners

The presentations shown below were selected for Excellent Poster Award and Jury's Special Award by the organizing committee of EJEA Conference 2021 in Kagawa.

Letter of gratitude to chairpersons and keynote speakers

EJEA Conference 2021 in Kagawa on
Human-centered Sustainability and Innovation for an AI-assisted Future:
New Interdisciplinary Education & Research for the Next Stages in Japan and Europe
22nd – 24th October 2021

2 November 2021

Dear XXX,

Thank you for your great contribution and support given to the EJEA international conference 2021 which have made the conference a successful meeting of scientists, students and experts from academia, industries as well as from public and administrative institutions.
Almost 200 participants from 12 countries listened to seven keynote lectures, and actively engaged in discussions during eight workshops with 60 oral presentations – not to forget 12 poster presentations by students from Japanese Universities as well as from Kagawa high schools. Three days of very interesting and inspiring contributions are now behind us, and we are looking ahead to continue and extend the bonds, initiated by this conference.
The outcome of the conference will be published in two journals ("Frontiers of AI" and "International Office Journal" of Kagawa University).
The conference has created the opportunities for joint collaboration and cooperation.
Also, EJEA cordially invites all participants to join the conference "Innovation and Action for Managing Urgent Future Local and Global Issues and Domains in Japan and Europe" that is scheduled to be held at the Japanese-German Center Berlin in November 2022!
As the host of EJEA international conference 2021, Kagawa University would like to convey special gratitude to your active participation which has made this conference fruitful. We regret that we couldn't welcome you in Kagawa, where beautiful nature and traditions are well preserved, and we wish to have the opportunity of welcoming you in the near future.

We hope to see you again soon!

Best regards,

Prof. Dr. Kakehi Yoshiyuki
President of Kagawa University

Prof. Dr. Dietrich Albert
Chairperson of EJEA

Message of gratitude to participants

Thank you very much for your participation in EJEA Conference 2021 in Kagawa

The EJEA Conference 2021 in Kagawa was held online for three days from October 22nd (Friday) to 24th (Sunday), 2021 . This conference, held in part to commemorate the 160th anniversary of Japan Germany diplomatic relations, was coorganized by Europe Japan Experts Association EJEA), Kagawa University, Fraunhofer Institute for Applied Information Technology (FIT) and Institute for Security Development Policy (ISDP).

We are grateful to the following 13 institutions which kindly sponsored and supported us; Toshiba International Foundation (TIFO), Frontiers in Artificial Intelligence, Kagawa Industry Support Foundation (KISF), Swedish Foundation for Strategic Research, Japanese German Center Berlin (JDZB), EU Japan Centre for Industrial Cooperation, German Research Ambassadors Network for Industrial Technology Endeavors (GRANITE), Japan-German Society Kagawa (JGSK), Japan External Trade Organization JETRO Kagawa , Kagawa Prefecture , Modular Management Group, Takamatsu City and Women's International Shipping & Trading Association (WISTA).

Although it was held online due to the COVID 19 outbreak, there was a total of 196 participants. 51 participants joined from 12 countries (eight European countries, three Asian countries and the United States of America). Within Japan, 105 participants hailed from Kagawa Prefecture while the remaining 40 participants attended from other prefectures.

There was a total of 80 presentations: comprising seven keynote lectures, one invited presentation, 60 oral presentations (held in eight Workshops), and 12 poster presentations (including four by high school students). The number of both participants and presentations exceeded our anticipation. Specifically, we expanded our scope to include regions/countries other than EU and Japan. Of special mention is the positive assessment on the large number of participants from the Asian region.

The theme of the conference was “Human centered Sustainability and Innovation for an AI assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe”. During the conference, participants discussed a wide range of issues in fields such as medical care, cities, environment, disaster prevention, agriculture, and education. One of the primary issues discussed was how to develop projects from a "human centered" perspective. This discussion encompassed keywords such as Society 5.0 (Industry 4.0) and SDGs (Sustainable Development Goals), areas which the university is currently focusing on.

Many cases focusing on high efficiency and high performance through technological innovation by AI were presented. Efforts and ideas that reflect the philosophy of "Human centered Sustainability" were also probed. Participants were stimulated by the presentations, which subsequently led to robust and vigorous discussions. Presenters were highly conscious, making attempts to propose and share ideas that may lead to innovation.

On a cautionary note, it was pointed out that it is important to deal with the inherent risks that come with improving efficiency and performance, and to consider the vulnerability of digitization. Furthermore, discussions were held on how to link up the conference content with education. Along this line, Kagawa University has started introducing and implementing the concept of DRI (Design thinking, Risk management and resilience, and Informatics) Education for the entire student body.

The conference was conducted very smoothly throughout the three days. Participants from Japan and overseas offered many accolades for the richness of the academic content and the splendor of its operation.

We would like to thank all parties for the exceptional cooperation and support in hosting this international conference at Kagawa University. We will make effective use of this achievement and connect it to the creation of future networks. The next EJEA Conference is due to be held in Berlin in 2022.

All the best,

27 October 2021

The Organizing Committee of EJEA Conference 2021 in Kagawa
Official HP: https://www.kagawa u.ac.jp/kuio/circ/event/ejeaconf/

Certificate of appreciation for presenters

The certificate of appreciation signed by Prof. Dr. Kakehi Yoshiyuki, President of Kagawa University and Prof. Dr. Dietrich Albert, Chairperson of EJEA was issued for all keynote speakers, oral presenters, poster presenters and discussants.

European Japan Experts Association

Fraunhofer FIT

Institute for Security & Development Policy

KAGAWA UNIVERSITY

EJEA Conference 2021 in Kagawa

Human-centered Sustainability and Innovation for an AI-assisted Future:
New Interdisciplinary Education & Research for the Next Stages in Japan and Europe
22 to 24 October, 2021

CERTIFICATE OF APPRECIATION

This certificate is presented to

Name of presenter(s)

for serving as a Keynote Speaker at
The EJEA Conference 2021 in Kagawa hosted by Kagawa University

1 November 2021

Prof. Dr. Kakehi Yoshiyuki
President of Kagawa University

Prof. Dr. Dietrich Albert
Chairperson of EJEA

Call for Publication

Dear presenters of the EJEA International Conference 2021 in Kagawa,

The online EJEA conference "Human-centered Sustainability and Innovation for an AI-assisted Future" is behind us. Kagawa University (the host of the conference) is preparing a special issue of "Conference Proceedings" at the "Journal of Kagawa University International Office (J.KUIO)" (ISSN 1884-8745). Additionally, a Research Topic in "Frontiers in Artificial Intelligence" is open for submissions of extended papers.
The special issue of J.KUIO will be a "Conference Proceedings" booklet and published also as printed matter. The idea is, to also include the program of the conference, keynotes, thanks to the sponsors and supporters etc.
On the other hand, the Research Topic 'Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence' invites "theoretical, empirical, and/or methodological papers that address topics related to 'Distributed Cognition' (DC)in learning and behavioral change based on human, digital and artificial cognition and intelligence (AI)" from the workshop and beyond. It will be Open Access and all articles will be available online.
All presenters (keynoters, contributors to the workshops, poster presenters) to the conference are invited to submit papers/manuscripts to one of the two journals – J.KUIO or Frontiers in Artificial Intelligence.

To publish your paper/manuscript in the journal 'Frontiers in Artificial Intelligence' you are requested to expand your contribution in form of the abstract to the conference by adding at least 30% of original content in the form of new raw material (experiments, data) or new treatment of old data sets which lead to original discussion and/or conclusions.
Please note that one can NOT publish 2 papers/manuscripts which have the same (similar) contents. If you wish to publish in 'Frontiers in Artificial Intelligence', J.KUIO will accept only a one-page abstract which you submitted to EJEA Conference. On the other hand, 'Frontiers in Artificial Intelligence' accepts only contribution as a paper/manuscript.

In the following some further explanation about the next steps - please refer to the attached flowchart:

In case you want to publish a manuscript, you have the choice between the journal "Frontiers in AI" and the "Journal of Kagawa University International Office" (J.KUIO).

In case of "A" you decide for a manuscript in "Frontiers in AI" you have also the option to combine with abstract-options C, D, or E in J.KUIO (see attached flowchart).
In case of "B" you decide for a manuscript in "J.KUIO".
In case you do not want to publish any manuscript, it is possible to publish an abstract in J.KUIO (C and D).
In case of "C" you have the possibility to revise your abstract, that has been published already in the Abstract Booklet (#) of the conference. This revised abstract will then be published in J.KUIO.
Case "D" is the option, that your abstract, that has been published already in the abstract booklet of the conference, will be published again (in J.KUIO) – without any changes.
Case "E" should be your choice, if you do not want to publish any abstract in J.KUIO.

#: Abstract Booklet has been uploaded in the EJEA Conference homepage.
https://www.kagawa-u.ac.jp/files/8616/3480/2305/AbstractBook_ver5.pdf

IN CASE YOU WANT TO PUBLISH YOUR MANUSCRIPT OR ABSTRACT IN J.KUIO (B, C, D) OR YOU DECIDE FOR NOT PUBLISHING YOUR ABSTRACT (E) PLEASE SEND YOUR REPLY (MENTIONING YOUR CHOICE AND – IF APPLIES – YOUR MANUSCRIPT/ABSTRACT) UNTIL DECEMBER 15 TO:
ejea2021conf-c@kagawa-u.ac.jp AND FOLLOW THE GUIDELINES MENTIONED BELOW.
In case we do not receive any reply from you until this deadline, your abstract, that has been published already in the abstract booklet of the conference, will be published again without any changes in J.KUIO (D).

Frontiers in Artificial Intelligence / AI for Human Learning and Behavior Change:
https://www.frontiersin.org/journals/artificial-intelligence/sections/ai-for-human-learning-and-behavior-change#
Submission deadlines:
22 November 2021: Abstract
2 March 2022: Manuscript
For further details please refer to:
https://www.frontiersin.org/research-topics/26055/distributed-cognition-in-learning-and-behavioral-change---based-on-human-and-artificial-intelligence

Journal of Kagawa University International Office (J.KUIO - ISSN 1884-8745) :
Submission deadline:
15 December 2021
Publication is scheduled for March 2022.
For further details please refer to:

https://www.kagawa-u.ac.jp/files/3716/3609/2224/Guidelines_on_Manuscripts_for_Journal_of_Kagawa_University_International_Office_Ver3.pdf

Kagawa University International Office
1-1 Saiwai-cho, Takamatsu, Kagawa, 760-8521 JAPAN
Phone: +81-87-832-1178 / Fax: +81-87-832-1192 / Email: ejea2021conf-c@kagawa-u.ac.jp

Many thanks to the supporters and sponsors of EJEA conference 2021 in Kagawa!

Journal of Kagawa University International Office（ISSN 1884-8745）特集号への投稿に関するお知らせ

EJEA Conference 2021 in Kagawa“Human centered Sustainability and Innovation for an AI assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe”は無事に終了しました。ご参加、ありがとうございました。 香川大学インターナショナルオフィスでは、“Journal of Kagawa University International Office（J. KUIO）”（ISSN 1884 8745）で EJEA Conference 2021 in Kagawa の 特集号を発刊する予定です。

香川大学J.KUIO の特集号は、分野は問わず、キーノートレクチャーを含む口頭発表およびポスター発表の発表者全員を対象としており、プロシーディングズの形で発刊します。

投稿の締切は少し延長して、12月15日（水）とさせてもらいます。

J.KUIOの特集号への投稿要領は、以下をご覧ください。

Guidelines_on_Manuscripts_for_Journal_of_Kagawa_University_Inte rnational_Office_Ver3. pdf（kagawa u.ac.jp）

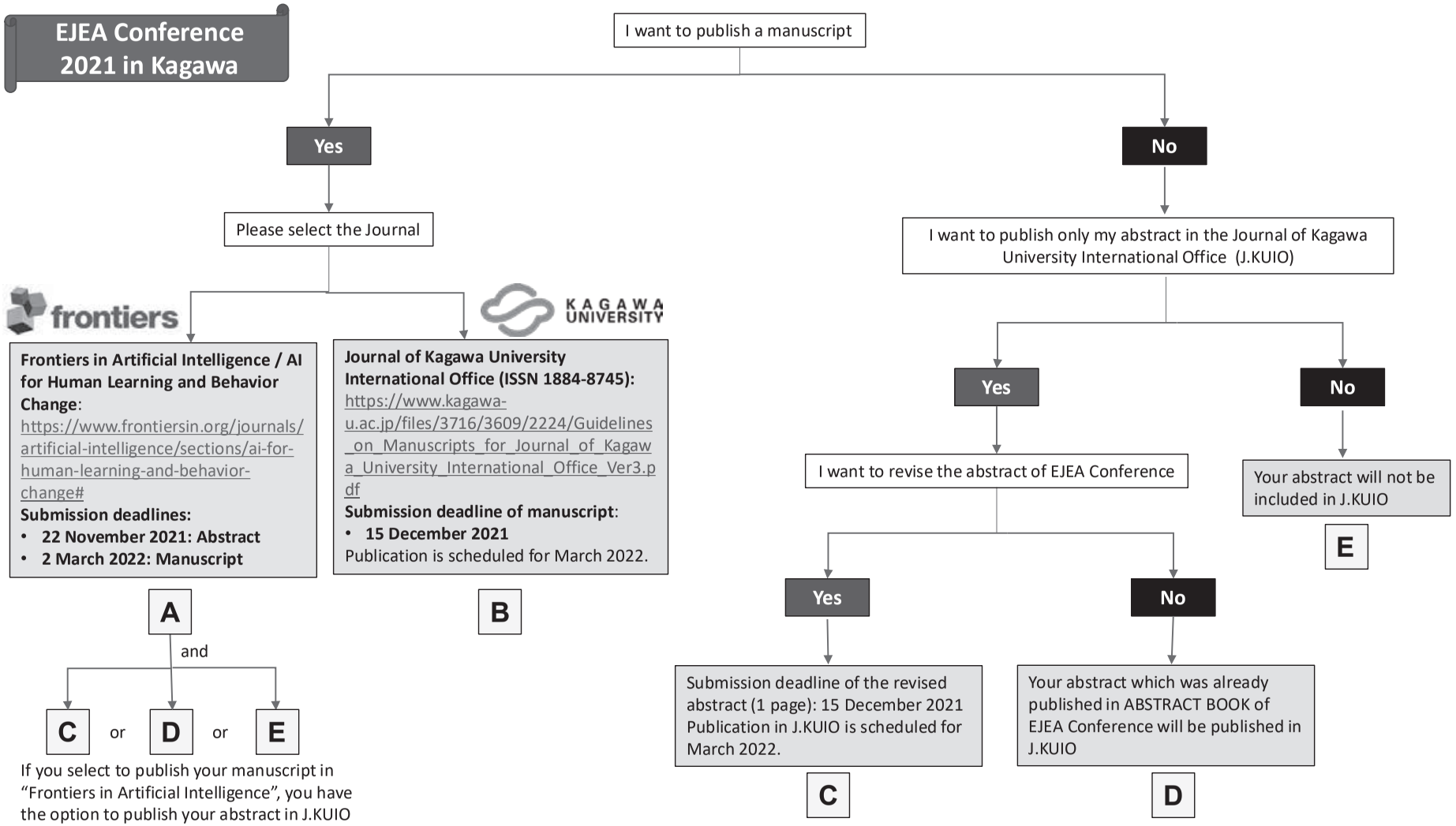
直接、次のURLにアクセスすることも可能です “https://www.kagawa u.ac.jp/files/3716/3609/2224/Guidelines_on_Manuscripts_for_Journal_of_Kagawa_Univer sity_International_Office_Ver3.pdf”（公式ホームページ : https://www.k agawa u.ac.jp/kuio/circ/event/ejeaconf/ にも記載があります）

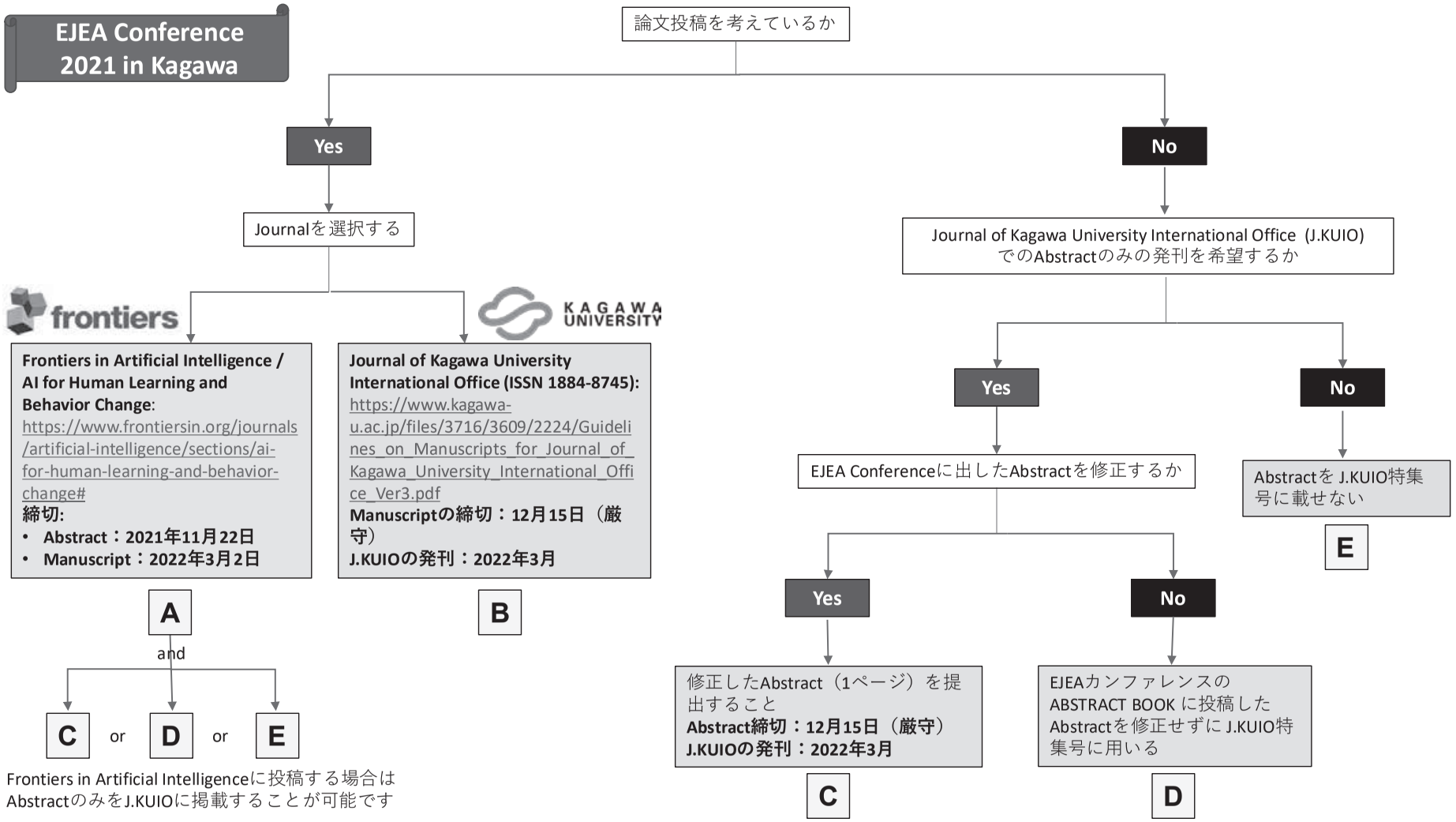
一方で、EJEAの会長の Dietrich Albert 先生からは、Frontiers in Artificial Intelligenceというジャーナルへの投稿も可能とのことで案内が来ています。これについては、現在EJEAと取りまとめていますが、'Distributed Cognition in Learning and Behavioral Change Based on Human and Artificial Intelligence' などの分野が中心になろうかと思います。 こちらへの投稿を希望される方は投稿ください。この詳細は近日中にお知らせしますが、以下のURLに情報は示されていますのでご参照ください。

Distributed Cognition in Learning and Behavioral Change Based on Human and ArtificialIntelligence | Frontiers Research Topic（frontiersin.org）

☆ 注意：

同様の内容の論文を 2 つ発行することはできません。 Frontiers in Artificial Intelligence に掲載したい場合、J.KUIOはEJEAカンファレンスに提出した 1 ページのアブストラクトのみを掲載させてもらいます。


EJEA Conference 2021 in Kagawa
I want to publish a manuscript
Yes
No
Please select the Journal
frontiers
KAGAWA UNIVERSITY
Frontiers in Artificial Intelligence / AI for Human Learning and Behavior Change:
https://www.frontiersin.org/journals/artificial-intelligence/sections/ai-for-human-learning-and-behavior-change#
Submission deadlines:
• 22 November 2021: Abstract
• 2 March 2022: Manuscript
Journal of Kagawa University International Office (ISSN 1884-8745):
https://www.kagawa-u.ac.jp/files/3716/3609/2224/Guidelines_on_Manuscripts_for_Journal_of_Kagawa_University_International_Office_Ver3.pdf
Submission deadline of manuscript:
• 15 December 2021
Publication is scheduled for March 2022.
A
and
C
or
D
or
E
B
If you select to publish your manuscript in "Frontiers in Artificial Intelligence", you have the option to publish your abstract in J.KUIO
I want to publish only my abstract in the Journal of Kagawa University International Office (J.KUIO)
Yes
No
I want to revise the abstract of EJEA Conference
Your abstract will not be included in J.KUIO
E
Yes
No
Submission deadline of the revised abstract (1 page): 15 December 2021
Publication in J.KUIO is scheduled for March 2022.
C
Your abstract which was already published in ABSTRACT BOOK of EJEA Conference will be published in J.KUIO
D


EJEA Conference 2021 in Kagawa
論文投稿を考えているか
Yes
No
Journalを選択する
frontiers
KAGAWA UNIVERSITY
Frontiers in Artificial Intelligence / AI for Human Learning and Behavior Change:
https://www.frontiersin.org/journals/artificial-intelligence/sections/ai-for-human-learning-and-behavior-change#
締切:
• Abstract：2021年11月22日
• Manuscript：2022年3月2日
Journal of Kagawa University International Office (ISSN 1884-8745):
https://www.kagawa-u.ac.jp/files/3716/3609/2224/Guidelines_on_Manuscripts_for_Journal_of_Kagawa_University_International_Office_Ver3.pdf
Manuscriptの締切：12月15日（厳守）
J.KUIOの発刊：2022年3月
A
and
B
C
or
D
or
E
Frontiers in Artificial Intelligenceに投稿する場合は
AbstractのみをJ.KUIOに掲載することが可能です
Journal of Kagawa University International Office（J.KUIO）
でのAbstractのみの発刊を希望するか
Yes
No
EJEA Conferenceに出したAbstractを修正するか
Abstractを J.KUIO特集号に載せない
E
Yes
No
修正したAbstract（1ページ）を提出すること
Abstract締切：12月15日（厳守）
J.KUIOの発刊：2022年3月
EJEAカンファレンスの ABSTRACT BOOK に投稿した Abstractを修正せずに J.KUIO特集号に用いる
C
D

Journal of Kagawa University International Office

(ISSN 1884-8745)

Guidelines on Manuscript Submission for

Special Journal Publication of EJEA Conference 2021 in Kagawa

1. Format of paper:
   Authors are requested to use and follow the format as illustrated in the attached file.
2. Length of paper:
   Maximum of 6 pages, in A4 size paper.
3. Deadline for paper submission:
   Not later than 15th December 2021 (Wed)
4. Method for submission:
   E-mail your manuscript to ejea2021conf-c@kagawa-u.ac.jp
5. Schedule for peer review process (tentative):
   - 30th November: Paper submission deadline
   - Late December: Start of peer review process
   - Late January: End of peer review process, results conveyed to authors
   - Early February: Re-submission of papers (if necessary, after corrections)
   - Late March: Commencement of printing (e-journal will also be published)
6. Editorial Committee of Kagawa University International Office:
   - Hara Naoyuki
   - Wada Kenji
   - Lrong Lim
   - Tokuda Masaaki
7. Reviewing Committee:
   Committee members consist of professors, researchers, and experts who are actively involved in the EAEJ Conference.
   - EJEA members
   - Chairpersons of the workshops
   - Steering committee members
8. Referee selection:
   After the submission deadline, the Editorial Committee in conjunction with the Reviewing Committee, shall nominate the referees for the papers based on the content matter. Referees may or may not be members of the Reviewing Committee.
9. Copyrights
   (1) The Journal of Kagawa University International Office retains the copyrights of published manuscripts.
   (2) Kagawa University International Office maintains the rights to electronically distribute published manuscripts.

(3) Authors may use or include their published manuscripts in other works conducted by the authors themselves, and they may distribute the published manuscripts electronically or by other means. However, authors should clearly acknowledge the references (Title, Volume, Pages, etc.) and should promptly contact Kagawa University International Office.

The Title Should Be Written in Title Case Except for Words Such as, and the (It can be up to 2 lines in length)

Author[1], Author[1], Author[2], & Author[3]

Affiliation[1], Affiliation[2], Affiliation[3]

Author[1]@xxxxx.com

Ⅰ. Abstract (Arial 10, numbered)

Titles of each subsection should be determined by the authors. The authors may also add subsections as appropriate.

Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals.

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Ⅱ. Results & Discussion (Arial 10, numbered)

Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point.

Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point.

Table 1: Table Format

	Details
Font	Times New Roman 10 point font.
Others	Tables must be referenced in the text. Tables must not be images. Tables should be created with the table function of Microsoft Word.

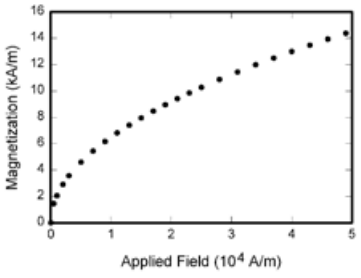

Figure 1. Magnetization as a function of applied field. Figures must be referenced in the text. Captions should be Times New Roman 8 point font.

Ⅲ. Conclusion (Arial 10, numbered)

Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point.

Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point. Numbers one through nine should be written in words while 10 and above are written in numerals. Body text should be justified, Times New Roman 10 point.

IV. References (Arial 10, numbered)

References should use any widely accepted referencing style from the field of the authors. If the author (s) has/have no preferences, we recommend APA style. Text should be Times New Roman 20 point.

References should use any widely accepted referencing style from the field of the authors. If the author (s) has/have no preferences, we recommend APA style. Text should be Times New Roman 20 point.

Conference report in the International Office News（Japanese）

香川大学がホストとしてEJEA Conference 2021 in Kagawaを開催

https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

香川大学がホストとなり、欧州側のEJEA（後述）を含む３組織と共同主催して、EJEA Conference 2021 in Kagawaを、2021年10月22日（金）～24日（日）を会期として日本で初めて開催した。『International Conference on Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe（AIが支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介)』をテーマに、医療・都市・先端工業・環境・防災・農業・教育など幅広い分野で、Artificial Intelligence（人工知能：AI）を「人間中心」に有効活用した技術革新等を議論する目的で開催した。EJEAからは"Human-centered", "Innovation", "AI-assisted Future"などのキーワードが提案され、本学からも"SDGs", "Interdisciplinary Education & Research "などを提案した。

当初対面での開催を目指したが、新型コロナウイルス感染症の影響によりオンライン開催となり、参加費も無料とした。ポスターセッションも実施し、対面・オンライン併設で、高大連携にも踏み込んだ内容となった。また、GRANITE（後述）の関係から信州大学へ参画を勧誘、アジアからの参加を勧誘するなどの新機軸を多く打ち出した。

プログラムに示す通り、タイトルに相応しい内容で、日本を含む13か国から196名の参加者を得て、80演題（キーノートレクチャー７、招待講演１、８のワークショップでの口頭発表60、ポスター発表12）があり、予測を上回る成果をあげることができた。また支援機関数も13機関と過去のEJEA会議と比較して最多となった。

EJEA Conference 2021 in Kagawaプログラム

10月22日（金）		10月23日（土）		10月24日（日）	
		11:30 –14:30	ポスターセッション（対面） 多目的ホール（オリーブスクエア）		
15:00-15:30	開会式 Mr. Hirai Takuya Mr. Onishi Hideto Prof. Dr. Kakehi Yoshiyuki Dr. Julia Münch Prof. Dr. Dietrich Albert	15:00-15:15	オープニング Dr. Lars Vargö	15:00-15:15	オープニング Dr. René Reiners
15:30-15:35	カンファレンス進行説明	15:15-15:35	キーノートレクチャー　3 Prof. Dr. Satoshi Murayama	15:15-15:35	キーノートレクチャー　5 Prof. Dr. Hiroshi Tsuji
15:35-15:55	キーノートレクチャー　1 Dr. Yuko Harayama	15:35-15:55	キーノートレクチャー　4 Dr. Lucas Paletta	15:35-15:55	キーノートレクチャー　6 Dr. René Reiners
15:55-16:15	キーノートレクチャー　2 Prof. Dr. Fredrik Heintz	15:55-16:15	招待講演 Dr. Philippe de Taxis du Poët	15:55-16:15	キーノートレクチャー　7 Mr. Colin de Kwant
16:15-16:30	ポスターセッション （オンライン）	16:15-16:30	ポスターセッション （オンライン）	16:15-16:30	ポスターセッション （オンライン）
16:30-19:00	**Workshop 1**: eHealth and Medical Engineering **Workshop 2**: Smart City	16:30-19:00	**Workshop 3**: Innovative Technologies for New Industry Creation **Workshop 4**: Environmental Humanities: Water, Air and Land for Sustainable Living Spaces **Workshop 5**: Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence	16:30-19:00	**Workshop 6**: GRANITE - Human-Centered Research and Transfer to Application **Workshop 7**: Human Security and Sustainability **Workshop 8**: Educational Change: New Models and New Thinking in Intercultural Concepts
19:00-19:15	ポスターセッション （オンライン）	19:00-19:15	ポスターセッション （オンライン）	19:00-19:15	ポスターセッション （オンライン）
19:15-19:45	まとめ "What I learned today"	19:15-19:45	まとめ "What I learned today"	19:15-19:45	まとめ "What I learned today"
19:45-20:00	閉会 Dr. Phoebe Stella Holdgrün	19:45-20:00	閉会 Prof. Dr. Takahiro Shinyo	19:45-20:00	閉会式・ポスター賞発表 Prof. Dr. Wada Kenji Prof. Dr. Tokuda Masaaki Ms. Sabine Ganter-Richter

EJEAとは EJEA – European Japan Experts Association（https://ejea.eu/） は1995年 に設立以来26年を経る。中心メンバーのDr. Dietrich Albert（オーストリア）、Dr. Anders Törnvall, Dr. Lars Vargö（共にスウェーデン）が2016年にMrs. Sabine Ganter-Richterに要請しEJEAのネットワークと活動の拡大のため、日欧間の基盤を提供し、持続可能で学際的なネットワークを確立する活動を強化した。この度は日独友好160周年を記念し、日本で初めて香川大学がEJEA国際会議を開催した。

GRANITEと香川大学とEJEA GRANITE（German Research Ambassadors Network for Industrial Technology Endeavors）は、日本の産業と連携を目指しFraunhofer研究機構(独)が2018年に開始したドイツ連邦教育研究省のプロジェクトで、香川大学、信州大学等が参加する。Sabine氏が橋渡し役となり香川日独協会の助力も得て、2019年10月にはDr. René Reiners（Fraunhofer FIT）等数名が来学し、創造工学部でネットワーキングイベントを実施。2021年３月にはFraunhofer FITと本学が協定を締結。EJEA国際会議では、香川大学とGRANITEの融合的進展を目指した。

世界からの参加者とともに始まった開会式

唯一対面で行ったポスターセッション風景

EJEA Conference 2021 in Kagawa University website

https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

国際研究支援センター / CIRC
基本方針
海外教育研究拠点
プロジェクト
国際研究助成

EJEA Conference in Kagawa 2021

Thank you for your participation in EJEA Conference 2021 in Kagawa

*New!*Thanking message for participants

*Updated*Conference archives for participants			
*Updated!*Reminder Call for Publication		*New!* Flow chart of Call for Publication	
Information for our colleagues	Excellent Poster Award	*Updated*Guidelines on Manuscript Submission	Template of Special Journal Publication
*New*Journal of Kagawa University International Office (ISSN 1884-8745)特集号への投稿に関するお知らせ			

EJEA International Conference 2021 on

Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe

AI が支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える： 新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介

October 22nd - 24th, 2021 in Takamatsu, Japan and online

Updated Program	*New!* Brochure	*New!* Keynoters	*New!* Abstract
Goto Registration Procedure of Conference			
Instruction for Poster Session(English)		Spatialchatポスター参加者マニュアル(和文)	
*New!*Submission for Special Journal Publication of EJEA Conference 2021 in Kagawa			
Guidelines on Manuscript Submission		Template of Special Journal Publication	

jointly organized by

the European Japan Experts Association (EJEA), Kagawa University, Fraunhofer Institute for Applied Information Technology FIT and the Institute for Security and Development Policy (ISDP)

supported by

Japanese German Center Berlin (JDZB), EU-Japan Centre for Industrial Cooperation, German Research Ambassadors Network for Industrial Technology Endeavors (GRANITE), Japan-German Society Kagawa (Japan), JETRO Kagawa (Japan), Kagawa Prefecture (Japan), Modular Management Group (Sweden), Takamatsu City (Japan), Women's International Shipping & Trading Association (WISTA Romania)

sponsored by

Toshiba International Foundation (TIFO), Frontiers in Artificial Intelligence

Kagawa Industry Support Foundation (KISF), Swedish Foundation for Strategic Research

The **conference is organized in hybrid-style** (physical meeting in Takamatsu, **Japan** and online participation daytime in **Europe**) on **Oct. 22nd (Fri), 23rd (Sat) and 24th (Sun), 2021 (8:00-13:00 CET / 16:00-21:00 JST)**

Due to the outbreak situation of COVID-19 all over the world, the committee decided as follows:

1. **The conference will be mainly accomplished ONLINE**
2. **Conference fee is FREE of charge**
3. **The deadline for submission has been extended until September 15th, 2021.**

Official **language** of the conference is **English**.

The conference program will be published and updated on the conference's website:

https://www.kagawa-u.ac.jp/kuio/circ/event/ejeaconf/

1) Call for Paper from 2021 EJEA Conference to be held in Kagawa University (PDF)

2) Template of Abstract to be submitted for 2021 EJEA Conference

3) Call for Posters :
English version　日本語版(Japanese version)　高等学校、高等専門学校向け

4) mail to: ejea2021conf-c@kagawa-u.ac.jp

5) submission of your abstract in English until September 15th ~~July 31st~~, 2021 via:

Either via: **e-mail to ejea2021conf-c@kagawa-u.ac.jp using the above template**
or via **https://easychair.org/conferences/?conf=ejeac2021conf**

Results will be notified by September 30th ~~August 15th~~, 2021.

6) Registration　Please remember that any speakers or accompanying persons who have not finished Official Registration will never be able to participate in the EJEA Conference.

You are officially asked to write an e-mail to our Conference Registration Address:

ejea-reg-c@kagawa-u.ac.jp

with the e-mail title:

2021EJEA_Conf_Regist .

-- Required information below must be included --
(1)First Name
(2)Family Name
(3)E-mail address
(4)Affiliation
(5)Affiliation postal address
(6)Participation type: Oral Presentation, Poster Presentation, Guest, Invited Speech, General participation etc.

(7)Paper Id　(if you have already received)

Attention:
Within a few days after you sending the registration form, the organizing committee of EJEA Conference in Kagawa 2021 will inform you how to participate in the conference and how to make your presentation there.

【 Abstracts 】

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EJEA Conference 2021 in Kagawa on

Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe

AIが支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：
新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介

ABSTRACTS

October 22nd - 24th, 2021
Hosted by Kagawa University in Kagawa, Japan

Jointly organized by

European Japan Experts Association (EJEA)
Kagawa University (Japan)
Fraunhofer Institute for Applied Information Technology FIT (Germany)
Institute for Security and Development Policy (ISDP) (Sweden)

～ Special thanks to the following institutions ～

Supported by

Japanese German Center Berlin (JDZB)
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Japan-German Society Kagawa (Japan), JETRO Kagawa (Japan)
Kagawa Prefecture (Japan)
Modular Management Group (Sweden)
Takamatsu City (Japan)
Women's International Shipping & Trading Association (WISTA) (Romania)

Sponsored by

Toshiba International Foundation (TIFO) (Japan)
Frontiers in Artificial Intelligence (Switzerland)
Kagawa Industry Support Foundation (KISF) (Japan)
Swedish Foundation for Strategic Research (Sweden)

Keynote Lectures

1. **Dr. Yuko Harayama,** Executive Director RIKEN, former Executive Member of Council for Science, Technology and Innovation (Japan)
2. **Prof. Dr. Fredrik Heintz**, Linköping University, Dept. of Computer and Information Science (Sweden); EU Commission High-Level Expert Group on AI
3. **Prof. Dr. Satoshi Murayama**, Co-convener of the International Consortium for Earth and Development Sciences, Kagawa University (Japan)
4. **Dr. Lucas Paletta**, Human Factors Lab at Joanneum Research Forschungsgesellschaft mbH, DIGITAL – Institute for Information and Communication Technologies (Austria)
5. **Prof. Dr. Hiroshi Tsuji**, Executive Director, University Public Corporation Osaka (Japan), former President of Osaka Prefecture University (Japan)
6. **Dr. René Reiners**, Head of Human-centered Engineering and Design at Fraunhofer Institute for Applied Information Technology FIT (Germany)
7. **Mr. Colin de Kwant**, Vice President Modular Management®; Lecturer at Royal Institute of Technology (Sweden)

Dr. Yuko Harayama

Executive Director RIKEN, Japan
Former Executive Member of Council for Science, Technology and Innovation

"Human in the loop or human-centered"

Abstract

The use of AI and digital technologies helps us to be connected each other, even under stay-at-home orders, and to be informed, almost in real-time, from multisources, of what is happening around the world, while bringing the question of how to ensure the quality, credibility and validity of information generated by these means. Also, an abundance of information does not necessarily mean better decision-making, it can also reinforce bias, and digital divide may occur.

"Human-in-the-loop" approach emerged in the context of machine learning could be perceived as an attempt to address these issues. Along this line of thought, I will invite the audience to revisit the role of "human" in the development and use of AI and digital technologies in my presentation.

CV

Dr. Yuko Harayama is an Executive Director principally charged with international affairs at RIKEN. Prior to joining RIKEN, she spent five years at the Cabinet Office of Japan as an Executive Member of the Council for Council for Science, Technology and Innovation, two years at the OECD as the Deputy Director of the Directorate for Science, Technology and Innovation, and ten years at the Graduate School of Engineering of Tohoku University as a Professor of Management Science and Technology. She is a Legion D'Honneur recipient (Chevalier) and was awarded honorary doctorate from the University of Neuchâtel. She holds a Ph.D. in education sciences and a Ph.D. in economics, both from the University of Geneva.

Dr. Fredrik Heintz

Associate Professor of Computer Science at Linköping University, Sweden

"Education for an AI-assisted Future - From Primary Education to Life-Long Learning"

Abstract

AI is influencing almost all aspects of life and society. To help people prosper in this new AI-assisted world, education is essential to provide the knowledge and skills needed. AI-related skills are no longer something only for developers and researchers, it is becoming necessary for all. We also need people that are both domain experts and proficient in AI and how to use it in their profession or domain.

At the same time, the amount of knowledge in the world doubles exponentially, which means that our education programs will cover less and less of the knowledge available and put more demands for on-demand and life-long learning. Further, as professions changes and become AI-assisted, people need to learn to solve problems together with computers. They need to develop their computational thinking.

To meet these challenges will require changes to all levels of education, from primary school to professional education. This talk will provide an overview of the challenges, present some partial solutions and make recommendations for how to proceed. Success is absolutely crucial. If we fail, millions of people risk being left behind. If we succeed, progress and quality of life could improve significantly!

CV

Dr. Fredrik Heintz is an Associate Professor of Computer Science at Linköping University, Sweden,where he leads the Reasoning and Learning group. His research focus is artificial intelligence especially Trustworthy AI and the intersection between machine reasoning and machine learning. He is the Director of the Graduate School for the Wallenberg AI, Autonomous Systems and Software Program (WASP) the largest research program in Sweden with more than 300 Ph.D. students, coordinator of the TAILOR ICT-48 network developing the scientific foundations of Trustworthy AI, and the President of the Swedish AI Society. He is also very active in education activities both at the university level and in promoting AI, computer science and computational thinking in primary, secondary and professional education. Fellow of the Royal Swedish Academy of Engineering Sciences (IVA).

Dr. Satoshi Murayama

Professor Emeritus / Co-Convener of the International Consortium for Earth and Development Sciences, Kagawa University, Takamatsu, Japan

"Environmental humanities: a long-term local history approach to living spaces to be sustained"

Abstract

Japanese rice fields have a long tradition of more than thousands of years. They have been constructed based on a logic of local organic economies, which have also become a foundation of early modern Japanese economy, but not a market economy in a strict sense, because the rice fields had two different spheres: one of them is a taxation system, and the other is a subsistence economy, a self-sufficient or fulfillment economy for local inhabitants. The latter function could be realized in small scale land holdings less than 0.5 ha, and then, they could survive in Japan until recent days.

Organic economies in early modern times have found their position between self-sufficiency and market economies. More self-sufficiency in Japan, and more in market economies in Europe.

Organic economies in early modern Japan have had a prolonged existence of more than 400 years everywhere in Japan. Such an ecological system has tended to disappear in recent years because of the de-population process and due to agricultural and environmental policies in Japan. However, a longterm local history approach can find some local efforts to sustain the organic economies. They show us a couple of evidence which could be a future possibility for a gradual departure from an "Anthropocene epoch" in the "short" twentieth century, which is dependent on "fossil fuel energies" in the world.

CV

Dr. Satoshi Murayama is Professor Emeritus at Kagawa University. His research field is environmental economic history with a particular interest in human, social and environmental capital management in medieval and early modern Europe and Japan. He comparatively investigates regional diversity, especially in the differences of all local Living Spaces. He acquired his Ph.D. degree from Justus Liebig University Gießen in 1990. He was a professor of socio-economic and environmental history at Kagawa University, Japan, served two years as President of the Association for East Asian Environmental History from 2013 to 2015, and organizes several research projects on Living Spaces.

Dr. Lucas Paletta

Head of Human Factors Lab and Research Team "Cognitive Sensing and Interaction" at the applied research center JOANNEUM RESEARCH Forschungsgesellschaft mbH in Graz, Austria

"Cognitive Sensing for the Future of Smart Health and Care"

Abstract

The healthcare industry is transforming at a rapid velocity that is offering new research and innovation opportunities based on AI-enabled sensing. With everincreasing health data from personal fitness trackers, connected medical devices, and other sensors that collect realtime information, healthcare platforms are among the earliest adopters of cognitive computing—systems that can understand, reason and learn while interacting with humans. In the care of neurodegenerative diseases, digital phenotypes were analyzed for prevention and intervention purposes. The keynote talk highlights the work on ICT assistance technologies for dementia with a focus on recent projects of the Human Factors Lab at JOANNEUM RESEARCH DIGITAL. This round trip starts with the household-based application of social robot Pepper that was particularly targeted to activate persons with dementia and to motivate them to adhere to multidomain gamified training. Furthermore, cognitive sensing is presented in terms of non-obtrusive eye tracking technology in VR and AR devices for the screening of cognitive decline during mindfulness and gamified executive function training. Finally, research trajectories for gaze interfaces in serious games for cognitive assessment and training are discussed from the view of monitoring neuropsychological profiles and with an outlook on future emerging technologies.

CV

Dipl.-Ing. Dr.techn. Lucas Paletta is Head of the Human Factors Lab and its Research Team "Cognitive Sensing and Interaction" at the applied research center JOANNEUM RESEARCH Forschungsgesellschaft mbH in Graz, Austria. He was visiting researcher at Fraunhofer IAIS (Germany) 1998-2000 and received his Ph.D. in Computer Science from Graz University of Technology 2000 on Machine Learning for Active Vision. Since 2000 he worked as principal investigator and coordinator of inter-/national application oriented research projects, such as, in the EU projects MOBVIS, MACS, euCognition, MARFT, MASELTOV, PLAYTIME, SIXTHSENSE and MARA on assistive technologies with AI-enabled sensing of psychological constructs. His research on smart care applications for persons with cognitive decline, such as, with Alzheimer's

disease, focused on intuitive interfaces for the measurement of executive functions, using mobile, serious games, AR-, VR- and social robot-based technologies. He founded/chaired the international and interdisciplinary workshop series, ISACS (International Symposia on Attention in Cognitive Systems), IDGEI (Intelligent Digital Games for Empowerment and Inclusion) and, recently, AIDEM (Artificial Intelligence for Prevention and Intervention in Dementia Care). He has (co-) authored more than 200 peer reviewed scientific publications, acted in service for the European Commission on future and emerging technologies, and has been Member of the Board of the Austrian Association for Pattern Recognition (AAPR) for many years.

Dr. Hiroshi Tsuji

Executive Director, University Public Corporation Osaka, Japan
Former President of Osaka Prefecture University

"From 45 years' experience on R&D and education on systems sciences"

Abstract

This talk presents personal view of systems sciences from the carrier in industry and academic society. At first, it reviews Cybernetics proposed by N. Winer and an empirical science of "artificial phenomena" argued by H. Simon. They pointed out that artificial things are synthetic and characterized in terms of functions, goals and adaptation based on observation. Then, touching the subtleties among data, information and knowledge, it illustrates how the computer systems (data processing, information processing and knowledge processing) have evolved to Society 5.0 and are evolving. To make Society 5.0 sustainable, we should make balance for multiple goals such as economic advancement with resolution of social problems. According to the social change, two education programs are also introduced in the context of higher education reform: undergraduate program "Sustainable Systems Sciences" and leading graduate program "System-inspired Leaders in Multidisciplinary Sciences". Finally, challenge for making co-creative research teams is also presented with cases.

CV

Dr. Hiroshi Tsuji is currently an executive director of Public University Corporation Osaka which operates two universities (Osaka Prefecture University and Osaka City University) and one college of technology. Receiving BS and MS degrees from Kyoto University, he worked with Hitachi, Ltd. in 1978-2022 where he was engaged in R&D for Management Information Systems including expert systems and decision support systems. While he was in Hitachi, he was also a visiting researcher of Carnegie-Mellon University (1987-88) and a visiting scholar of Stanford Japanese Center (1995-2001).

He joined in Osaka Prefecture University as a professor at Department of Industrial Engineering in 2002. As a dean, he started multi-disciplinary education in College of Sustainable Systems Sciences in 2012. As a vice president, he started leading graduate program called "System-inspired Leaders in Multidisciplinary Science" in 2013. He was the president of Osaka Prefecture University in 2015-2019.

Dr. René Reiners

Head of Human-Centered Engineering and Design at Fraunhofer Institute for Applied Information Technology FIT, Germany

"Human-Centered System Design for Successful Digital Transformation"

Abstract

Digitalization and the need for innovation pushes at all parts of businesses, organizations and institutions. Be it in production, the energy sector, healthcare, work and home office support or even private, everyday life: We must life the change and adapt to upcoming technologies...

However, is that really a satisfying scenario? Information and communication technology (ICT) offers a plethora of innovations and benefits. The challenge we all face nowadays lies in the handling of and interaction with systems whose complexity is increasing continuously.

In order to face that challenge, technology must evolve but the whole technical steps necessary to operate the systems must step in the background. Mark Weiser already formulated this demand in the early 90s as "ubiquitous computing", the disappearance of technology from our focus. The aim is that users can follow their tasks that they want to perform, assisted by technology – not being distracted.

During the talk, we will have a look at the methodology of user-centered design here engineering of solutions happens in close collaboration with stakeholders. This approach is very promising in coming up with solutions that widely satisfy the users' needs and requirements. In addition, the user experience should be high enough, to accept the system and regard it as beneficial for the tasks that need to be fulfilled.

The talk will present examples from practice where this approach was followed and thus provide insights into working environments and the way system and interaction designers work.

CV

Dr. René Reiners leads the department Human-Centered Engineering & Design at Fraunhofer FIT where more than 30 researchers work on user and data-driven innovation on top of IoT technologies.Applications deal with the digital transformation in Industry 4.0 environments, Smart Food Ecosystems and Smart Cities.

Currently, he coordinates the project GRANITE within the research marketing campaign "The Future of Work" funded by the German Ministry of Education and Research in which he teamed up with Sabine Ganter-Richter and Marco Invernizzi from Lyogroup International to strengthen common activities regarding collaboration between German and Japanese industry and academia.
René Reiners obtained his diploma in computer-science from RWTH Aachen University, Germany. After his studies, he gained experience in industrial software development within the REWE Group Germany. In 2007 he joined Fraunhofer FIT. During his work, he obtained his doctoral degree in natural sciences at RWTH Aachen University in 2013. Within research and industry projects, he is responsible for project management and coordinating research efforts in the field of system and application design, user-centered design, human-computer-interaction and knowledge management with the aid of design patterns.
He is certified PMI Project Management Professional (PMP), IREB certified Professional for Requirements Engineering, OMG certified UML Professional and Fraunhofer-Certified Usability Engineer.

Mr. Colin de Kwant

Vice President of Sweden Modular Management AB, Former Second Cycle University Lecturer of product modularization at Royal Institute of Technology, KTH, Stockholm, Sweden

"Sustainable Mobility Scenario Modeling: Evaluating Future Resilience of Modular Concepts for Electrified Trucks"

Abstract

Facing a myriad of megatrends such as sustainability, servitization, digitalization, electrification, automation and urbanization one of the greatest concerns for companies is how well their business will fit their future markets. Failing to timely prepare products for future markets may cause substantial losses. Consequently, many companies have drawn their interest to flexible product development strategies to cope with the complexity of changing and diffuse requirements. Research has highlighted Modularization as one such strategy. But how does one modularize against the uncertain future? Mobility solutions like trains, trucks and busses are designed to sustain long lifecycles as do the modular product and infrastructure platforms from and for which they are designed. While serving economic goals and keeping material resources in use, long life products, platforms and infrastructure may lock manufacturers and societies into paths limiting the transformation to more sustainable solutions. Mentioned megatrends, as well as sustainable socioeconomic goals for safer, affordable and sustainable mobility stress the need to ensure future resilience and flexibility in such product platform development and innovation processes.

This talk proposes to integrate futures studies into the modularization process and model a evaluate the effectiveness of modular products against future scenarios. The case example used concern battery and hybrid fuel-cell electric trucks for long-haul goods transport mission.

The case study builds upon profound scenario frameworks from earlier research, developed with participation of more than 50 experts from 30 different organizations within the transportation industry.

The scenarios do not intend to frame the most likely future. Instead, the scenarios provide a set of possible but distinctive different futures. The scenarios provide context for evaluation and modelling of performance and robustness of modules and product configurations around three key customer values: Total Cost of Ownership, Transport Effectiveness and Sustainability. The modular product configurations simulated in the model consist of the most significant but yet

largely independent highlevel modules. Results enabled, for instance, to reflect on most and least robust modular design and configurations choices across multiple futures to guide the scope for platform development.

The pathways and application scenarios for the continuation of this study are multiple. One is to evaluate both near term (more certain but also constrained) versus long term (more uncertain, but unlocked) futures to support assessment of evolving, transient or new product platform design strategy, and configurations enabled or disabled in each. Another would be to include decision making pro's and con's such as the possible financial impact of design strategy alternatives to guide product platform planning and R&D investments.

We welcome you to join the conversation with industry-, research and public sector, as we are all stakeholders to a sustainable future. We believe scenario frameworks and models such as these can provide an effective common language and shared configurable future contexts to connect people and organizations, evaluate ideas and accelerate projects, as modules in societies' present and futures.

CV

Mr. Colin de Kwant is a Vice President and partner at Modular Management AB. He currently leads in Modularization Programs, Product Development Management-, and Supply Chain Development.

He was the second cycle university lecturer of product modularization at Royal Institute of Technology, KTH, Stockholm, Sweden from 2011 to 2018 and is currently a centre coordination group member as researcher and industry partner at Royal Institute of Technology, ECO2 Vehicle Design. His consulting experiences include modularization at Ericsson (Sweden), Danfoss Drives (Denmark, US) Körber Mediseal (Germany), Alstom Hydro (France, India), Whirlpool Corporation (Italy) and so on.

Workshop 1
eHealth and Medical Engineering

Chairpersons
Prof. Dr. Kazuhiro Hara, Kagawa University (Japan)
Prof. Dr. Ichiro Ishimaru, Kagawa University (Japan)

Mid-infrared (LWIR) passive-active spectroscopic imaging for non-invasive blood glucose sensors

Ichiro ISHIMARU
Faculty of Engineering and Design, Kagawa University
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Ⅰ. Abstract

For realizing non-invasive blood glucose sensors, we proposed the mid-infrared (LWIR) passive-active spectroscopic imaging. From human body itself, mid-infrared lights, whose wavelength is around 10 μm, are emitted as well-known as thermography. These radiation-lights spectroscopic characters include components information inside of human bodies. The 2-dimensional Fourier transform spectroscopic imaging are able to measure relative intensities in each wavelength of emitted objective lights, so called the passive spectroscopy. We also proposed the separation method of near skin-surface and interior compared with the active spectroscopy.

Ⅱ. Fourier transform mid-infrared (LWIR) passive-active spectroscopic imager

As shown in figure 1, we had developed 3 kinds of LWIR spectroscopic imager, so-called hyperspectral camera, with microbolometer array sensors. One is the palm-size 2-dimensional Fourier transform spectroscopic imager.

The proposed imaging-type 2-dimensional Fourier transform spectroscopy was configured with the nearcommon- path and temporal-phase-shift interferometer [1]. Thus, because of the strong robustness against mechanical vibrations, the developed apparatus without anti-mechanical vibration systems are able to be constructed as the simple optical configurations. Furthermore, to improve time resolutions, 2 kinds of one-shot Fourier transform spectroscopy were proposed. The one-shot type was a kind of spatial phase-shift interferometer [2]-[4]. Also, we solved the annihilate interference intensities between each bright point by the conjugate-plane multi-slits superimposed method [5]. Thus, even if spatial frequencies are low like heat images, we could acquire 2-dimensional high-visibility interferograms of emitted lights from object's heat.

Conventionally, TES (Thermal Emission Spectroscopy), what was well-known in the field of interplanetary explorations, is the point detection spectroscopy. And a few kinds of commercially available products were known such as Hyper-Cam (Maker: Telops), HI90 (Maker: Buruker) using the high-sensitivity cooled-device MCT (Mercury Cadmium Telluride). We presumed that because these methods could not overcome the annihilate interference intensity problem, too expensive (over one million USD) and inconvenient and large size apparatus could not be inevitable with liquid nitrogen cooling MCT to improve visibilities of interferograms.

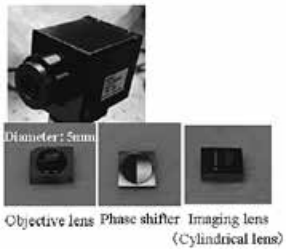
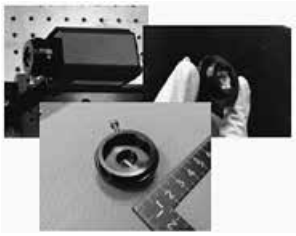
	2Dimensional Fourier transform spectroscopic imaging (2D-FSI)	Line one-shot Fourier transform spectroscopic imaging (LOS-FSI)	Pont one-shot Fourier transform spectroscopy imaging (POS-FSI)
Spectroscopic apparatus			
	2D spectroscopy	1D spectroscopy	0D (point) spectroscopy
External dimensions	Palm size	Beans size (lens: 3 pieces)	Beans size (lens: 1 piece)
Weight (Target market price)	0.5[kg] (1,000 USD)	0.3[kg] (several thousand USD)	0.1[kg] (several hundred USD)
Applications	Healthcare sensor mounted on smart phone Environmental measurement with drone		

Figure 1. Using uncooled microbolometer array sensors, high-portability and un-expensive 3 kinds (Time Domain type, Spatial Domain type) of mid-infrared (LWIR) passive spectroscopic imager.

Ⅲ. Internal components analysis of emission lights from skin surfaces with passive-active spectroscopy by the multi-layered emission and absorption linear-sum optical model

Figure 2 shows the multi-layered emission and absorption linear-sum optical model to analyze and separate internal components of near skin surface and interior from surface emitted light derived from internal bodies.

Passive and active spectroscopy have the negative and positive relationship. We could confirm emission peak wavelengths of the passive spectroscopy as same wavelengths as absorption peaks for the active spectroscopy.

And emitted lights from deep part forms spectral characters as same as black bodies that follow Plank's law. Thus, baseline correction was operated based on Plank's law. We used the Plank's law function as the basis function to evaluate appearance-temperatures of human bodies with consideration of radiation coefficients and spectral characters of microbolometer array sensors. For multi-layer model for emission and absorption, linear sums of these optical phenomena are observed as radiated lights from human bodies. But as for active spectroscopy, spectral absorption characters of only near skin-surface could be measured. Thus, from the subtraction of inverted absorption spectral characters of near skin surface and emission spectral characters, we could acquire interior spectral characters respectively.

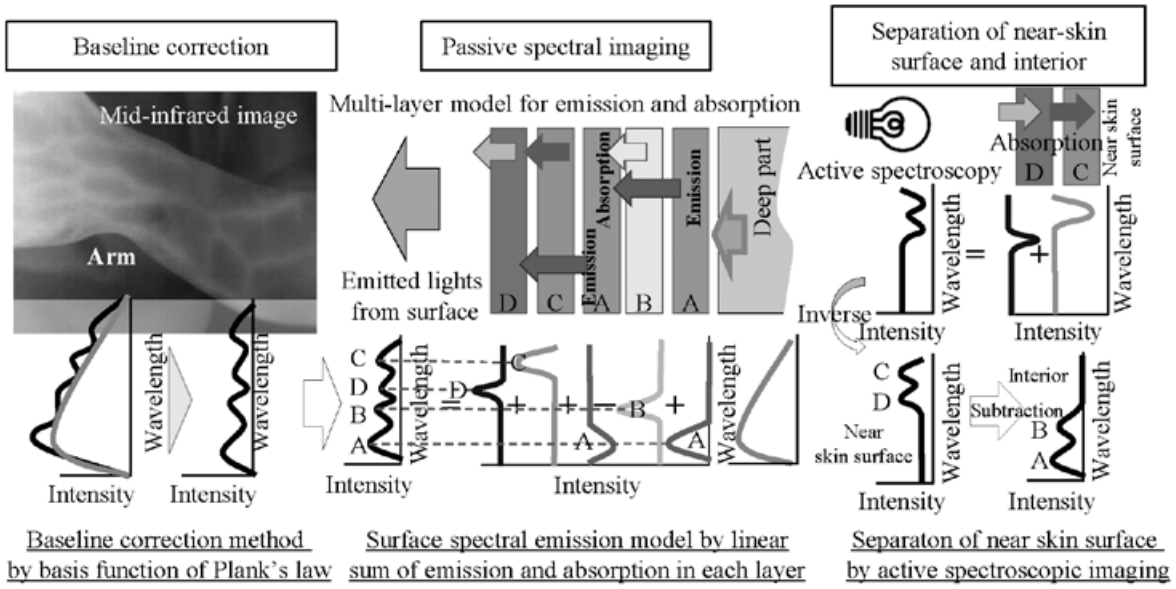


Figure 2. Conceptual diagram of analyzing spectrum of each layer from detected emission spectroscopic data radiated from skin surface.

IV. Conclusion

We proposed the mid-infrared passive-active spectroscopic imaging to analyze body internal components like non-invasive blood glucose sensors.

V. References

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EU-Japan Project E-VITA - a Virtual Coach for Smart Aging

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Ⅰ. Description

E-VITA: EU-Japan Virtual Coach for Smart Aging is a EU-Japan joint project under Horizon 2020 and MIC funding. Altogether 22 partners in Japan and the EU are researching about new technologies and methods helping aging people. In Japan the project is headed by Tohoku University, Smart Aging Research Centre（SARC).

The combination of the socio-technology excellence "Made in Europe" with the excellence of technology "Made in Japan" will produce an innovative coaching system based on the needs and wishes of older adults. The virtual coach will provide personalized recommendations and interventions to improve the quality of life of older adults in Europe and Japan while offering opportunities to SME's and NGO's to explore the feasibility of a new ecosystem. The impact should be Empowering older adults to better manage their own activities will have an impact on increasing the wellbeing of older adults and will improve their quality of life via socio-technological support of "Active and Healthy Ageing" in Europe and Japan.

Ⅱ. Participants

Japanese Consortium

Participant no. *	Participant organization name	Country
13 (Coordinator)	TOHOKU UNIVERSITY – SMART AGEING RESEARCH CENTER (TOHOKU)	Japan
14a	AIST – AI RESEARCH CENTER TOKYO (AIRC)	Japan
14b	AIST – HUMAN AUGMENTATION RESEARCH CENTER CHIBA (HARC)	Japan
15	WASEDA UNIVERSITY – INSTITUTE OF LIBERAL STUDIES (WASEDA)	Japan
16	NATIONAL CENTER OF GERONTOLOGY AND GERIATRICS (NCGG)	Japan
17	JAPAN QUALITY ASSURANCE LTD. (JQA)	Japan
18	J. F. OBERLIN UNIVERSITY - INSTITUTE OF GERONTOLOGY (IGOU)	Japan
19	GATEBOX INC. (GATEBOX)	Japan
20	MISAWA HOMES INSTITUTE OF RESEARCH AND DEVELOPMENT CO. LTD. (MISAWA)	Japan
21	NEU CORPORATION LTD. (NEU)	Japan

NAME OF THE COORDINATING PERSON
Yasuyuki Taki, Tohoku University Sendai (Japan)

European Consortium

Participant no. *	Participant organization name	Country
1 (Coordinator)	UNIVERSITAET SIEGEN (USI)	Germany
2	AGE PLATFORM EUROPE AISBL (AGE)	Belgium
3	DIOCESAN CARITAS ASSOCIATION COLOGNE E.V. (CARITAS)	Germany
4	DELTA DORE S.A. (DELTA)	France
5	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG)	Italy
6	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V. (FHG)	Germany
7	ASSISTANCE PUBLIQUE DES HÔPITAUX DE PARIS (HBP)	France
8	ISTITUTO NAZIONALE DI RIPOSO E CURA ANZIANI (INRCA)	Italy
9	INSTITUT MINES-TELECOM (IMT)	France
10	INSTITUT FÜR ANGEWANDTE INFORMATIK E.V. (INFAI)	Germany
11	INSTITUT FUR EXPERIMENTELLE PSYCHOPHYSIOLOGIE GMBH (IXP)	Germany
12	UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM)	Italy

NAME OF THE COORDINATING PERSON
Volker Wulf, University Siegen (Germany)

Ⅲ. Biography

Dr. Lorenz Granrath is Specially Appointed Assistant Professor at Tohoku University, Smart Aging Research Center (SARC) since May 2021. The competence of SARC is fighting dementia by researching the correlations with health and lifestyle. Dr. Granrath is supporting SARC in organizing the Japanese side of the project e-VITA, especially looking at the dissemination and he is initiating new international collaborations with institutes and industry for SARC. Besides that, he also acts as Non-Key Expert for the EU in Human Centric AI, he is Senior Advisor for some companies and Visiting Lecturer for the Ph.D. course EnergyNext at Waseda University. He worked the past seven years as Senior Innovation Coordinator at the AI Research Center of AIST, initiating international AI research projects. Before that he set up the Fraunhofer Representative Office Japan since 2001 building up a big network in industry and science.

Ryan Browne is research assistant at the Smart Aging Research Centre. He completed an MSc in Basic Medical Science at the Graduate School of Medicine, Tohoku University, investing the relationship between the neuro-immune system and Alzheimer's disease progression using mouse models; as well as investigating the relationship between the APOE e4 allele and brain structure in young adults from SARC's human-MRI database; and joined an international collaborative research project that looked at cellular stress defense mechanisms in the context of space flight.

Before that, he completed an MSci at Imperial College London in Chemistry with Molecular Physics, researching nanoscale devices in the field of non-equilibrium thermodynamics.

Multidisciplinary Approaches and AIs

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Ⅰ. Abstract

The development of multiple multidisciplinary projects led to the creation of new technologies and strategies that were mostly not designed at the start of the projects. As a result, the new technologies and strategies themselves open doors for new possibilities beyond the scope of these projects. This talk will start with a few exemplified multidisciplinary technologies and strategies that have been developed or are being developed to resolve the obstacles encountered during the development of the projects. Then digital control, coding and CNC systems came into play towards multidisciplinary AIs.

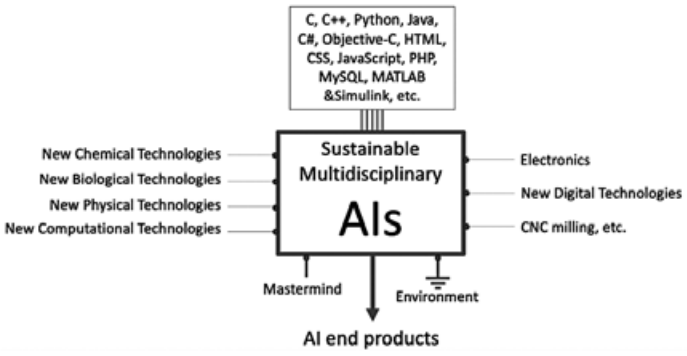
Ⅱ. Results & Discussion

In a chemistry project that aimed for chemical synthesis of polysaccharides, a novel polyglycosylation approach was developed to tackle the problem and showed for the first time a pattern of polycondensation from monomeric oligosaccharides. This polyglycosylation technology if further developed could itself enable the chemical access to polysaccharides that is not possible so far.

In a biophysical project that aimed for detection of molecular interaction of oligosaccharides with a membrane protein at the single-molecule level, a DIB-fusion system was developed to enable same-pore experiments for various experiments.

In a biological system, a new antibacterial strategy that combines antibodies and antibacterials presented new opportunities in the fight against drug-resistant bacteria.

More recently, multiple new technologies that incorporated digital control and coding are being developed to enable the extension of the capabilities of existing instruments and devices towards (semi-) automation and integration, which will eventually foster sustainable multidisciplinary AIs that will benefit academia, industries and a human-centered sustainable AI planet. On the other hand, new educational strategies need to be developed to catch up with these trends accordingly.



Ⅲ. Conclusion

Cross-disciplinary approaches often bring new ideas and applications in relevant disciplines. The multiple examples out of personal research experience elaborated how every occurrence followed this principle. The abilities to continue learning, especially new areas and even disciplines, is essential for sustainability in creation.

Cutting-edge technology developments in the forthcoming overwhelmingly digital era require not only typical or traditional interdisciplinary research approaches but more importantly digital control systems and coding for best efficiency and invaluable freedom in creation for individuals.

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Development of ultra-small mobile CTG and its effectiveness on remote monitoring of the pregnant women, as well as its global expansion. ～Teleconsultation of the pregnant women are now receiving attention in midst of COVID-19 pandemic～

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The cardiotocomonitor was developed back in the 1970s, but the device itself weighed more than 10kg, and its usage was limited within the hospital facility. About 50 years has passed since then, and the improvement of cardiotocomonitor was seen gradually. Enhancements were performed in reducing the device size as well as incorporating wireless technologies to connect the device and the transducers, enabling users to move free within the facility while being measured. If devices are connected to the central monitor, all of the data from active devices can be observed in the staff room. There are recent attempts to send fetal heart rate pattern to distant doctors and nurses via internet, but many of the devices used to measure such data are still stationary type, and the pregnant women have to be in the hospital setting to be measured.

Therefore, the mobile fetal monitoring system, the mobile CTG, that can be used outside the hospital setting is now receiving attentions. We have been developing such device since the 1990s, and with recent trend of mobile devices like cellphone and smartphone, we developed a portable system (2kg weight). This system was implemented in Iwate Prefecture's "Ihatov" system, as well as Japan's remote islands like Okushiri Island and Amami Island. Additionally, it was used abroad in countries like Thailand, Laos, and Myanmar. Recent addition to that list is the country of Bhutan, in which the devices were implemented with reimbursement from the UN.

The recent trend of downsizing the mobile devices demanded our mobile CTG to follow the same tendency, which made us decide to develop a brand new ultra-small mobile CTG "Petit CTG". Upon developing it, we were not so much captured with the conventional technologies but rather basing everything on a new concept.

The Petit CTG system is made up of ultrasound transducer for detecting fetal heart rate (166g), a toco transducer for detecting uterus contraction (137g), and a tablet device. Transducers and the tablet are connected via Bluetooth. Once the data is transmitted to the tablet, the information is then transmitted to its destination via 3G/4G network or Wi-Fi network within hospital or household setting, allowing data to be monitored from virtually anywhere. The cardiotocomonitor system from 1970s weighed up to 15kg (including the cart), whereas the Petit CTG's weight is about 300g (total weight of 2 transducers), reducing its weight up to 1/40 to 1/50 from the past devices. Petit CTG is connected to cloud server, which means that if the user has an internet connection, he or she can view data and monitor the well-being of the fetus from anywhere in the world.

Response to the COVID-19 pandemic

In response to the recent outbreak and widespread pandemic of COVID-19, the telemedicine and teleconsultation is starting to get accepted widely. The biggest concern for pregnant women nowadays is how to prevent themselves from getting a disease. Unlike caring for chronic illness like high blood pressure and diabetes, pregnancy monitoring involves the checking of the well-being of fetus, and that is especially difficult to do when making diagnosis remotely.

Currently, Hokkaido University has started the test usage of Petit CTG and its results are promising, gathering interests from worldwide. In this webinar, the issue of remote checkup of the pregnant women as a preventative measure for COVID-19 will be covered.

Developing Medical Devices for e-Health to Work towards The Overseas

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Ⅰ. Abstract

The global maternal mortality rate remains high and many of these deaths were preventable and occurred in developing countries. The perinatal mortality rate in developing countries is significantly higher than the global average of 17.7 deaths per 1,000 live births. The Global Burden of Stillbirths, released by UNICEF and others in October 2020 (1), two million babies a year are stillborn because of poor perinatal management.

We propose our solutions to solve these problems. For the effective use of medical resources, we have developed Melody i, a communication platform for pregnant women and doctors. Melody i has the IoT devices called Fetal Monitor iCTG, Which has a fetal heart rate meter and a uterine contraction meter. (Fig 1) If the mother and her baby have any concerns, they can immediately see a remote doctor via the internet. In an emergency, she can be referred to a large hospital very smoothly. It can prevent baby's problems such as hypoxia, stillbirth and so on.

The core technology of the Fetal Monitor-iCTG is a medical device with IoT communication technology, lightweight, wireless, and easy to carry. It offers the same high-level performance as a conventional CTG.

Ⅱ. Results & Discussion

With the solution Melody i, the doctor diagnoses from the CTG graph as before. What is different is that the diagnosis can be made remotely. In Japan, we use it for the management of high risk pregnant women and to avoid the risk of infection under infections like COVID-19. (2) At this time, it is also advantageous that the iCTG can be washed with water or wiped with alcohol.

In Thailand and Bhutan, we mainly use it for referrals. By placing iCTG throughout the community, if there is a risk to the pregnant woman or the fetus, we send the pregnant woman to a secondary or tertiary hospital as soon as possible.

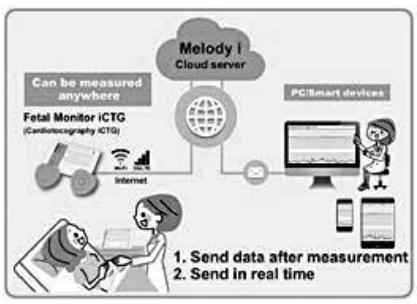

Fig 1. The solution Melody i and fetal monitor iCTG in use

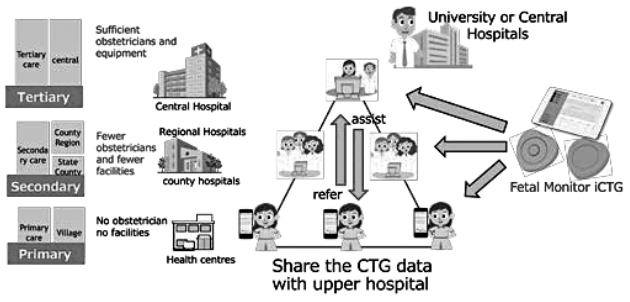

Fig 2. A system of wide-area perinatal referral solutions to look after pregnant women and their unborn babies in developing countries and elsewhere.

Ⅲ. Conclusion

In conclusion, we will show you three type of perinatal eHealth made possible by fetal monitor iCTG. First, pregnant women living in island and mountainous areas, can be referred to the central hospital as soon as possible. Second, for high-risk pregnancies and infection risks, online medicine will be available. Finally, fetal monitoring data in shelters and emergency vehicles can be sent to doctors real-time.

As in these two cases, you do not have to be in a hospital to use the Fetal Monitor iCTG. That device can be delivered to the pregnant woman home and her CTG data can be sent to a doctor at the hospital.

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(2) Feasibility and safety of urgently initiated maternal telemedicine in response to the spread of COVID-19: A 1 - month report https://obgyn.onlinelibrary.wiley.com/doi/full/10.1111/jog.14378

Development of a Novel Program to Detect Atrial Fibrillation Using Pulse Wave from Automated Blood Pressure Monitor

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2) Seto Inland Sea Regional Research Center, Kagawa University, Kagawa, Japan.

Ⅰ. Background

Atrial fibrillation (AF) frequently remains undetected and contributes to an increased risk of stroke, heart failure, dementia, and death[1)]. The aim of this study is to develop a novel program that can accurately diagnose AF by discriminating it from other arrhythmias using the pressure pulse waveform data outputted from Omron automated BP monitor HEM-907.

Ⅱ. Methods

BP measurements were performed 3 times each for 303 general cardiac patients using the Omron BP monitor HEM-907 with recording the real-time single lead ECG as the reference. The pressure pulse waveforms recorded in the HEM-907 device during BP measurements were outputted to a computer in real time. A total of 850 pressure pulse waveforms from 280 patients (include 40 AF patients), which were completely saved to a computer, were used for further analysis. We developed a program to analyze and visualize uniquely the characteristics of AF waveform through the autocorrelation-based waveform processing system. All visualized results were judged and classified into AF and other by two individuals blinded to the ECG results. For each patient who obtained 3 results, a two by two contingency table was created; and then sensitivity, specificity, and accuracy for diagnosing AF were calculated.

Ⅲ. Results

Ⅰ. Among 720 waveforms with Sinus or Non-AF arrhythmias, only 21 waveforms (2 Sinus and 19 Non-AF arrhythmias) were misjudged as AF using the novel program. Among 120 waveforms with AF, only 7 waveforms were misjudged as Other.

Ⅱ. In analysis for each patient, when two or more AF judgements with the novel program were found in 3 waveforms, the diagnosis of AF had the sensitivity of 100% and the specificity of 97.9%. In this rule, the accuracy of AF reached up to 98.2%, and none of patients with Sinus was misjudged as AF.

Ⅳ. Conclusions

The novel program, which applied autocorrelation methods uniquely to analysis of the pressure pulse waveforms recorded by automated BP monitor, showed high sensitivity and specificity for AF diagnosis in general cardiac patients.

Ⅴ. References

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Workshop 2
Smart City

Chairperson
Mr. Orfeas Voutyras, National Technical University of Athens (NTUA) (Greece)

City of Linköping (Sweden)
City of Takamatsu (Japan)
City of Santander (Spain)
City of Fujisawa (Japan)
City of Malmö (Sweden)

City of Linköping - a smart city!

Jakob Algulin[1], Tomas Larsson[1], Daniel Stendahl[1], & Lars Vikinge[1]
City of Linköping[1]
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Ⅰ. Abstract

Linköping is the 5th largest city in Sweden, constantly increasing in population, making it one of Sweden's fastest-growing cities. Linköping is a part of the expansive East Sweden Business Region with a clear high tech profile with development comprising, among other things, medical IT, telecommunications and advanced aeronautics including fighter jets. Furthermore Linköping University is a leading European innovative university along with a hospital environment being cutting edge in several fields.

The city has high ambitions for a clean environment and the fight against climate change, thus, a smart city is much more than IT, sensors and data. It is all about meeting the needs of businesses and the citizens and creating the city of the future.

This abstract describes smart city projects in Linköping managed by the city. The projects were compiled following a survey with municipally owned companies. The purpose of the survey was to compile an overview of the current projects. In Linköping municipality there are a variety of activities in the area of smart city. The projects are divided into the following categories: *Real estate, Municipal services, Environment, Mobility, Future of care, Public safety and Strategy and architecture.*

Ⅱ. Results & Discussion

Real estate

Technologies to optimize property management is perhaps the most developed area in terms of technologies supporting environmental as well as business values. Linköping is a national driver in establishing a digital twin, a concept for digital planning, design, construction, and management of a sustainable, intelligent, and liveable city by 2030. Knowledge of energy consumption is used for maintenance of buildings but also storing and optimizing Cetetherm technologies. Smart watering systems of city plantations reduce water consumption as well as optimize travel for municipal employees.

Municipal Services.

Unified digital-/self services for citizens and business are developed to increase the quality of service as well as external and internal effectiveness.

Environment

A wide range of technologies use environmental sensor data, from city air quality, public bath temperatures in nearby lakes, to “live” fish recognition in nearby streams, in order to base discussions and decisions on facts and to create a data driven development of the metrics. In smart waste management, GPS and waste bin level sensors are being used.

Ebbepark, a new city district, has been declared a “test bed” for smart applications, which has generated solutions for storing and sharing energy in the city, as well as fossil free logistics with the help of mobile cistern of renewable biodiesel. District heating is being optimized by Hot remote technologies to store energy in buildings. The university is researching ways to harvest energy for IoT sensors. This research might help create a more sustainable environment.

Sewers are monitored when large amounts of rain put pressure on the sewers. In order to release pressure, the sewer will flood into a river. The amount of flooding is registered and measured by level sensors at the water's edge.

Mobility

The city's public transportation system, based on anonymized counting of individuals, helps the city and people to plan their routes. They can see how long it takes to move from one place to another in a car or on a bus. This will help the city know what is wrong and what needs fixing so everything is better for everyone.

Self driving busses have been active for a few years in defined areas and have now started running in regular traffic with the ambition to learn how it should be incorporated in the regular planning of the city.

Public safety

Political initiatives on camera surveillance have included projects for other smart technologies that support public safety in the city, incorporating a holistic view on sensors, for both visual as well as sounds with AI.

Public lighting as well as other actions are triggered to increase the perception of safety in the city.

In collaboration with the housing companies a concept is developed to accommodate safety solutions at home, the primary target group being the elderly and their relatives. The concept has the aim of improving the possibilities for old people to stay healthy in their home as long as possible.

Future of care

Instead of traditional personal oversight to pay attention when a person needs help, projects on how to use security and safety-creating technologies in care are being deployed, in order to create an environment without unnecessary intrusion of privacy.

Strategy and architecture

For development of a smart city strategy, the reference architecture is of paramount importance. Linköping is an active part in the development of national standards of IoT and closely follows European initiatives on interoperability, for example Open and Agile Smart Cities, OASC, MIM initiatives.

Linköping participates in a range of national projects like City as a platform to develop national interoperability, but also innovative projects like playground and city gym projects for the development of IoT in public spaces.

Ⅲ. Conclusion

Building a smart city incorporates all aspects of a city and must be aligned with the strategic objectives of citizens, businesses and the political leadership. A smart city is more than smart sensors and technologies - it is value creation. However at the end of the day, technology is a key component of almost all projects.

The biggest challenge is to align the objectives and work together in the different professions to create the city of tomorrow. Linköping's brand promise to its citizens "where ideas come to life" and the positioning of the city of Linköping is "future now". Only with great collaboration and hard work to create a better life for the citizens of Linköping, will we be able to meet the promise.

Smart City Takamatsu Solutions for Disaster Prevention/ Management

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City of Takamatsu[1]
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Ⅰ. Abstract

In 2017, the City of Takamatsu launched a smart city project in order to deal with urban issues and to ensure the city's sustainable growth by incorporating ICT and data while working with diverse entities including Kagawa University. The city established the Smart City Takamatsu Promotion Council with academia and the private sector in October that year. Takamatsu became the first municipality in Japan to introduce FIWARE, an IoT platform developed and standardized in Europe. Since then, the City of Takamatsu has been developing/validating several Smart City projects in various fields, such as Disaster Prevention (Tide Level), Tourism (Bicycle Sharing), Well-being (Wearable Device for the Elderly), and Traffic Accident Regulations (Incident Map).
Of particular importance is disaster prevention/management. Nonetheless, the operation is labor intensive and time consuming and a local government is chronically understaffed. That's why the centralized management and analysis of data on a common platform is vital. Sensors are placed to collect real-time data on water level and tide level that are visualized on the map. The city can respond quickly and take safety measures by offering shelters and other critical information. Real-time data visualization is also available for residents to place sandbags as well as information of affected areas for transportation service providers.

Ⅱ. Results & Discussion

In the event of heavy rains and typhoons in 2018, we were able to improve the level of disaster response by utilizing these water/tide level data. We are working to further enhance data by, for instance, installing cameras and collecting information on flooded roads. Also, sensors that measure the water/tide level of rivers are installed to collect real-time data on FIWARE. In addition, data from sensors placed by Kagawa Prefecture and information on weather are acquired and centrally displayed on a map (Figure 1). When there is a high risk of flooding or storm surge, public facilities become evacuation shelters, and they can be monitored centrally using data from the smart meters that are electricity meters. It could be applied to other areas of disaster preparedness.

Fig 1. The following data and information are centrally managed and displayed on the map (dashboard): (1) data on water level and tide level sensors installed by the city, (2) water level data from the prefecture, (3) weather information, and (4) status of evacuation shelters (via smart meters).

Fig 2. Example of a Water Level Sensor The device at the bottom is the water level sensor and the box at the top is the control box.

Ⅲ. Conclusion

The use of data in the field of disaster management has made it possible to reduce the amount of work that used to rely on human power. Now we can respond to disasters by placing personnel where they are needed. As open data, some of the visualized data are available for viewing by any citizen. Future subjects are more analysis of the accumulated data in order to further enhance the city's disaster response capabilities, including short-term predictions and announcement of evacuation information to the residents.

Secure and Trustworthy Mobile Participatory Sensing over M-Sec Platform

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Ⅰ. Abstract

M-Sec project has been providing a set of components for security and integrity of data traffic with a modular approach for the IoT and Smart City domain. Fujisawa City hosts two pilot studies: Secure and Trustworthy Mobile Sensing and Secure Affective Participatory Sensing.

Ⅱ. Secure and Trustworthy Sensing: Pilot Studies in Fujisawa

The former illustrates how environment monitoring data can be captured from the real world, handled in the cloud system, and delivered to citizens securely (Figure 1). In the latter, the participatory sensing data from the smartphone apps "SmileCityReport (Figure 2)" is leveraged for sharing fun with "smile" photo.

Figure 1. Sensor box mounted over trucks (left), visualization of PM2.5 density (middle), and image-based road damage detection (right)

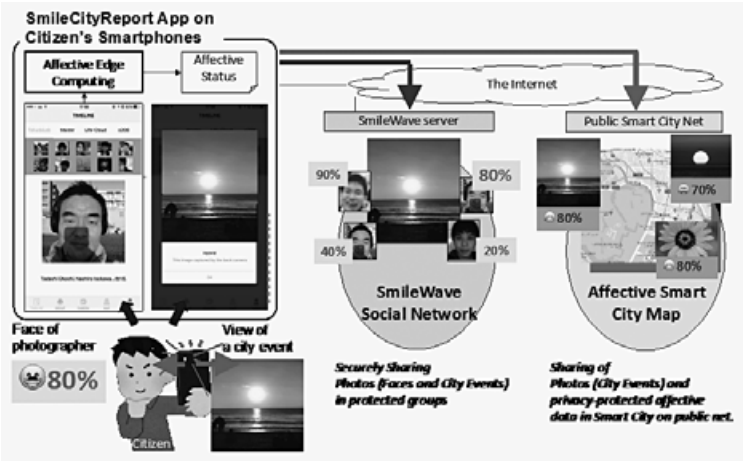

Figure 2. SmileCityReport: Hyper-connected participatory sensing application

Ⅲ. Multi-Layered Security and Blockchain-based Marketplace

In these studies, the IoT devices, the cloud system, and applications consuming sensor data streams are extended with Multi-Layered security mechanisms. One of the key components is Secure SOXFire (Figure 3), a distributed middleware system that enables matching between the data providers and consumers without being conscious of the other party. Another is GANonymizer that automatically removes the privacy-related objects from images using deep learning.

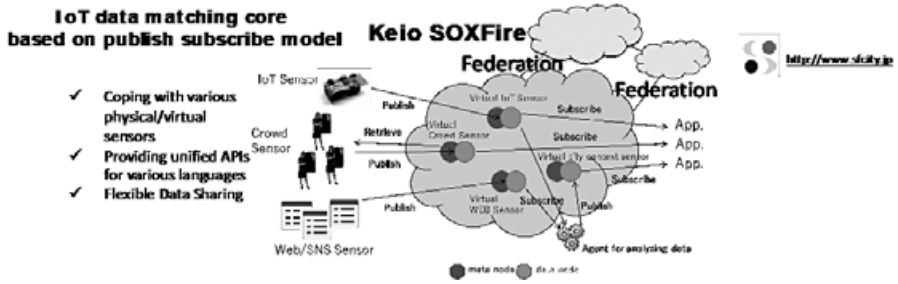

Figure 3. Publish/Subscribe-based scalable data distribution platform "SOXFire"

The data, which are not personal or sensitive, generated by the whole service are sent to the blockchain-based MSec Marketplace to foster a secure IoT data exchange. This Marketplace includes a Trust & Reputation component capable to evaluate the actual content being shared, resulting to form secure end-to-end data transaction over the Internet among stakeholders (Figure 4).

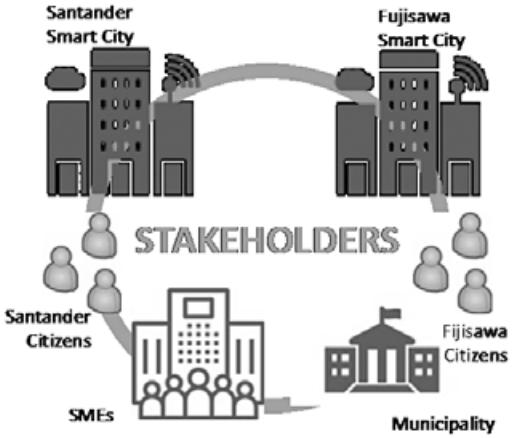

Figure 4. Stakeholders securely connected over M-Sec marketplace

Ⅳ. Conclusion

Fujisawa City, as one of the advanced IoT-rich cities in Japan, has been collaborating with the M-Sec consortium.

This collaboration will continue to make Fujisawa smarter, leveraging its strong partnership of leading EU+JP universities, research centers, and companies in the area of Big Data, IoT, Cloud Computing, Blockchain.

Workshop 3
Innovative Technologies for New Industry Creation

Chairpersons
Prof. Dr. Kiyoshi Tanaka, Shinshu University (Japan)
Prof. Dr. Tomohiko Ishii, Kagawa University (Japan)

Lithium-ion Battery Anode of Mesocrystalline $CoTiO_3/TiO_2$ Nanocomposite with Extremely Enhanced Capacity

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Ⅰ. Abstract

Mesocrystalline materials consisting of nanocrystal subunit alignment with the same crystallographic orientation, have a potential application to active materials for lithium-ion battery (LIB) electrodes. In this study, a topochemical process was developed to the synthesis of mesocrystalline $CoTiO_3/TiO_2$ nanocomposites using a layered titanate $H_{1.07}Ti1.73O_4$ (HTO) as the precursor. The introduction of H_2O_2 into the interlayer space of HTO leads to access of Co^{2+} intercalation into the interlayer space by ion-exchange reaction and the formation of a sandwich layered structure by stacking HTO layer and $Co(OH)_{2-x}^{x+}$ layer. This sandwich layered structure was topotactically transformed into a mesocrystalline $CoTiO_3/TiO_2$ nanocomposite by heat-treatment at above 600oC. The SAED result suggests that the $CoTiO_3/TiO_2$ nanocomposite is constructed from [010]-oriented $CoTiO_3$ nanocrystals and [110]-oriented rutile TiO_2 nanocrystals. The electrochemical results indicate that mesocrystalline $CoTiO_3/TiO_2$ nanocomposite exhibits an extremely enhanced anode capacity of about 400 $mAh{\cdot}g^{-1}$ for LIB, which is two times higher than that of polycrystalline $CoTiO_3$. The excellent anode performance is attributed to the high mobility of Li^+ in the mesocrystalline nanocomposite and the synergistic effect of TiO_2 nanocrystals in the nanocomposite by enhancing cycling stability and electron conductivity.

Ⅱ. Results & Discussion

Layered titanate $H_{1.07}Ti_{1.73}O_4{\cdot}H_2O$ (HTO) was treated with H_2O_2 to obtain H_2O_2-HTO. After H_2O_2-HTO ionexchanges with Co^{2+}, a sandwich layered structure by stacking HTO layer and $Co(OH)_{2-x}^{x+}$ layer was formed (Figure 1c). The sandwich layered structure was transformed to mesocrystalline $CoTiO_3/TiO_2$ nanocomposite after heat treatment (Figure 1f). Figure 2 shows the electrochemical performance of mesocrystalline $CoTiO_3/TiO_2$ nanocomposite as LIBs anode. The discharge-charge capacity of mesocrystalline $CoTiO_3/TiO_2$ nanocomposite (400 $mA{\cdot}g^{-1}$) is much higher than that of polycrystalline $CoTiO_3$ (180 $mAh{\cdot}g^{-1}$), which can be attributed to two effects. One is the synergistic effect of TiO_2 nanocrystals in the $CoTiO_3/TiO_2$ nanocomposite, which can act as cycling stable buffer and enhance the electron conductivity. And other is mesocrystal effect. The mesocrystalline nanostructure provides superior interface network for the fast migration of Li^+. Furthermore, the oriented nanocrystals can also promote Li^+ migration in the mesocrystalline material, naming the Li^+ migration in the mesocrystalline material is much smoother than that in a normal polycrystalline material or their nanocomposite.

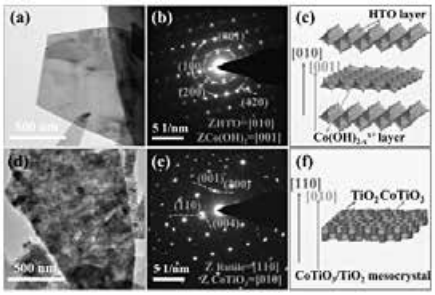

Fig 1. TEM images, SAED patterns sketching nanostructures of (a) (b) (c) Co-H_2O_2-HTO and (d) (e) (f) $CoTiO_3/TiO_2$ nanocomposites.

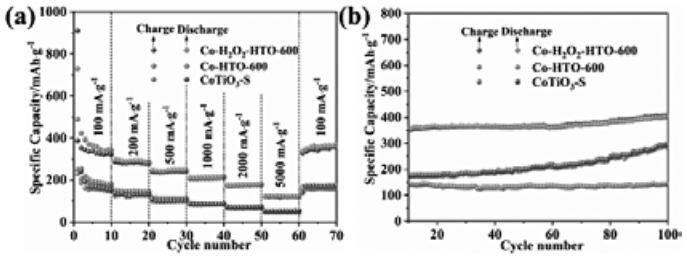

Fig 2. (a) Rate capabilities and (b) cycling performances of Co-H_2O_2-HTO-60, Co-HTO-600, and $CoTiO_3$-S at 100 mA g^{-1}.

Ⅲ. Conclusion

The platelike mesocrystalline $CoTiO_3/TiO_2$ nanocomposite is successfully prepared by *in situ* topotactic conversion reaction from HTO platelike precursor. The introduction of H_2O_2 causes the access of more Co^{2+} intercalation into the interlayer space of HTO and the formation of Co-H_2O_2-HTO with high Co/Ti molar ratio. Co-H_2O_2-HTO can be topotactically transformed into mesocrystalline $CoTiO_3/TiO_2$ nanocomposite during the heat treatment process. The electrochemical test results indicate that the mesocrystalline $CoTiO_3/TiO_2$ nanocomposite exhibits the much-enhanced reversible discharge-charge capacity of 400 mAh·g^{-1} than that of polycrystalline $CoTiO_3$. The excellent anode performance of the mesocrystalline $CoTiO_3/TiO_2$ nanocomposite can be attributed to the high mobility of Li^+ in the mesocrystalline nanocomposite and the synergistic effect of TiO_2 nanocrystals in the nanocomposite by enhancing cycling stability and electron conductivity.

Development of Air Supply System for Wearable Robot -Effectiveness of Hollow Cylindrical-shaped Variable Volume Tank

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Ⅰ. Abstract

Air supply systems for the pneumatic power assist devices are required to have portability. Conventional air supply systems have employed constant volume tanks. If a small constant volume tank is used in order to downsize the system, inner pressure of the tank drops significantly when compressed air is supplied to the actuator. In this study, a hollow cylindrical-shaped variable volume tank is developed as a solution to this issue. This paper describes the effect of decreasing pressure drop based on the pneumatic energy characteristics when compressed air is stored in the developed hollow cylindrical-shaped tank. We also explain the feasibility of achieving the desired energy characteristic at high pressure by multi-layering the tanks to increase outer pressure.

Ⅱ. Results & Discussion

Figure 1 shows the overview of the hollow cylindrical-shaped variable volume tank. This proposed tank is made of elastomer, which expands by increasing inner pressure and accumulates part of inflow energy as elastic energy. Figure 2 shows the measurement results of the energy characteristic of the hollow cylindrical-shaped variable volume tank. Figure 3 shows the energy characteristics of the constant volume tank. Elastic energy can be converted into compressed air energy when air is supplied to the actuator. Therefore, the pressure drop in the tank can be decreased compared to the conventional constant volume tank. The hollow cylindrical-shaped variable volume tank is compact as the initial inner volume is small. Moreover, it contributes to reducing remaining energy in the tank after compressed air is supplied to the actuator. These characteristics of the hollow cylindrical-shaped variable volume tank lead to low energy consumption of the entire air supply system.

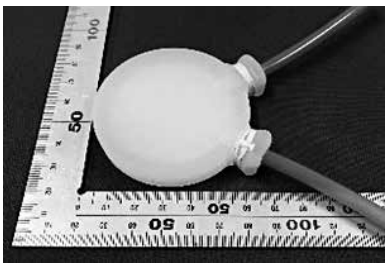

Figure 1. Hollow cylindrical-shaped variable volume tank

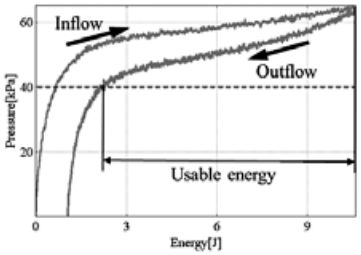

Figure 2. Energy characteristic of hollow cylindrical-shaped variable volume tank

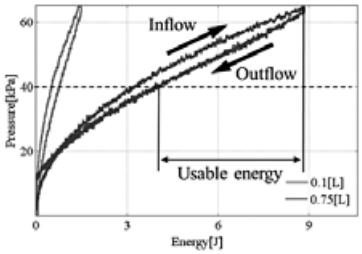

Figure 3. Energy characteristics of constant volume tank

In addition, a multi-layered tank is proposed to improve energy characteristic. Figure 4 shows the structure of the multi-layered tank. The inner tank is inserted between two outer tanks. The expansion of inner tank is restricted by increased pressure between inner and outer tanks. Figure 5 shows the energy characteristics when the outer tank is pressurized.

It is confirmed from the result that the value of relaxation-pressure and the amount of stored energy in the tank can be increased.

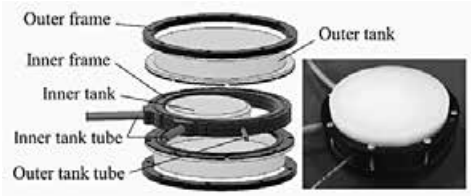

Figure 4. Multi-layered variable volume tank

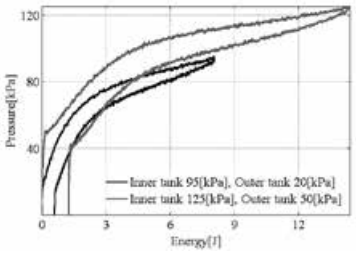

Figure 5. Energy characteristics of multi-layered variable volume tank

Ⅲ. Conclusion

In this paper, the structure and characteristics of the hollow cylindrical-shaped variable volume tank were described. In addition, the multi-layered variable volume tank composed with cylindrical-hollow ones was proposed. The experimental results indicated that the relaxation-pressure value and the amount of stored energy in the tank can be increased. These results lead us to the conclusion that the multi-layered hollow cylindrical-shaped variable volume tank can contribute to the realization of portable energy-saving air supply systems.

Mid-infrared Passive Spectroscopic Imaging of Microplastics Using Imaging-typee 2-D Fourier Spectrometer for Wide-field Measurements

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Ⅰ. Abstract

In recent years, microplastic (MP) pollution in oceans and rivers has become a serious problem. Surveying the types, sizes, and numbers of MPs floating in water is important for clarifying their impact on ecosystems. The attenuated total reflection (ATR) method, which is conventionally used for the identification of MPs, is timeconsuming because each particle is measured individually. In addition, because of the need to handle with tweezers, only particle sizes down to a few-hundred microns are able to be investigated (Veerasingam et al., 2020). Therefore, we propose mid-infrared (wavenumber: 700–1250 cm^{-1}) passive spectroscopic imaging using an imaging-type two-dimensional Fourier spectrometer. An object at room temperature (300 K) emits light with wavenumbers smaller than 5000 cm^{-1}. This emitted light is measured by the spectrometer and analyzed to identify the type of plastic. In addition, this method can perform two-dimensional measurements. Furthermore, by simply adjusting the magnification of the interchangeable lens, a wide field-of-view can be measured in only 13 seconds. It is well known that the amount of emitted light from a sample depends on the emissivity (ε) of the materials included in a sample. For example, metals have very low emissivity (<0.1) and plastics have high emissivity (>0.9). Therefore, it is possible to identify the location of MPs by image binarization processing from the difference in the amount of emitted light by spraying MPs on a metal plate and then performing the measurements. In this presentation, we present the results of the measurement of polystyrene (PS) particles of Φ20 dispersed on an aluminum plate.

Ⅱ. Measurement of PS particles by mid-infrared passive spectroscopic imaging

Figure 1 (a) shows a schematic diagram of the optical system for mid-infrared passive spectroscopic imaging. PS particles with a diameter of 20 μm were sprayed onto an aluminum plate using a mist sprayer. The plate was then heated to 408 K on a hot plate. Spectroscopic measurements were performed at a magnification of 3.2 (fieldof-view: 1.2×0.9 mm, 3.75×3.75 μm/pixel). Fig. 1 (b) shows an image obtained with a microbolometer. As shown in the left image of Fig. 1 (b), we confirm that PS particles ($\varepsilon_{ps} \fallingdotseq 0.95$) emitted brightly against the aluminum plate ($\varepsilon_{Al} \fallingdotseq 0.01$). In addition, we confirmed that the PS particles were single particles by comparing them with a pinhole of 20-μm diameter. The spectra of five PS particles, indicated by red dots in the image, are shown in Fig. 1 (c). We compared these spectra with the PS spectrum in the Internet database. As a result, the wavenumbers of the peaks were identical. Therefore, we succeeded in detecting the emitted light of PS particles. The feasibility of wide-field measurement

of MPs by mid-infrared passive spectroscopic imaging is demonstrated.

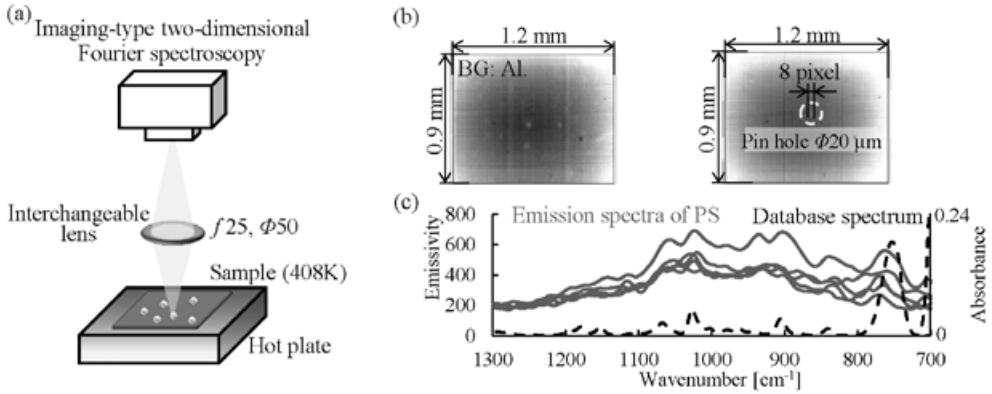

Figure 1. Measurement of PS particles by mid-infrared passive spectroscopic imaging: (a) schematic diagram of the experimental optical system; (b) observation image (left: PS particles, right: pinhole), (c) emission spectra of PS particles.

Ⅲ. Reference

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Real-Time Infrared Spectroscopic Monitoring of Fermentation Process to Support Sensory Evaluation

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Ⅰ. Abstract

Fermented foods that we eat contain a vast variety of ingredients, which are produced through complex fermentation processes. Among them, the production of sake uses an advanced fermentation method that is unparalleled in the world, where two chemical reactions are carried out simultaneously by using two types of microorganisms. Therefore, the crucial importance of quality control during fermentation requires the use of highly versatile sensory evaluation and measurement devices tailored to the ingredients to be measured (Li et al., 2009). In this context, we propose a method of quality control by quantitative measurement of fermented foods using a one-shot infrared Fourier spectrometer (Sato et al., 2016). Because this spectroscopic method uses Fourier spectroscopy it can measure multiple components simultaneously, while its small size allows it to be installed at the production site so that quality information can be confirmed in real time. This instrumentation makes it possible to measure and quantify important information in the fermentation process, such as microorganisms that act in the fermentation, compounds like glutamic acid that affect the taste of fermented foods, and volatile components that produce aroma. In this paper, we describe the feasibility of quality control in fermented food production by using a one-shot infrared Fourier spectrometer.

Ⅱ. Quantitative measurement of ethanol and glucose

Ethanol and glucose, which are the main components of fermented foods such as soy sauce and sake, were specifically selected for the measurement using a one-shot Fourier spectrometer. An IR light source (manufacturer: HAWKEYEY, model number: IR-Si217) was used to irradiate the samples with mid-infrared light by critical illumination at an applied voltage of 24 V. The experimental optical system is shown in Fig. 1. Ethanol (1, 2, 3, 4 mg/dL) and glucose (1, 5, 10, 20 g/dL) were sealed in a liquid cell with an optical path length of 25 μm, respectively. As shown in Fig. 2, the absorption peaks of ethanol and glucose were detected at 9.33 μm and 9.60 μm, respectively, and high correlation coefficients between concentration and absorbance were observed. These results demonstrate the feasibility of ethanol and glucose measurements using our proposed one-shot infrared Fourier spectrometer.

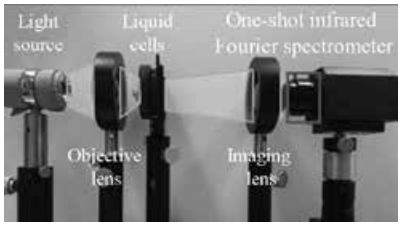

Fig 1. Optical configuration of one-shot-type spectroscopy for ethanol and glucose in liquid cell.

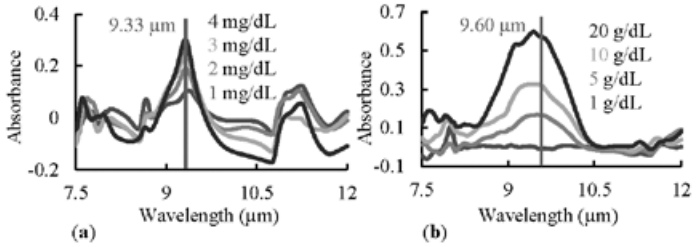

Fig 2. Spectral absorbance of ethanol (a) and glucose (b).

Ⅲ. Conclusion

Quantitative measurement of ethanol and glucose concentrations in fermented foods was carried out using a oneshot infrared Fourier spectrometer. From the experimental results, we confirmed the intrinsic absorption peaks of ethanol and glucose, and found high correlations between concentration and absorbance, which demonstrated the feasibility of quantitative measurement of the target analytes using this method. In the future, we will use the oneshot infrared Fourier spectrometer to broaden the range of measurement targets, such as microorganisms acting on fermentation and flavor components, with the aim of commercializing a compact measurement device that can provide quality control during fermented food production.

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Modelling and Simulation of Introduction of RFID in Warehousing of a Supply Chain

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Ⅰ. Abstract

The Supply Chain Management has become more complex over the years and has transcended basic analysis of the transit of goods/information between its agents, therefore it is necessary to study these agents and its subdivisions as well, such as warehousing. One of the main problems when dealing with warehouse management is the Bullwhip Effect that Forrester (1961) initially called Amplification which is an overestimation of the response by one of part of the system that propagates throughout the Supply Chain. Among the many methods to deal with this problem is reducing uncertainty within the system by sharing information while decreasing its inaccuracies. One of the ways to reduce uncertainty is to introduce new technologies available in the context of Industry 4.0, especially RFID. For instance, Masudin et al (2021) stated that between the several IT tools available in the market like bar code scanners, warehouse management system (WMS) and electronic data interchange (EDI), studies have stablished that RFID has a significant effect on both warehouse and inventory management than any other technology. When introducing RFID in a hypothetical company that used to do the data entry of inventory manually there are two aspects of inaccuracies that will be observed in this study as KPI's is the inventory accuracy and the delay of the real inventory and the inventory currently in the system. This study expects to observe an improvement of the inventory accuracy and a shortening of the real and system inventory.

Ⅱ. Results & Discussion

This study will not be conducted based on a real company with real data that was extracted and observed, instead it will be done with a hypothetical plant with one product and one costumer. The modelling and simulations will be made on the Matlabs's Simulink software.

The first KPI that will be observed is the inventory accuracy which is the actual inventory divided by the inventory in the system, the closer this number is to one more accurate it is. The second KPI that will be observed is the delay of the real inventory and its system counterpart, it will be measure by time it takes to a change in inventory to be reflected in the system. Although there are many other indicators like damaged inventory, orders per hour or on-time delivery (Ilies et al, 2009) not all of them are not relevant to this study.

Table 1 represents how the accuracy fluctuates overtime, it can be affected by the timing of the data entry and also by mistakes that worker can make during this process, in this example however only the timing was considered. The accuracy in this example varies between 0,75 and 1,36, however with the introduction of RFID the expected accuracy throughout the day is expected to be 1 (one) constantly and also a possible improvement in the Bullwhip Effect for the supplier.

Table 1: Tracking of Inventory (Real vs System)

Time in hour	Inventory Real (A)	Inventory System (B)	Difference (B-A)	Accuracy (B/A)
1	730	730	0	1.00
2	742	730	−12	0.98
3	535	730	195	1.36
4	678	678	0	1.00
5	734	678	−56	0.92
6	654	678	24	1.04
7	590	590	0	1.00
8	512	590	78	1.15
9	776	590	−186	0.76
10	649	649	0	1.00
11	573	649	76	1.13
12	656	649	−7	0.99

The Figure 1 shows how the inventory behaves over time and the delays that happens because of how the policy of data entry is established. In this example the data entry is done once every three hours which causes a gap between the graphics and generates a potential error in decision, because what is the system is not what is in the warehouse. Actually, there would also be a deformity in the graph of the "Inventory System (B)" since not all data entries would per hour, but in this example, it was ignored for the sake of illustration. With the introduction of RFID it is expected to see an almost perfect overlap of both inventories as seen on Figure 2.

Figure 1. The Delay of Inventory

Figure 2. Inventory after introduction of RFID

Ⅲ. Conclusion

The introduction of RFID in a company shows promising results in improving financial performance, customer service, inventory management and operational performance (Masudin et al, 2021). In the inventory management aspect, it can help reduce inaccuracies that otherwise would impact the decisions of a company. For example, a delay in a system can results in orders not fulfilled because of conflicts in the system of orders formed ready for shipment but no actual product, or the inverse can also occur when the physical product is ready to be sent but it can not leave the facility because the order cannot be formed due to not existing in the system. This kind of inaccuracies can also affect the relationship between the agents of the supply chain, causing a sense of distrust that could exacerbate the Bullwhip Effect. Industry 4.0 more specific RFID in this case can solve some of these problems by eliminating the human factor in a more precise and reliable way.

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Theoretical research aiming at high-efficiency hydeogen production using solar thermochemical energy for the goal of sustainable energy supply

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Ⅰ. Abstract

Novel energy styles and energy productions are so required, hydrogen energy has been much attraction from the viewpoint of the environment. Many utilities of the hydrogen energy have been studied, and the industry studies of hydrogen production have also been done. In Fig. 1, it is shown that the facility of the hydrogen production in Jülich. The "Green hydrogen technologies" project has been demonstrated, and the hydrogen gas has been sourced continuously from solar heat. It has the advantage of storing sustainable "solar energy", which can be irradiated from the sun to the earth as the form of "hydrogen energy". So, it makes good sense to convert intermittently solar energy (clean energy) to hydrogen energy (clean energy). Considering these points, Kodama *et al.* has studied new energy production of the solar thermochemical production by an oxidation-reduction reaction of the cerium oxide (CeO_2, ceria). In Fig. 2, the hydrogen production facility uses the solar thermochemical process at Miyazaki University in Japan. The flow of hydrogen production is shown in Fig. 3. Then, the sunlight can be concentrated by many heliostats and converted to thermal energy. The hydrogen gas can be generated by the thermal redox reaction with control of the reaction temperature. Moreover, the redox reaction is the cycle reaction that consisted of two-step reactions, which makes it possible to produce hydrogen gas efficiently. If the solar energy can be supplied

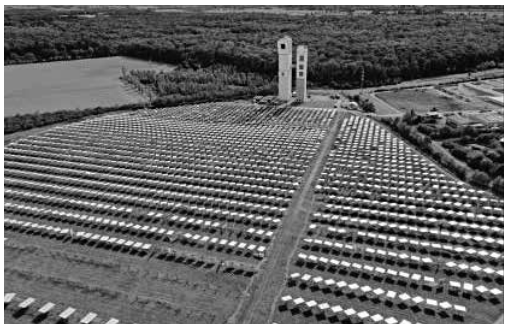

Figure 1. DLR concentrated solar thermal test site at Jülich image@DLR (Ref: SolarPACES)

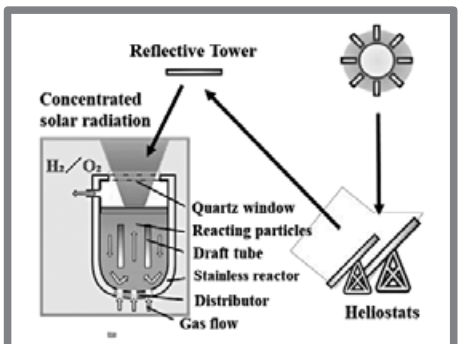

Figure 3. Floor plan of solar reactor concept for a circulating reaction measure.

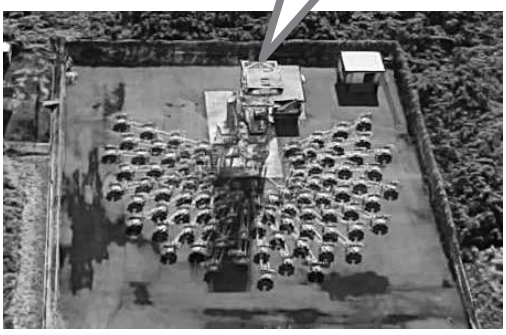

Figure 2. The solar thermochemical production at Miyazaki University. (Ref: Google map.)

stably, we can get hydrogen energy continuously.

Ⅱ. Results & Discussion

The cycle reaction used Mn-doped ceria shows the high efficiency of hydrogen gas production than the non-doped ceria in recent research. We investigated to find why the transition metal-doped ceria increases the hydrogen production using the first principle calculation. The calculated results show that the bonding in doped ceria is stronger than non-doped ceria. In addition, Mn-doped ceria shows a stronger bonding than the Co, Ni-doped ceria ones. These results suggest a correlation between the calculated results and the experimental results since the experimental high hydrogen production was obtained in the doped ceria with stronger bonding in the theoretical results.

Ⅲ. Conclusion

It is considered that doping transition metals into a ceria can stabilize the crystal system. It is suggested that the crystal structure was not easily collapsed, which improved the productivity of hydrogen. We want to develop materials that improve sustainable hydrogen production by conducting more experiments and theoretical research.

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Workshop 4
Environmental Humanities: Water, Air and Land for Sustainable Living Spaces

Chairpersons
Prof. Dr. Satoshi Murayama, Kagawa University (Japan)
Prof. Dr. Toru Terao, Kagawa University (Japan)

Contributing Towards Sustainable Living via Environmental Cleaning - a community-based movement in action -

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Ⅰ. Abstract

This paper documents a movement initiated by a group of four individuals in Kagawa Prefecture, to organize a continuous series of environmental cleaning activities with the aim of contributing to a more robust experience in sustainable living at the local community level.

Ⅱ. The background

Although widely acknowledged as a clean society, Japan is inflicted with the problem of marine garbage, especially that of plastic. Japan is a voracious consumer of single-use, disposable plastics as in evident in the packaging of goods and lunch boxes. The per capita consumption of plastics in Japan is about 30 kilograms, second only to that of USA. Aided by the winds and rains, much of these plastics find their way into the oceans via rivers and water ducts. At the Japan Inland Sea, almost 90% of marine garbage washed ashore is plastic or Styrofoam.

Ⅲ. The beginnings

Kagawa Prefecture has for several years, been engaging her citizens to be more aware of the marine garbage problem. One of the main vehicles used is the 'Satoumi University', which is somewhat like a lifelong learning platform (Matsuda, 2010). This platform offers a wide range of classes and field work for citizens to learn about and to get involved in the issue of marine garbage. One of the four individuals in the team received instructions and became motivated enough to start this movement. Note: 'Satoumi' is defined as marine and coastal landscapes that have been formed and maintained by prolonged interaction between humans and ecosystems.

Ⅳ. The events executed so far

In a span of two years, this team planned and executed five environmental cleaning activities in the coastal areas. Each event had about 30 participants and lasted from two to three hours. For each event, the team incorporated a sub-theme and related educational skits to enrich the learning process of the participants. The respective subthemes are (1) Micro-plastics (2) 'Tengusa' seaweed (3) Marine art (4) International exchange (5) 'Satoumi' and 'Satoyama'.

Ⅴ. Impressions by participants

Questionnaires were taken on two events, and reports from students were obtained on one event. Participants come from three sources: the public, the local community, and the local university. Three impressions are highlighted. The first revealed most participants to be very satisfied and

happy after taking part in the cleaning events. Secondly, many participants were surprised at the amount of marine garbage, particularly that of microplastic garbage in the beaches. Thirdly, students found the experience to be very inspiring and many planned to get involved in future events.

Ⅵ. The future

Two events are currently being planned. The first one, based on International Coastal Cleanup (ICC) procedures, involves an attempt to record the types and amount of marine garbage washed ashore in an uninhabited island off the coast of Takamatsu City. The second event is an online cleaning event jointly planned with universities from Chiang Mai, Thailand, and Chiayi, Taiwan. University students shall form the bulk of participants in both these events. Presently, planning is being withheld due to the COVID-19 situation.

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Global warming as one of the causes of decrease in fisheries resources; the case of Manila clam

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Drastic decrease of the standing stock of Manila clam in the Seto Inland Sea, Japan

Manila clams are one of the most popular bivalves of fisheries in Japan. In the Seto Inland Sea, the typical catch gradually increased until the 1980s, culminating in a maximum catch of approximately 40,000 tons in 1985, then decreased rapidly. A decrease in fish catches is currently a serious problem in the Seto Inland Sea, with the poor nutritional value of the seawater suspected to be a major cause. Indeed, a decrease of Chl a concentration has gradually occurred, and is speculated to be the result of a reduction in the nutrient load in the western Seto Inland Sea since the 1980s. On the other hand, global warming has been observed in the Seto Inland Sea region since the late 1980s. Although it is not known whether this is a direct or an indirect effect, the rise of temperature appears to be contributing to the decline of clams. We monitored the standing stock of Manila clams from 2007 in a tidal flat of the Shinkawa estuary located in the eastern Seto Inland Sea where the number of clams found in this area markedly decreased from 2008. Here, we carried out a long-term survey of temperatures and Chl a concentration, as well as an observation of planktonic larvae of the Manila clam.

Effect of high temperature on the standing stock of Manila clam

A marked decrease in clam abundance in Shinkawa estuary, to less than one-tenth of the original standing stock, began to occur in 2008 (Fig. 1). A decrease in Chl a concentration in the surface sediment and in the water column measured in 2003-2015 was not large enough to explain the catastrophic decline of clams. It is speculated that high water temperatures in summer-autumn, which have been frequently observed since 2007, may be implicated. In addition, planktonic larvae of Manila clams were scarcely detected in the autumn spawning season of 2012/2013. In contrast, high densities of planktonic larvae were observed in 2014/2015. Less Chl a concentration was observed in the summer-autumn of 2015, and food environment did not affect the magnitude of planktonic larvae over 4 years. On the other hand, water temperatures in summer-autumn of 2012/2013 were ca. 1°C higher than in 2014/2015; therefore, high temperature stress may have influenced the reproduction of adult clams, resulting in a significant decline in clam numbers, and interfering with the recovery of the standing stock.

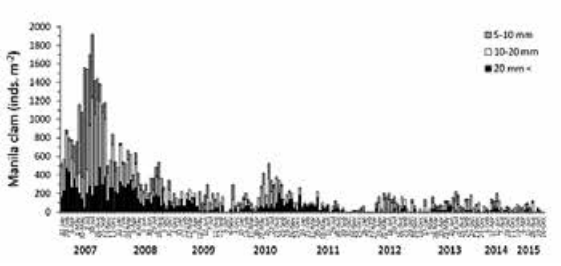

Figure 1. Changes in standing stock of Manila clams at a station in Shinkawa estuary with shell lengths.

Importance of shingle beaches as a habitat for Manila clam

We carried out surveys to clarify how the individual density of Manila clam is different between estuarine tidal flats and shingle beaches (Ichimi et al. 2019). The individual density of Manila clams at estuarine tidal flats has been decreasing since around 2008. In contrast, Manila clams were found at considerably high densities in some shingle beaches. As an indicator of the amount of food, chlorophyll a concentrations in the bottom seawater were similar in both habitats, although the seawater and mud temperatures at low tide in summer was 4–6 °C higher at the tidal flat than at the shingle beach. The maximum seawater and mud temperature at the tidal flat reached 34.1 °C and 35.4°C, respectively, showing that Manila clams inhabiting in the tidal flats are exposed to critical high temperatures. These results indicate that shingle beach is an important environment to keep the resource of Manila clams as another main habitat.

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Environmental Conservation and Fishery of the Seto Inland Sea, Japan

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Ⅰ. Objectives

The Seto Inland Sea is the largest enclosed sea in Japan (Fig.1). The sea is well known as beautiful landscape including about 600 islands. This sea is also an industrially developed area and about 30 million people live in the coastal area. During high economic growth since the 1960s, this sea became heavily eutrophicated due to serious water pollution by industrial effluent and urban wastewater. At that time, red tides often occurred. To resolve the situation, the Law for Conservation of Environment of Seto Inland Sea was enacted in 1973. Since 1973, the industrial effluent and urban wastewater were regulated by this law. After that, the number of red tide occurrences decreased from 300 times to 100 times per year and then it is now constant under 100 times. Whereas the water quality has improved, recent seaweed (*Nori*) bleaching due to lack of nutrient has often occurred and *Nori* culture in this sea was heavily damaged, and Fish catches have also gradually decreased. Here, we review the change of water quality for about the last 40 years in this sea. We will discuss the nutrient decrease, focusing on Harima Nada, the eastern part of the Seto Inland Sea based on information obtained during our previous study.

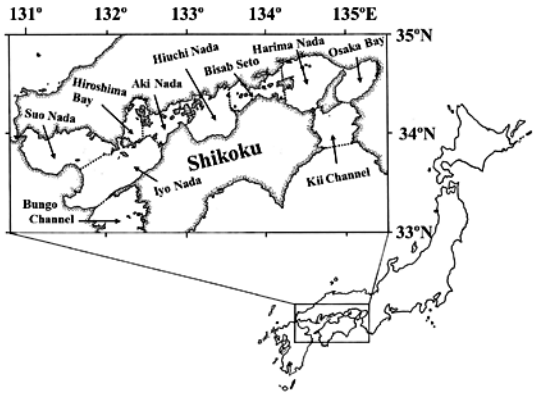

Figure 1. Location of the Seto Inland Sea

Ⅱ. The nutrient dynamics in Harima Nada

The nutrient concentrations (NO_3, NH_4, and PO_4) have apparently decreased since 1970s, as has dissolved inorganic nitrogen (DIN: NO_3 + NO_2 + NH_4). However, total nitrogen (TN) and phosphorous (TP) concentration have not apparently decreased, although TN and TP loading to the sea were reduced 40% and 61%, respectively, from 1979 to 2009 by implementing a Total Pollution Load Control System. It suggested that the decrease of nutrient concentrations could not be explained by only reducing of TN and TP loading. To maintain the appropriate nutrient condition, we need to know the mechanism of nutrient circulation and nutrient behavior. The nutrient concentrations of this sea water should be decided by the balance of nutrient income and outgo at three sites. Those are the freshwater inflow from the river, the interface between the coastal sea and open ocean or adjacent sea, and the interface between the bottom sediment and

bottom water. In three sites, we monitored the upward nutrient flux across the overlying water-sediment interface. In Harima-nada, it was estimated that nutrient flux from bottom sediment during summer was larger than nutrient inflow from the river by 3.2 times (Tada *et al.* 2014). To know the nutrient dynamics, we are trying to reveal the budget of the nutrient cycle in the water column, including the primary production of phytoplankton, organic matter settling fluxes, decomposition of settling matter in the bottom layer, and nutrient upward flux from bottom sediments.

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Green Chemistry for the investigation of in Agricultural Products and Functional Foods:Statistical approach

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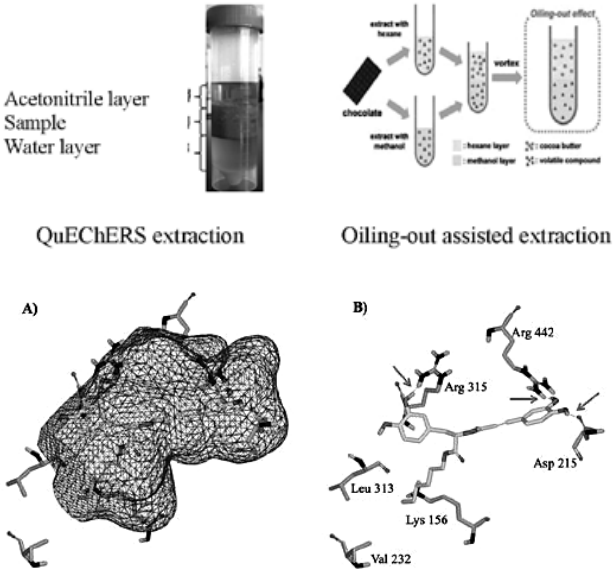
Ⅰ. Abstract

Natural products are the source for health beneficial chemicals. To elucidate the chemical structure of natural occuring pharmaceuticals by means of bioassay and instrumental analysis, we have to extract the ingredients from valuable and rare natural resources. To preserve natural resources and their living environments, systematic and solvent-saving approach for isolation and purification of health-beneficial chemicals are required. So, QuEChERS and Oiling-out extraction methods, and statistical approach were newly developed to find the positive relationship between biological activities of chemicals and abundance of chemicals under SDGs consideration.

Ⅱ. Results & Discussion

For isolation of antiallergic-active flavonoids from eleven onions, the correlation coefficient between the antiallergic activities and thirty-four peaks in HPLC chromatograms of eleven onion extracts isolated using the QuEChERS method[1)] indicated that quercetin 4′-glucoside has a highly-positive correlation ($r = 0.91$) with the antiallergic activity. Indeed, quercetin 4′-glucoside was found in high concentration (140.1 mg/kg) in Hokkaido onions, and the isolated compound showed high antiallergic activity ($IC_{50} = 3.0\,\mu g/mL$). For isolation of non-polar chemicals which contribute to the aroma of coconut oil[2)], olive oils[3)], butter[4)] and others , oiling-out effect (olive oil) assisted extraction method using a hexane-methanol bilayer solvent was applied for volatile compounds.

For investigation of biologically active chemicals, correlation coefficient mentioned above and computational molecular docking method were applied for determination of active substances and active sites of the molecules[5)]. These kinds of approach may short-cut the whole process of find active substances in nature. For instance, rosmarinic acid (RA), commonly found in Nepetoidae subfamily of Lamiaceae family, possesses various biological activities. To expand its application, RA was modified by esterification with methyl (me), propyl (pro), and hexyl (hex) alcohols and then tested antibacterial, α-glucosidase inhibitory, and lipid accumulation suppression activities. Consequently, RA derivatives, especially the RA-pro and RA-hex effectively suppressed lipid accumulation of 3T3-L1 cells, superior to EGCG, a well-known anti-obesity phytochemical. RA-hex also inhibited α-glucosidase inhibitory activity greater than luteolin. By computational molecular docking, dihydroxyphenyl group and hexyl group were selected as essential groups for interaction with the active site of α-glucosidase through hydrogen bonding and hydrophobic interaction, contributing to the great inhibitory activity. These biological effects of RA derivatives commonly attributed to hydrophobicity, hydrogen bonding, and steric bulkiness of the side chain.



Estimation of molecular interaction between rosmarinic acid and α-glucosidase by means of computational molecular docking

Ⅲ. Conclusion

With 5g level of sample with 10 mL organic solvents, natural occurring substances that may have biological activity could be isolated and estimated the molecular interaction after selection of target compounds by correlation coefficient and molecular docking method. Reduction of organic solvents and sample amount was done under environmental friend in agriculture and food science.

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A Study on Estimation of Air Conditioning Load from Human Body and Equipment Using Image Analysis

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Ⅰ. Background

Rationalization of energy consumption in buildings is important to build a smart city with low environmental impact. Air-conditioning equipment (HVAC systems) accounts for a large percentage of the total energy consumption and needs to be addressed. In the design of the HVAC systems, it is necessary to predict the air conditioning load caused by the heat and humidity generated by the human body and exhalation. However, due to the long lifespan of buildings, it is difficult to predict how they will be used in the future at the design stage, and the actual usage of buildings after construction is completed is not fully understood. This has led to a tendency for HVAC systems to be designed with larger than optimal capacities [1)], increased initial costs for HVAC systems, and reduced energy efficiency rate.

Ⅱ. Purpose and Outline

In this study, we estimate the time series change of the number of people in the room by image analysis in order to improve the load estimation method for HAVC systems design. The structure of this paper is shown below.

Initially, the outline of the building and office to be used for the trial and the air conditioning system will be explained. The subject of the study is an office building located in Kochi Prefecture. The period for taking photographs was from June 2021 to September 2021. One camera was set up in each of the three different rooms, with a viewing angle of 160 degrees Celsius, and 1-minute interval photography was performed. (Figure 1)

Then, the captured images are analyzed using YOLOv3, YOLOv5, etc. to try to classify the number of people in the room and their behavior (standing, sitting, etc.). (Figure 2)

Finally, the obtained changes in the number of people in the room and their activities are used as input values to estimate the impact of the changes on the air conditioning load using simulation model[2)]. Based on the results of this estimation, we discuss how to assume the load when designing HAVC systems.

Figure 1. Examples of photos taken by Raspberry Pi Camera and detection results. Detection accuracy is high within a range of 6 to 8 meters from the camera. On the other hand, some cameras are less accurate for distant occupants.

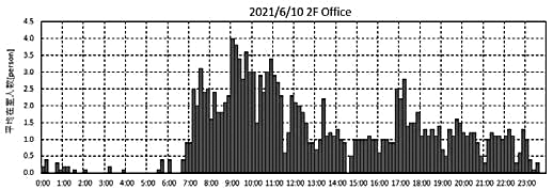

Figure 2. Time series change of the number of people in the room created by yolov3. The photos were taken in one-minute intervals, but the graphs were compiled into a 10-minute average. The target room is an office of an electric power supplier, so the number of people in the room changes rapidly.

Ⅲ. Conclusion

In this report, it was found that it is possible to analyze the number of people in the room and their activities that can be used to improve the operation of the air conditioning system by taking Raspberry Pi, which is relatively inexpensive and easy to use.

Compared to the conventional monotonous assumption of the number of people in a room, the calculations based on the change in the number of people in a room made in this study tended to reduce the required air conditioning system capacity. In recent years, the amount of ventilation required per person in the room is expected to increase to prevent the spread of COVID19. The findings of this study are also important in considering countermeasures.

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The practical application of smart precision forestry project using laser scanning for an AI-assisted in Japan

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Ⅰ. Abstract

Japan has 10 million ha of coniferous plantations over 50 years old and is in the harvest season. Our project has started since 2017 and attracted attention from both inside and outside the country. By developing smart precision forestry by collecting Individual tree-level data using integrated technology combining Airborne Laser Scanning (ALS), Unmanned Aircraft (UAV) -LS, and Mobile LS (MLS), Working to reduce labor costs and improve sustainable timber productivity. ALS grasps topography and roads in forest areas from DEM created with a point density of 4 points / m2, classifies forest resources from DCHM, and selects harvest areas. ALS grasps forest landforms and the existing road network from a DEM with a point density of 4 points / m2 and performs forest resource zoning from DCHM to select harvest areas. Next, use UAV-LS to select thinned trees and check the harvested trees. MLS assesses forest damage and wood grades and serves as an alternative to ground and harvest studies. The next step is to use UAV-LS to select the thinning trees and detect the planted trees from the AI assisted program in the 3D precision database. MLS assesses timber grades with tree damage and bending and timber diameter, serves as an alternative to manual ground surveys. Using the high-performance harvester with IOT function locally to produce logging, branch cutting and timber cutting. Finally, we are going to challenge timber supply chain by linking Individualtree information from harvester operator to offices and Saw mill companies via internet. Our smart precision forestry project using laser sensing is supported the Ministry of Agriculture and Forestry of Japan, which is a collaboration among Shinshu University, local governments, timber producers, and the forest industry companies to strengthen the competitiveness of Japan forestry. It will spread in Japan.

Ⅱ. Results & Discussion

1 Precise crown extraction by individual tree detection

The original LS data were influenced by abnormal values caused by hardware and noise caused by sensors, which resulted from overlapping forest crowns, long branches, and underlying vegetation. To automatically extract the precise crown by the ITD method, it was necessary to eliminate such noise and preprocess by filtering and statistical means to clarify the outline of the forest canopy. Figure 5 shows the usefulness of the ITD method after eliminating data noise and removing forest roads and underlying vegetation. Tree height was extracted by assigning the maximum DCHM to one crown.

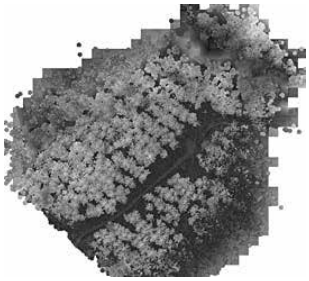

Figure 1. Image interpretation of an enchanted CHM

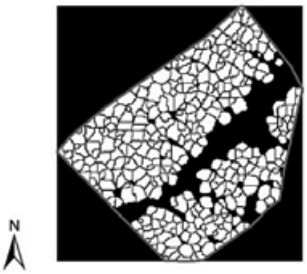

Figure 2. Precise crown extraction by ITD method

2 Automatic detection for planted trees from the AI assisted program

We have developed an automatic detection technology for planted trees by AI (k-Fold cross validation) machine learning model from aerial images of wide-area forests from aircraft and drones. Since it is possible to grasp the position and height of seedlings, the growth status, and the growth status of surrounding weeds, it is a technology that can eliminate field surveys by humans.

Figure 3. Automatically extract only planted trees from a large forest area using AI

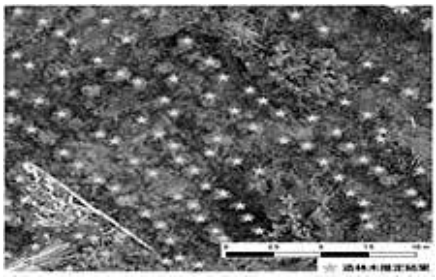

Figure 4. Automatic detection result of planted trees shown in yellow by machine learning model

Ⅲ. Conclusion

Automatic detection of original seedlings by machine learning from aerial images of popular drones in a safe and short time. The match rate is 85% or more, the mis-extraction rate is 15% or less, and accuracy of 90% or more can be expected by increasing the learning data.

The entire survey site was tabulated and the seedling information in the 100% survey was calculated.

The developed seedling detection method can also be used for point cloud data of laser measurements for aircraft, drones, etc., and has a wide range of applications.

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Community Response to Local Environment: Reflection in Certain Micro-Landscapes of the Brahmaputra River Valley in Assam, India

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Abstract

With an area of 56,194 sq.km., the Brahmaputra river valley in Assam, India is an environmentally unique area characterized by the presence of a variety of micro-landscapes within its broad geographical framework. Endowed with various natural resources such as habitable lands, fertile soils, water bodies, fauna and flora, these micro-landscapes have attracted people of different ethnic background from around for settlement since time immemorial. These people have responded to their local micro-landscapes sustainably, and in course of time set good examples of harmonious living with nature. However, due to the rapid growth of population and growing external influences during the recent period, these landscapes have experienced remarkable change in their ecological and cultural characteristics.

The present study is an attempt to investigate the process and pattern of response of the communities to their local environment and how the micro-landscapes shared by them are getting modified in course of time. It has been observed that certain unconformities have already emerged in the process of natureculture interaction leading to a number of environmental and socio-cultural problems in the concerned landscapes. The study is mainly based on field survey carried out in selected landscapes within the valley and systematic interaction with the targeted communities sharing the landscapes through generations. The landscapes are mapped using conventional and modern techniques in order to understand their environmental characteristics and modifications made by the associated communities.

Key words: Micro-landscapes, ethnic communities, nature-culture interaction, Brahmaputra valley.

Modeling for Prediction of Extreme Floods in Urban Landscapes: Developing Land for Sustainable Living Spaces during Floods

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Ⅰ. Abstract

At present half of the humanity are living in urban areas and its agglomerations. In future, it is projected to two thirds of the world population going to be make permanent places in urban landscape. This is going to be made urban landscapes as more risky and unsuitable living spaces during floods. The identification and making the sustainable development of urban landscapes as living spaces for future humanities is utmost important. A simple distributed urban hydrological model is developed to generate and predict extreme flood scenarios for different land scape conditions and at real time. The developed model is integrated with weather radar rainfall and it can be incorporated with changing urban feature such as man-made artifacts, natural terrain. This model can be used to identify the suitable living places and future planning for the development of sustainable living space in urban landscape by simulating the model at different projected future scenarios. Here the development of model along with the prediction of weather radar rainfall and performance of the model is demonstrated. A nowcasting model was also developed to predict extreme rainfall events using Maxwell approximation of reflectivity rainfall hyetographs. Finally, the nowcasting model is integrated with developed distributed urban hydrological model to forecast extreme flood inundation. Both the developed models are performed well for extreme flood events with the NSE around 0.9 and Coefficient of determination around 0.85.

Ⅱ. Methodology

Initially the reflectivity rainfall hyetographs were extracted from historical weather radar reflectivity datasets. Each reflectivity-hyetograph was split into two components namely atmospheric and turbulent waves shown in Figure 1.

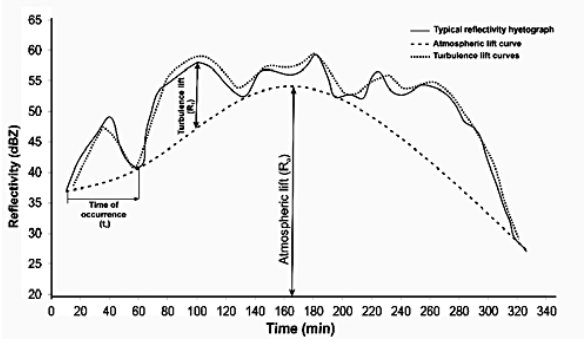

Figure 1. Typical reflectivity rainfall hyetograph.

Each wave patterns were statistically fitted using Maxwell probability approximation (Maxwell,

1960) and the model parameters were quantified using equation 1. The model parameters such has wave lifts and fitted parameters were analyzed with a probability distribution function and Cholesky decomposition. The model was evaluated by statistical parameters such as RMSE, NSE, MRMSE and other error matrices (Perera et al., 2016). The error matrices indicated the propped ensemble approach is reliable. Then finally, the precipitation has been nowcasted using initial 30min assimilation window and model parameters using proposed approach.

$$Z(t) = Z_i + Z_a\left[\frac{t_D^o}{k_a} exp\left(1 - \frac{t_D^o}{k_a}\right)\right]^{r_a} + \sum_{i=1}^{n} Z_t^i\left[\frac{t_D^{o,i}}{k_t^i} exp\left(1 - \frac{t_D^{o,i}}{k_t^i}\right)\right]^{r_t^i} \qquad (1)$$

Secondly the physically distributed urban runoff accounting hydrological model (PURAHM) was developed. This model uses the concept of LISFLOOD-FP model (Bates et al., 2010). In this model the explicit expression derived from Saint-Venant equation by neglecting the convective acceleration is used to compute flow at the next time steps. The equation was solved by decoupling the x-direction and y-direction. The infiltration was computed using Green-Ampt infiltration equation over saturation. The evapotranspiration was approximated using simple seasonal sine curve (Calder et al., 1983). The incorporation of large number of impervious classes as an impervious factor compartment was added in this model. This compartment is useful to select and develop the sustainable living land spaces for future humanity.

Ⅲ. Results & Discussion

The turbulence lifts separated from hyetographs. It was found that the number of lifts and its occurrence are depended on the duration of storm. The lifts were fitted with probability distribution most of them are followed the family of extreme value distribution. The evaluation using error matrices shown that the generated ensembles member at n = 5 are predicting well. It was also identified that there is an interdependency between extracted variables, fitted parameters and time of occurrence (Fig.4). This interdependency was established by Cholesky decomposition. The model was evaluated with the error metrices such as MRMSE/RMSE ratio and others. The model was predicted well but slightly underpredicted with the ratio of 0.84 to 1.02. Finally, the rainfall hyetographs were predicted and compared with observed one.

Then finally the hyetographs are predicted with initial 30 min data assimilation window. The ensemble means of generated hyetographs matched fairly with observed one as shown in figure 2.

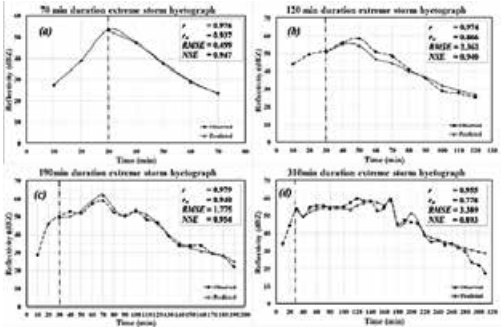

Figure 2. Predicted storm hyetographs at different storm durations.

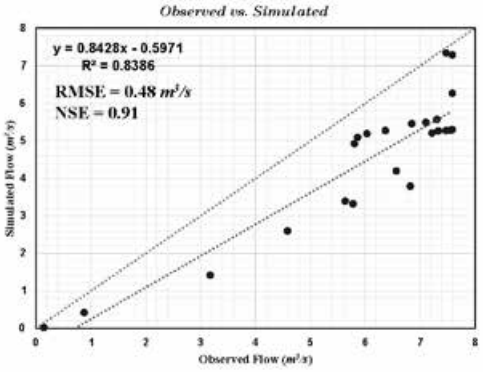

Figure 3. Performance Comparison of simulated flow with observed flow measured at outlet gauge station using error metrics RMSE, NSE and PCC during the period of peak flood occurred on 13-08-2014 (EST Time zone).

The predicted rainfall is incorporated into the developed distributed urban hydrological model then the model is simulated. The model was validated with the discharge measured at outlet of the watershed located on valley stream channel. The model was performed well and the simulated results were well matched with the observed gauge discharge at outlet (Fig.3). It is observed that the model is sensitive in low friction land use dominated large areas and the topography. The instability in model was observed at areas surrounded by buildings and at low Manning's n range.

IV. Conclusion

The importance of the distributed urban hydrological model which incorporated weather radar rainfall is ever increasing especially for flash flood prediction. The distributed urban hydrological model also helpful to design the future flood scenarios which indicates the suitable and sustainable living spaces for future generations in urban landscapes. With this view, the present research aimed to develop a physically based distributed hydrological model for urban watershed by incorporating predicted weather radar rainfall. The Maxwell approximation hierarchical machine learning based ensemble nowcast/prediction of high-intensity rainfall was developed. Finally, the inertial-based hydro-inundated distributed hydrological model is developed, which applies at street scale to city-scale during the nuisance to flash flood situations.

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Socio-hydrological aspects of event-based flood hazard in Assam, India

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Ⅰ. Abstract

This is an observation-based, primarily quantitative sociohydrological study on flood inundation events Assam floods in Northeastern India. The anthropogenic socio-economic factors regarding coupled human-water system and its evolution in flood disasters were studied. Geospatial techniques were applied to visualize the flood inundation extent and the event-based flood inundation phenomena were reconstructed through a hydrological 2-D shallow water inundation model. From the state government's daily flood hazard dataset, the socio-economic variables were characterized by multi-criteria decision-making, and a ranked vulnerability map for different flood seasons for the state was generated. The study tries to use the remotely sensed results and perturbation theory to model the flood hazard, while associating it with a few important societal factors and feedback mechanisms within the co-evolutionary dynamics of hydrology and human behavior in the context of specific emergent hydrological phenomenon i.e. the events of inland flooding in the state of Assam, India.

Ⅱ. Results & Discussion

The study has used and analyzed the daily flood hazard data of the years 2018, 2019, and 2020 from the Assam State Disaster Management Authority (ASDMA) through a multi-criteria decision-making approach. Comparison of these datasets and their validation with remotely sensed flood inundation extent and field-based surveys indicate that most of the damages were done by the flood waves coming during the mid-week of July and lasting for around two weeks. Most of the districts face another flood wave during the last week of June which precedes the main flood wave and lasts for one week. Some of the northern districts can also be subjected to a third flood wave occurring during the mid-week or last week of September. The short-staying flood-waves simultaneously act as economic and psychological shocks to the affected communities, as well as the catalyst for their socioeconomic resilience by building up knowledge and relatively expensive protection measures e.g. embankment heightening or landfill.

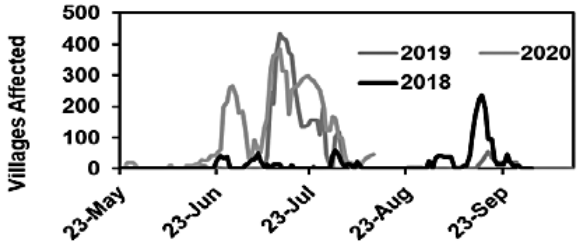

Figure 1. flood hazard characteristics in the district of Dhemaji, Assam, India for years 2018, 2019, 2020

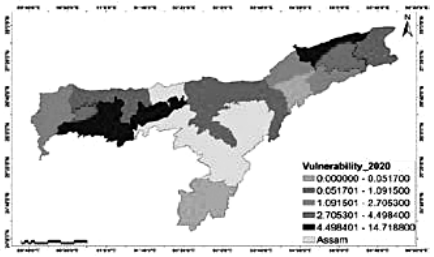

Figure 2. Thematic map of district-wise flood vulnerability for the flood event of the year 2020 in Assam, India

Ⅲ. Conclusion

The duration of inundation and intensity of damages were observed to have very distinct and often counterintuitively inverse correlations among each other. For example, the district of Dhemaji was observed to have a long inundation period yet less intensity of damage whilst the district of Dhubri with a relatively low inundation period has faced severe damages. Also, it was observed that the areas with the most unanticipated and extensive inundations were inside former wetlands that have been encroached and currently utilized for residential, fishery, and agricultural activities where embankments were breached to cultivate pieces of land. From the observations, a simple, conceptual, dynamic model was developed to further explore and predict the process of coupled humanwater interaction in the cases of encroached wetlands vulnerable to flooding. The study further intends to develop a holistic human-water framework for exploring the emergent vulnerability criteria and resilience measures of the local population against flood-induced hazards, which can be useful during relief distribution as well as managing and planning rescue operations.

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Influence of Natural Disasters on Surface Water: A Spatiotemporal Study in A Disaster-Prone Area from 1988 to 2021

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Abstract

Surface water is crucial for flora and fauna and livelihood. Natural disasters such as floods, cyclones, and storms have enormous influence to intensify surface water especially, low-laying coastal areas. The study purposively targets the Bay of Bengal coastal plain delta, particularly the southwest of Bengal delta, which frequently experiences natural disasters. The primary objective of the research is to compare the extent of surface water before and after the natural disasters between 1988 and 2020. More than 10 such historic natural disaster events are considered to estimate the spatial distribution of surface water with a view to comparing between two administrative boundaries of Bangladesh – Satkhira, a coastal district, and Jessore, an inland district. Remote sensing ratio-based method based on Landsat level-1, collection-1 16-day temporal and 30m ground resolution observations has been employed to detect the extent of surface water. The provisional result reveals that cyclones significantly intensify surface water in the coastal district compared to the inland district, followed by floods. While storms have low-level influence to increase surface water. The study also finds a rapid expansion of aquaculture spreading towards the inland district after 2004 that also contributes to increase surface water from natural disasters. The study may be helpful in disaster management from particular natural disasters in the southwest of Bangladesh.

Keywords: Surface water, remote sensing, natural disaster, cyclone, Bangladesh.

Risk Associated with Rohingya Refugee Settlements at Ukhia Camp, Cox's bazar, Bangladesh------A Threat for Sustainable Development.

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Abstract

The humanitarian crisis due to ethnic cleansing of Rohingya citizens from Myanmar to Bangladesh since 2017 has been creating a major environmental crisis for Bangladesh. Due to this cleansing more than one million people have fled from Myanmar to Ukhia, Teknaf, Cox'sbazar area Bangladesh. These refugees have been forced to build temporary shelters on the steep, deforested slopes of sand and clay hills of Kutupalong –Balukhali camps of Ukhia, Cox'sbazar. Thousands of hand-built tarpaulin (heavy-waterproof sheet used as a covering) and bamboo shelters on hill slopes are threatened by slope failures, slumping, sliding, strong winds, rains and cyclones during monsoon season. This low cost adaptation system with water proof sheets for Rohingya refugees housing helping to survive more than half million refugees in the camp area during monsoon in a unsustainable way of living (without light and air passing facilities) in addition to the risk of slope failure and earthquake induced liquefaction.

From the numerical stability & liquefaction analyses at different earthquake magnitudes suggest that these hills are at high risk and are not suitable for sustainable community based living in the camp area. At higher earthquake magnitudes (M= 5 or above) theses soils are susceptible to liquefy up to a depth of 5 m. An integrated rainwater harvesting system with other sustainable solutions are recommended to reduce the risks. Proper measures must be taken immediately by the concerned authorities for alternate sustainable housing and to relocate the refugees in a safer land.

Workshop 5
Distributed Cognition in Learning and Behavioral Change – Based on Human and Artificial Intelligence

Chairpersons
Prof. Dr. Dietrich Albert, University of Graz (Austria)
Prof. Dr. Xiangen Hu, The University of Memphis (USA)
Prof. Dr. Tomoko Kojiri, Kansai University (Japan)
Prof. Dr. Paul C. Seitlinger, University of Vienna (Austria)

Do We Need a Holistic Interpretation of 'Distributed Cognition'? Past and Future Research Questions with respect to AI

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For more than 30 years, *Distributed Cognition* (*DCog*) (*Cognition in the Wild; Distributed Intelligence; Extended Mind*) has been an interdisciplinary, hot topic in cognitive science. This raises the question, is DCog 'old or new wine in old or new wineskins?' - or in other words, 'what is new about DCog' compared to previous classes of models and theories, such as associationism, behaviorism, cognitivism, connectionism? Of course, also classes like *cybernetics* (*systems theory, control theory*), *information theory, automata theory, complexity theory, generalized latent variable modeling, and multilevel, longitudinal, and structural equation models* seem to be relevant in this context.

Starting with the concept of 'association', which is considered as a basic element of cognition since ancient Greek philosophy, some meta-theoretical remarks will be reminded in terms of a top down view. Furthermore, as a bottom up view the question using AI methods in order to discover overlaps, differences and dependencies in the sense of e.g. von *Foerster et al.* (1974), *Scott* (2016), *and Townsend et al.* (1990, 2018) will be mentioned.

However, not only the comparison with former and established cognitive concepts is necessary, but also with current competing approaches. According to Wikipedia, we are currently in the phase of post-cognitivism. In addition to *distributed cognition*, 14 other topics are listed as "examples of post-cognitivist thinking," *namely action-specific perception, activity theory, autopoiesis, direct realism, discursive psychology, dynamicism, ecological psychology, embodied cognition, embodied embedded cognition, enactivism, group cognition, neurophenomenology, situated cognition, post-cognitive psychology* (https://en.wikipedia.org/wiki/Postcognitivism). Even for such current directions, the questions are what characterizes them and how DCog is related to them.

Distributed Cognition (DCog) is a broad concept that assumes that cognition exists both inside and outside the individual mind. Typical applications include for instance computersupported collaborative learning (CSCL), collaborative tagging on the World Wide Web, workplace learning, open education in- and outside of school, cognitive properties of airline cockpits and air-traffic control, sharing database systems, collaboration between programmers.

Future applications of the DCog approach appear to be even broader - according to *Michaelian & Sutton* (2013), *Peters* (2020) *and Heylighen* (2015/2017): "systems that address complex challenges

in a distributed manner by collecting, processing, and routing information and actions distributed across a global network of human and technological agents."

But what about the underlying theory of distributed cognition, its theoretical basis? What is its current status? And how does theory relate to applications? DCog-theory is still work in progress, prominently developed by *Heylighen* et al. (2004, 2012, 2014, 2016, 2017) in "Foundations for a mathematical model of the global brain: architecture, components, and specifications", and "Mind outside brain: a radically non-dualist foundation for distributed cognition."

Thus, several questions arise: What is missing? What needs to be done next to accommodate individualism on the one hand, and collectivism on the other? To integrate the different perspectives of humans and the nonhuman actors in their environments? And finally, what is really new with DCog?

Remote Design Thinking for Sustainability - Investigating the Role of Distributed Cognition

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This work is an oral contribution for the workshop Distributed Cognition in Learning and Behavioral Change.

Ⅰ. Abstract

Design Thinking has become a popular framework to facilitate the creation of innovation. It is an open-ended (Pusca & Northwood, 2018), "human-centered, iterative problem-solving approach that involves stakeholders from various backgrounds" (Buhl et al., 2019). Further, it contains the creation, examination, and manipulation of artifacts (Brereton & McGarry, 2003) – a concept that has been studied by distributed cognition researchers as external representations (Zhang & Norman, 1994).

Remote work of distributed teams has been studied for several years now (e.g.in the CSCW community, see Bjørn et al., 2014) and the world has seen a huge surge of remote work due to the COVID pandemic since 2020 (Brynjolfsson et al., 2020). Yet there is little research on how design thinkers' interactions with artifacts change, if these artifacts are digital ones, instead of analogous.

Our work looks at the current body of literature for Design Thinking practices. Our special interest lies in Design Thinking projects for Sustainability-Oriented Innovation (SOI) because it addresses the four key challenges of sustainability, as defined by Buhl et al.: innovation scope, user needs and behaviors, stakeholder involvement and the assurance of positive sustainability effects (Buhl et al., 2019).

Therefore, we examine case studies, in which Design Thinking was used to design strategies and interventions for the purpose of sustainability. For this, we draw on sustainability literature as well as on HCI research. After identifying these practices, we use the theory of distributed cognition to examine the challenges that practitioners face when applying Design Thinking in a remote environment.

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Conceptual Structure of an Intelligent Educational Support System Using Various Kinds of Cognitive Characteristic Information

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Ⅰ. Abstract

In the viewpoint of "how educational system can estimate student's status", the existing methods for acquiring student's information and for estimating student's status usually put focus on limited aspect which shows student's characteristics, for example, learning history, score, knowledge status and so on. Therefore, it is not said such educational systems can understand students as same as human teachers can do. Teachers always watch their students from multiple viewpoints. In other words, they always monitor multiple information of their students and estimate student's status by integrating the information. In this case such information includes learning history, knowledge status, individual personality, mindset, thinking style, learning mode, feeling, cognitive stress, and so on. We call "Cognitive Characteristic Information" as a concept of the integrated information.
This paper shows a conceptual structure of COCORO (COgnitive Characteristics ORiented Online-learning support system) as an intelligent educational support system by using cognitive characteristic information (CCI hereafter) acquired by monitoring student's knowledge status and cognitive status. COCORO has a special system structure extended from that of intelligent educational system (Wenger, 1987).

Ⅱ. Results & Discussion

Figure 1 shows system structure of COCORO which handles with CCI. The original structure of COCORO is same as that of intelligent educational system. CCI contains various kind of student information which has different data format each other. The target of CCI widely exists from emotion to knowledge. For example, emotion might be represented by binary multimedia data and knowledge is usually represented as explainable texts. We design an extended structure of intelligent educational system for well-handling CCI. We cannot determine the number of elements of CCI in advance. Therefore, we introduce "monitor channel" as a general module in COCORO. Each monitor channel handles with an element of CCI. If technology becomes to be able to handle with a new element of CCI, it is easy to add it in COCORO because of general frame work of monitor channel. In addition, the extended user interface provides input path to

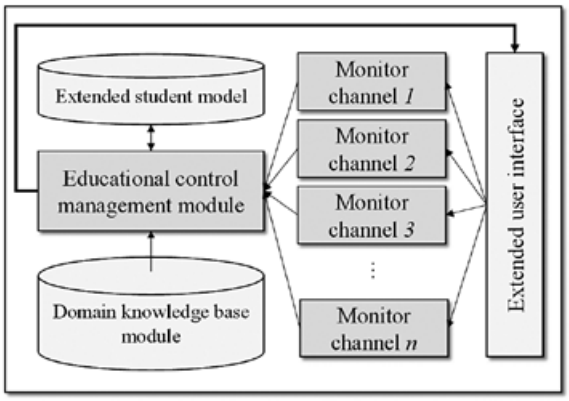

Figure 1. System Structure of COCORO

each monitor channel. On the other hand, the educational control management module provides output path to each monitor channels. This means this module can parallelly acquire CCI and can estimate student's status from CCI. The estimated result can be stored into the extended student model. Knowledge status of student is usually stored in general student model of intelligent educational system. However, the extended student model can store CCI including knowledge status. In this way, we believe our designed system structure can well-handle with CCI.

Ⅲ. Conclusion

This paper briefly explained a structure of COCORO (COgnitive Characteristics ORiented Online-learning support system) as an educational support system by using cognitive characteristic information. COCORO gives a framework of new intelligent educational system for approaching to behaviors of human teachers, although this study is working in progress. The implementation and evaluation of COCRO is future work. This work was supported by JSPS KAKENHI Grant Number 20K12109.

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Self-Improvable Adaptive Instructional Systems (SIAIS)

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Adaptive Instructional Systems (AIS) has become a category that includes Intelligent Tutoring Systems (ITS) and all other instructional systems that adapt to the learner for pedagogical purposes. In general, there is no requirement that an AIS use artificial intelligence (AI), and in fact there are many grey areas concerning what "AI" actually means in this context, and there is also no requirement that adaptation be dynamic or triggered by events that take place during instruction. The AIS for which this occurs are called *Self-improving AIS* (SIAIS), where "selfimproving" implies that (1) the AIS learns from interacting with the the learner (s) and potentially with instructors, sensors, external data sources, and other components of the learning environment; and (2) the AIS dynamically alters its interactions with learners and presentation to learners with the goal of improving learning outcomes in some fashion (e.g. better test scores, better retention, or shorter time to mastery). This paper presents a framework for analyzing and classifying such SIAIS inspired by observations about real-world ITS and other AIS that have self-improving capabilities. This framework assumes that the SIAIS uses machine learning (ML) and focuses on what models are learned and how they are applied. Typical uses of ML are for (1) estimating learner properties such as the current state of Knowledge, Skills, and Abilities (KSAs); (2) predicting what activities will be most beneficial to a learner and computing the probability that a learner will acquire a particular KSA as the result of an activity or action; (3) creating a learner model that may include machine-learned components that are not humaninterpretable; (4) aligning activities and resources with learning goals, topics, or KSAs; and (5) detecting learner misconceptions based on the learner's interaction with the system. We will first present the framework and use it to analyze existing SIAIS. We will then discuss how this model leads into an architecture that enables SIAIS to be more easily compontenized, scaled, and deployed.

Models of Learner-Teacher-EdTech Partnerships In The Future Learning Ecosystem

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From Traditional To Autonomous AI-driven Learning Environments

Our vision of the future of education is a learning ecosystem encompassing various forms of instruction (tutoring, classroom-based, remote schooling, etc.) and learning environments (instructor driven, technology as the primary driver of instruction, etc.). It should be noted that this is work supported by the National Science Foundation under the Learner Data Institute project (LDI; www.learnerdatainstitute.org).

For instance, we imagine a traditional learning environment where technology is simply in the background, capturing the environment through data, e.g., the instructor – learner (s) interaction, in order to enable researchers and other stakeholders understand what works and what doesn't work in traditional, e.g., classroom, instruction. The analysis of the data capturing the learning environment will in turn provide input to instructors and other stakeholders with the goal to improve the learner and instructor experience and offer insights to other stakeholders such as parents and policy makers. In other words, the technology is in the background assisting the instructors, not driving the instruction.

At the other extreme of the spectrum of learning environments, we can imagine autonomous AIdriven learning environments where the technology, i.e., adaptive instructional systems (AISs), drives the interaction with the learner(s) with humans (instructors, researchers, policymakers, etc.) playing more of a behind-the-scene force focusing on the development, analysis, and refinement of such learning technologies and environments. Anything in between those two extremes – traditional versus autonomous AI-driven learning technology – is possible implying various distributions of roles for human and computer-based instruction. For instance, we can imagine an environment where the AI-technology drives the so-called outer loop, i.e., the selection of instructional tasks, whereas the human instructor handles the inner loop, i.e., the within-task monitoring and feedback which currently is harder to do with technology. Furthermore, for instance, the teacher/instructor can focus on the social aspects instruction. Our goal is to enable through data and Data Science a learning ecosystem in which all such learning environments are available to learners, understand the advantages and disadvantages of each such environment in order to make recommendations to learners and their guardians who, based on the recommendations and other personal preferences, may opt for one format or another or a subset of them. Indeed, it is part of our mission to contribute to understanding what instructional format works for whom and under what circumstances and disseminate the findings

and make recommendations accordingly. A key issue is designing and exploring human-technology interactions in the learning environments of the future, which we elaborate next.

Models of Learner-Teacher-Tech Partnerships In The Future Learning Ecosystem

Finding the best teacher/learner-AISs partnerships could have transformative impact on the learning ecosystem, potentially freeing teachers from certain duties that AISs can do in an autonomous manner and allowing teachers to focus on higher level tasks such as tailored, individualized interventions for students, motivational support, and other tasks for which AISs are not ideal. This better distribution of duties and coordination between teachers and AISs should lead to a more effective, efficient, engaging, and equitable learning ecosystem.

We defined and intend to study four levels of AISs' "autonomy" with respect to how teachers can use such AISs: (1) fully autonomous – teachers need little (if any) training and have little (if any) involvement in "tuning" AISs, (2) minimal teacher involvement – teachers tune the parameters of the AISs with the help of the AISs developer at the beginning of the school year or semester (minimal teacher training with respect to the workings of the AISs), (3) average teacher involvement – teachers require training, and they work with the system on a weekly basis selecting instructional tasks and receiving information from the AISs, (4) teacher-driven – the teachers exerts full control of the AISs including overriding decisions the AISs may take or suggest, the teacher will interact almost daily with the AISs. There is in fact one other level (level 0) which are self-improving, fully autonomous AISs – they improve with experience with minimal or no developer intervention. While we will explore as resources permit the role of data science to enable such level 0, self-improving fully autonomous AISs, from a teacher and learner perspective they are similar to the fully autonomous level of AISs (level 1).

We plan to study and understand the trade-offs in terms of teacher involvement in tuning AISs vs. levels of AIS autonomy. For instance, teachers may choose a fully autonomous mode of operation for an AIS meant for students working independently with the system afterschool as supplemental instruction, whereas for student interactions with the AIS during a class period (i.e., in a blended-learning environment), the same teacher may choose to control more the behavior of the AISs. Similarly, teachers may decide to use/download a pre-trained learner model and update it with data from her students, assuring data security and privacy and maintaining full ownership of the data. They may decide to share a sample of her own student data to benefit the pooled/pre-trained models that everyone can download as default.

Visualization System of Nonverbal Information in Medical Interviews for Training Doctors' Credible Attitude

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Ⅰ. Background & Objective

In medical interviews, doctors are necessary to obtain enough information to correctly diagnose the patient's illness. In order to make the patient to talk about his/her private life, the doctors need to communicate with credible attitude and get trust from the patient.

Medical interview training is a place for medical students to train the attitudes of the medical interview. In the training, a medical student plays the role of a doctor and conducts a simulated medical interview with a simulated patient. The medical faculty members observe the interaction between the two and give feedback to the medical students. Since attitudes are often given by nonverbal information, which is often implicit, to give feedback is difficult.

A credible attitude is an attitude of listening to and empathizing with the patient's story. In order for the medical faculty members to judge whether a medical student has such an attitude, it is desirable to be able to judge the relationship between the nonverbal information of the medical student and the patient. For this purpose, we have constructed a system that uses various sensors to acquire nonverbal information [1], such as facial expressions, and visualizes them in chronological order. In this paper, we propose a method to analyze the relations between the nonverbal information of the medical student and a patient and develop a system for visualizing the relations.

Ⅱ. Visualization of Nonverbal Information

A medical student needs to behave in response to the reaction of the patient. By looking at the nonverbal information taken by the medical student regarding the behaviors of the patient, it is possible to judge whether the attitude of the medical student is appropriate. In order to judge whether the medical student respond to the patient, the contextual relationship among nonverbal information between the patient and the medical student is analyzed. Nonverbal information generated within a certain period of time after nonverbal information is generated is considered to have a contextual relationship.

Although, even if two nonverbal information happens within a certain period of time, there is a possibility that the medical student's nonverbal information interferes with the patient's one. For example, taking notes while the patient is speaking is not appropriate. In order to judge whether the medical student interferes the patient, the cooccurrence relationship is analyzed. Two nonverbal information that appear at the same time for a certain period of time are regarded to have a co-occurrence relationship.

In this study, the relationship among nonverbal information, such as contextual relationships and co-occurrence relationships, are represented in a graph structure. Figure 1 shows graphs showing the contextual relationship and co-occurrence relationship.

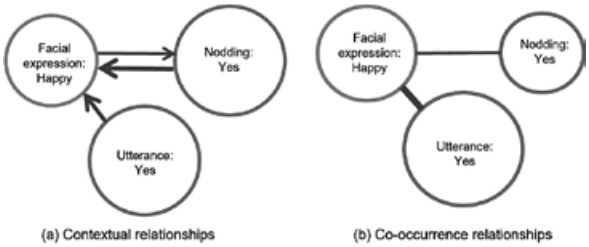


Figure 1. Graphs representing the relationships

The co-occurrence relationship is represented by an undirected graph, and the context is represented by a directed graph. Nodes represent nonverbal information. The color of the node distinguishes between a medical student (*blue*) and a patient (*red*). The size of the node represents the frequency of occurrence of the nonverbal information: large one shows that the nonverbal information is frequently generated. The link represents the existence of the relationships and the thickness of the link indicates the strength of the relationship.

The arrangement of nodes in the graph is also important for grasping the attitude. This research proposed two types of arrangement: one-centered alignment and parallel alignment. Figure 2 is the example of two arrangements. One-centered alignment is the arrangement where one nonverbal information comes to the center of the circle and the rest are placed around the circle. This arrangement facilitates understanding of the relationship between specific nonverbal information and others. The parallel alignment is the arrangement where the nonverbal information of the medical student is placed on the left, that of the patient is placed on the right. This arrangement leads to the understanding of the interaction between the medical student and the patient.

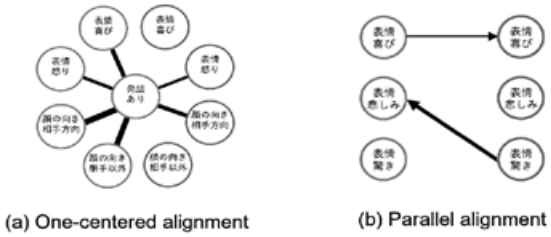
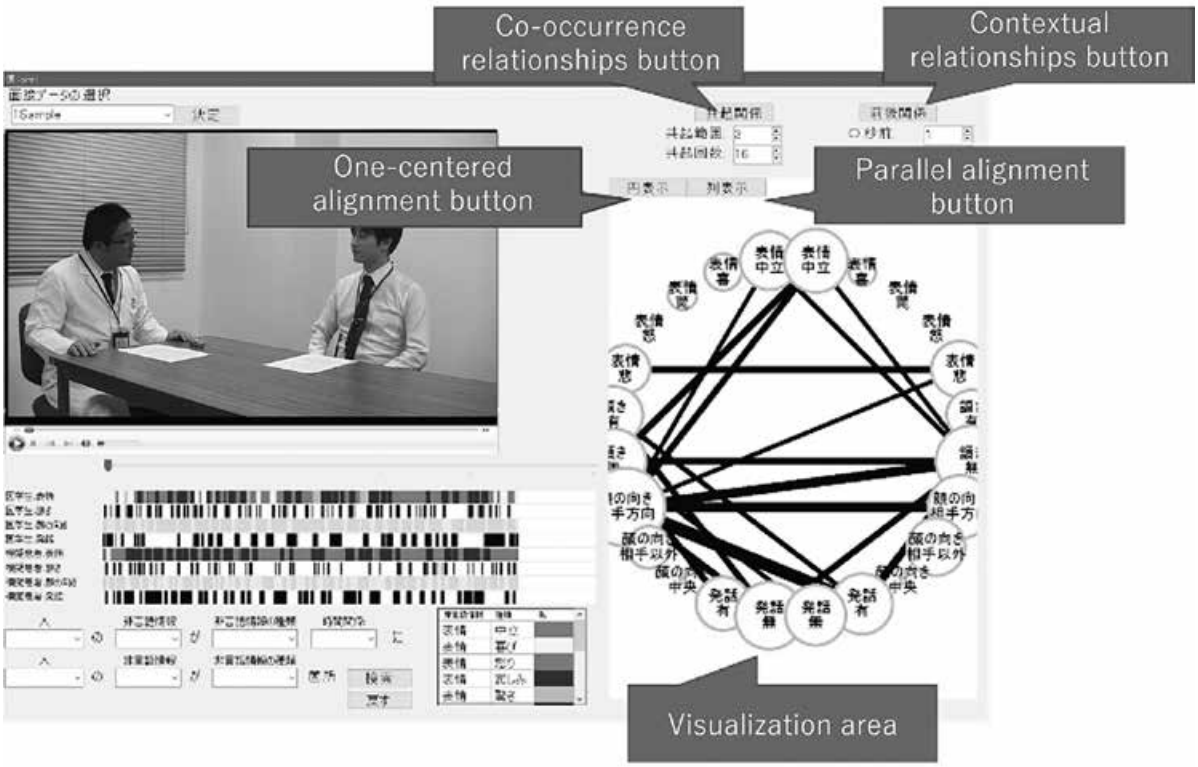


Figure 2. Example of two arrangements

Ⅲ. Prototype System

Figure 3 shows the interface of the visualization system. Left area shows the video of the medical interview training and the existence of the nonverbal information in chronological order. When you select the interview data, the graph is drawn in the visualization area. By pressing the one-centered alignment button or the parallel alignment button, the arrangement of the graph is changed. By pressing the contextual relationships button or the co-occurrence relationships button, the represented relationships are changed.



IV. Conclusion

In this paper, we constructed a system to support the review of attitudes by medical faculty members in medical interview training. It analyzes the contextual relationships and co-occurrence relationships among nonverbal information acquired by various sensors. In addition, in order to make it easier to recognize attitudes, two arrangements methods are proposed, such as one-centered alignment and the parallel alignment. In the future, it will be necessary to carry out evaluation experiments and evaluate the effectiveness of the proposed system.

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Distributed Cognition in Innovative Problem Solving

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Insight problem solving, creativity and innovative problem solving share the need to search for and combine new and remote semantic concepts (Jung-Beeman et al., 2004; Öllinger & von Müller, 2017). We propose a cognitive model that rests on the interplay of distributed cognition and attempt to utilize concepts and mechanisms of the domains of insight problem solving and creativity to model innovative problem solving. Innovation as problem solving is defined as a solving applied technological or societal problems.

We assume that innovation is driven by often ill-defined problems. These characterizes problems whose initial and goal representation is unclear, or different and competing goals exist. Facebook can be seen as innovation which allows user to share, provide, and distribute social information (such as images, comments etc.) via the internet (Jiang & Thagard, 2014).

It solves the problem to connect distant people via the internet. Innovation needs preparedness that means that certain information and technological developments are already available. Although innovation creates something new, it is based on already existing information and concepts.

Consequently, an innovative cognitive system has to consider information processing from two directions. First, there is a known and significant problem, such as finding new solutions for public transportation in a city. Second, the cognitive system generates new and remote combinations of already existing semantic information and searches for potential applications of those new findings, and utilizes problem solving by analogies (Gentner et al., 2001).

Our proposed cognitive system relies on a combination and the concerted interplay of implicit and automatic as well as explicit and deliberate processes. The core of our framework is an associative semantic search machinery which provides coarse and remote semantic search through the existing knowledge space. A Bayesian process will generate and test candidate solutions from the knowledge space. After repeated failure of candidate solutions the system will reach an impasse. To overcome an impasse, we assume that a representational change is necessary. Constraint

relaxation helps to overcome a restricted search space and providing a larger search space. A larger space requires even more efficient search strategies to find a proper solution (Ohlsson, 2011; Öllinger et al., 2014). A representational change can be elucidated by a generative neo-Darwinian process which replicates existing concepts with tiny variations (Fedor et al., 2017). This implicit process is steered by deliberate creative abduction which allows the system to come up with the discovery of new solution approaches and provides criteria for the selection of the best candidate solution. The latter is important to restrict the search space after constrains are relaxed by a representational change.

Distributed Cognition in Modeling Cross-Modal Short-Term Memory for the Design of Smart Sensory Prostheses

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Abstract. New AI-based technologies allow for the enhancement of complex forms of distributed cognition, for example, an orchestral sound production distributed among musicians and technical artifacts, like musical instruments and sensory prostheses, such as hearing aids. The examination thereof requires a conceptualization of cognitive processing that scales and cuts across different levels of observation: from a micro-level, e.g., multisensory integration distributed among cross-modal cortical circuits, over a meso-level, e.g., frequency perception distributed among cortical circuits and hearing aids, up to the macro level, e.g., a collaborative sound production.

The present talk introduces the stand-alone project @STM (Audio-Tactile Short-Term Memory) that investigates distributed pitch perception with a focus on the micro-level (Project Goal 1) and the mesolevel, the latter in the sense of novel human-AI interactions (Project Goal 2). With respect to Goal 2, a new family of cochlear implants (CIs, i.e., hearing aids) takes advantage of the well-evidenced crossmodal priming phenomenon that pitch perception improves, if the presentation of frequencies is distributed among the auditory and tactile modality, e.g., through a vibration pulse at the index finger slightly preceding the auditory stimulation. However, a more fine-grained understanding of this priming phenomenon (Goal 1) has been lacking and needs to be developed for future CI research (Goal 2).

The talk starts by outlining our modeling approach towards Goal 1: A novel cross-modal STM model is introduced, assuming information of successive items (e.g., tactile vs. auditory perceived frequencies) to blend into one evolving (temporal) context signal: The bindings formed between items and their contexts are used for later retrieval of item information, e.g., to compare frequencies from memory. Core characteristics of the novel STM model are (1) an integration of distributed sources of memory interference; and (2) a mechanistic explanation of statistically optimal decisions based on distributed modality-specific item layers and one shared, i.e., orchestrating, context layer.

The talk continues discussing the potential impact of the cross-modal STM model on the design of smart CI algorithms (Goal 2). For instance, the model could estimate a person-specific sensitivity to auditory vs. tactile stimulation, in turn controlling an adaptive balancing of the CI's auditory vs. tactile channel's amplitude.
We conclude by relating our research endeavor to distributed cognition at the macro-level: We propose a perspective according to which micro-level models of cognitive psychology not only

provide scalable metaphors for describing processes at a meso- and macro-level; they too have potential to act as computational components of accurate multi-agent simulations, anticipating and explaining complex phenomena (e.g., collaborative sound production) bottom up.

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BeMe Jacket - Using Vibrotactile Body-Centric Displays for Distributed Emotion Regulation.

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Abstract. We present BeMe Jacket—a body-centric vibrotactile display for distributed self-perception change through emotionally resonant tactile stimulation generated from natural soundscapes and music pieces. Here we view self-perception change as a process distributed across the individual user and her or his artifacts, such as the BeMe Jacket as well as among multiple brain regions (subserving visual, acoustic, tactile processing). We first present the theoretical underpinnings related to distributed cognition, and supramodal operators in memory process. We then present BeMe jacket design rationale and possible use cases. We finalize by discussing the results from our user study investigating the effect size of vibrotactile patterns that aim to translate the affective information conveyed by corresponding sound patterns. We contribute a discussion on smart wearables for distributed emotional regulation and propose novel vibrotactile display design based on the empirical evidence.

Keywords: Body-centric · vibrotactile display · affect.

1 Introduction

The importance of touch for humans has been demonstrated in numerous studies [6,5]. One of the powerful properties of touch is to communicate and influence the emotional state of a person. The researchers from the field of affective vibrotactile technologies utilize the knowledge about physiological aspects of tactile sense in the design of novel affective touch technologies for the purposes of emotion regulation, enhancing remote communication and more [1].

Prior research shows some consistent results on how various combinations of engineering parameters (e.g., amplitude, frequency, placement) influence the affective state of a person, specifically the levels of arousal and valence [4,3]. We also know how to simulate types of touch to elicit various sensations (e.g., pleasant touch) [2]. While some knowledge about the design space of vibrotactile stimuli and their effect on perception is well-established [7], there are many remaining areas worth investigating further. One of them includes understanding how to achieve (or influence) a specific affective state by using different emotionally resonant natural sounds in the form of vibration [3].

In an exploratory study, we evaluated whether a complex sound, such as a happy song, can systematically influence a person's affective state when only presented via a tactile channel. The participants experienced ten distinct patterns on their back, implemented through the Wearable Confidence interface. We found a significant and differential influence of most of the vibrotactile

patterns, belonging to distinct affective clusters, on physiological responses, and for some patterns on self-reported evaluations. These findings help further our understanding of the role of the tactile modality in the emotional processing of complex sounds. Such understanding lays the foundation for richer tactile language and novel HCI applications.

Fig. 1: Wearable Confidence concept dress. Photo credit: Marin Sild.

2 Envisioned Applications

We envision that the concept of BeMe Jacket can be used in two main scenarios
—— for the purposes of emotion regulation and immersive experiences.

In the case of emotion regulation, imagine such a situation. You are about to go for an important interview and feel nervous and even insecure. Your "BeMe" jacket that you currently wear knows about it because it has access to your daily calendar. It also knows your current physiological parameters and decides (or you give an explicit command to it) to make you feel more confident. The jacket does it by applying specific emotionally resonant tactile stimulation for a specific duration so that by the time you reach your interview destination, you feel ready to conquer the world!

In the case of an immersive experience, we envision a wearable that can make one feel what others feel. Imagine you are watching an online performance. During this performance, both spectators and the performer wear an affective vibrotactile display. Such displays can translate the emotional state of the performer back to the audience and the other way around, making everyone's heart and soul beat in unison.

These are only two examples. If we know how to influence specific affective states with emotionally resonant vibrotactile stimuli, the applications are endless. We can enrich remote communication, help the elderly feel less lonely, influence our mood, and even become more empathic.

3 Conclusion

To conclude, during the workshop presentation we would like to present the concept of BeMe Jacket as an interface for distributed emotion regulation, discuss its design rationale and envisioned application scenarios. Additionally, we will briefly discuss the results from our exploratory study that investigated the effects of vibrotactile stimuli, generated from music, have on affective responses, both subjective and physiological. We will conclude by summarizing how

these results may aid us in further development of effective vibrotactile displays for distributed emotion regulation.

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Robust Joint Plan Execution in Teams of Mobile Robots

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A real test for the robustness and the cleverness of an autonomous robot or agent or a team of them is to perform a task in interaction with a real unpredictable environment. Sensing and execution of actions may fail for various reasons, relevant circumstances might not be known and events not under control of the agent may alter the environment in an unpredictable way. Humans are quite good in executing a given plan in an dynamic environment robustly. In order to obtain such a performance in artificial agents methods for monitoring the plan execution and for reacting to perturbations of the plan are needed. In order to realize this models about the intended as well as the possible unwanted behavior of actions are needed. Moreover, because sensing is never perfect and not all important aspects of the world can be observed a representation of uncertain knowledge is needed. In order to address this challenge we use non-monotonic reasoning or more precisely techniques from model-based diagnosis to monitor the execution of a plan and to uncover problems in the execution. One of the key problems is here how do we get the models for the actions. For the indented behavior usually there are requirements that can be used. For the faulty behavior usually we have only models if they are required for safety certification or fail-safe operation in safetycritical systems. A promising idea is to learn such models on the fly. In simulation where many repetitions even with a bad ending can be simulated this approach works quite well. In real systems where one has only a few or even only one example of a particular behavior learning is much harder. Execution of plans in teams is even more challenging as coordination and communication is needed. While rigid centralized approaches perform quite well they rely much on communication capabilities and do not scale well. For decentralized monitoring we need also decentralized diagnosis approaches that are able to locally estimate the progress of the global plan. In this talk we will review our work on execution monitoring for single agents, will present actual ideas to learn behavior models and will sketch our plans for the adaption of that methods for a multi-agent scenario.

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Workshop 6
GRANITE - Human-Centered Research and Transfer to Application

Chairpersons
Dr. René Reiners, Fraunhofer FIT (Germany)
Prof. Dr. Satoru Takahashi, Kagawa University (Japan)

A practical approach of integrating sustainability goals in the Human-Centered-Design-Process

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Ⅰ. Abstract

Human-Centered-Design (HCD) is a well-known and established process for designing products, systems and services by putting the human in the center. Looking at a present societal challenge, sustainability, the involvement of society is crucial which leads to HCD being a promising approach for designing sustainable projects. For this, an easy way to integrate sustainability goals when following HCD would be useful. We will therefore have a look at the HCD process defined by the ISO 9241-210 and examine possibilities and challenges of adapting sustainability goals for each of the HCD process phases from a practical point of view.

First, we will analyze the possibilities of setting sustainability goals when planning the HCD process. In the first phase of the HCD process the focus will lie on how the set goals can be addressed when analyzing the context of use, e.g., by involving relevant stakeholders. In the next phase, we will then discuss the interplay between both, the user requirements as well as the stakeholder requirements that include sustainability efforts. Further, we will explore possibilities to integrate the sustainability perspective throughout the design phase. In the following evaluation phase, providing the foundation for further iteration, we will discuss how the set sustainability goals were met with the design solutions.

As a result, we aim for a first, practical approach to adapt sustainability goals to the HCD process phases, which can be used for further development towards sustainability and HCD for practical use.

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Digital Technologies as Lean Augmentation: A Preliminary Study of Japanese Automotive Manufacturers

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Ⅰ. Abstract

This paper explores how Japanese automotive manufacturers, whose production systems are characterised by the lean principle, address digital transformation. We conducted case studies of seven Japanese carmakers and suppliers to investigate the interplay between lean production and digitalisation. We found that the firms selectively adopted digital technologies to enhance the existing lean production system. We labelled this type of digitalisation 'lean augmentation'. Further, we developed theoretical hypotheses regarding the potential of digitalisation to limit kaizen, the roles of human involvement and organisational coordination in digitalised manufacturing.

Ⅱ. Results & Discussion

All but one of the investigated firms were engaging digitalisation proactively. Remarkably, firms were not engaging digitalisation guided by a vision such as Industry 4.0, but rather deployed digital technologies insularly. Further, digital technologies were typically deployed in ways that support *kaizen* (continuous improvement) activities, i.e. data are often but not exclusively focusing on the production process. Firms typically not aim to collect all process-related data, e.g. data of programmable logic controllers are seldomly utilised. Thus, the characteristic of the Japanese automotive firms studied is that they deploy digital technologies in a way that augments existing practices such as group-based *kaizen* instead of focusing on big data and sophisticated tools such as machine learning. While such technologies are deployed, their deployment is rather to solve specific problems but not to collect all process-related data to establish a digital twin.

Ⅲ. Conclusion

Our case studies of seven Japanese automotive firms find that said firms selectively adopt digital technologies, mainly to achieve paperless shop floors, compress the time needed to grasp the status of operations, and pursue unmanned logistics. This usage of technologies is within the lean principle of existing production systems which seek to compress the time needed to perform or to completely eliminate not directly value-adding tasks. Thus, we label this utlisation type 'lean augmentation'.

Further, studied firms' digitalisation approaches were predominately practically oriented to solve problems of current lean production systems but were not driven by encompassing visions such as Industry 4.0 or the industrial internet of things. Of particular note is that firms seek to employ

technologies in a way that involves human operators in kaizen instead of aiming at autonomously adjusting production processes. Despite this tendency, more research is necessary to investigate how representative these cases are, and especially to investigate if such rather piecemeal digitalisation approaches are competitive against wholistic visions such as Germany's Industry 4.0.

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Planck's Law Base Function for Background Correction of Remote Sensing with Compact and High-Sensitivity Mid-Infrared Spectrometer

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Ⅰ. Abstract

We aim to perform remote sensing in outdoor environments using a compact high-sensitivity mid-infrared spectrometer. Infrastructure facilities such as gas transportation lines and bridge piers are exposed to the natural environment and these facilities deteriorate because of corrosion. To solve this problem, maintenance management technology that enables nondestructive and noncontact measurements to be performed over a wide area is required. Previously, spectroscopic measurements of salt damage to concrete and other materials using light in the near-infrared band have been reported (Watanabe et al., 2019). However, at common temperatures (300 K), these objects emit little light in the near-infrared band, according to Planck's law. Therefore, it is necessary to illuminate each object and measure the intensity of the transmitted or reflected light, and this leads to issues with instrument portability and illumination uniformity over wide areas. Therefore, we perform spectroscopic measurements using mid-infrared light, where the object emits light at a temperature equivalent to 300 K and illumination is not required. In this report, we propose a new method for background correction, which has been problematic in mid-infrared spectroscopy. We verified the usefulness of the proposed method via experiments using dimethyl ether (DME) gas and confirmed the reduction in gas concentration over time.

Ⅱ. Concept of background correction method using base function of Planck's law

Figure 1 (a) shows the concept for the Planck's law based-background correction. In this correction, there are two mode types: the emission mode, in which the background spectral characteristics are aligned along the lower of the measured spectral characteristics, and the absorption mode, in which the background spectral characteristics are aligned along the envelope. In the former mode, the emission from the measurement target can be detected by predicting the monochromatic radiation of a blackbody at the same temperature based on the measurement target's spectral characteristics. In the latter mode, the amount of light absorbed by the measurement target can be detected by predicting the light from background sources such as pipes from the light transmitted through the measurement target. However, in the actual system, the spectral characteristics are detected through a camera based on the radiance, which is indicated by Planck's law. Therefore, the background can be estimated by multiplying the camera's sensitivity characteristics by the measurement target's spectral characteristics to determine the temperature to be substituted into Planck's law. Figure 1 (b) shows the experimental environment. The midinfrared spectrometer was placed 780 mm from the light source, which is

a blackbody set at 573 K. DME gas was then injected in front of the blackbody for 15 s, and data were acquired five times in successive measurements at 16 s intervals. Figure 1 (c) shows the results for measurement of the DME gas using the proposed method. The reduction in the amount of DME gas with elapsed time confirms the usefulness of the proposed method.

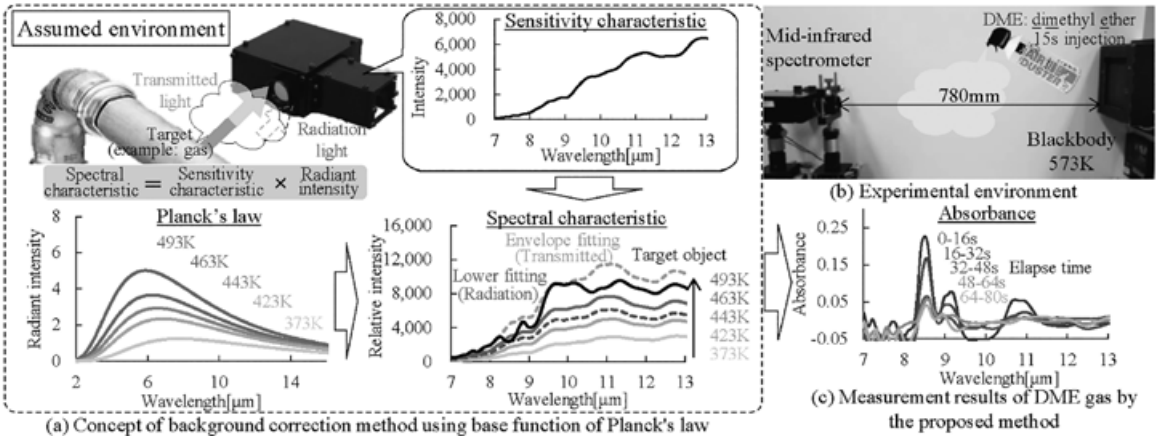

Fig. 1 Planck's law base-function for background correction and measurement results of DME gas

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Service Design for Beneficial Technology Integration: A Glance at the Renova Project

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Ⅰ. Introduction

This paper investigates the case study of Renova, a product salvage service that followed service design methods, which enhanced sustainable and innovative aspects. Renova is a study project developed in Politecnico di Milano by six Product-Service-System Design (PSSD) students. This project addresses the issue of construction waste, which contributes the most extensive amounts of solid waste [1]. By identifying a vast amount of construction waste from private renovations, Renova addresses this issue through its service [2]. The service offering reduces the waste of home and business renovations by salvaging products and creating a platform for connecting renovators and buyers. This paper will look into Renova's service design method and tools. Therefore, it will use the three most promising methods: expert and focus group interviews, customer journey maps, and system maps [3].

Ⅱ. Approach

Technology needs to address human needs and solve global challenges to create value for our society. Our approach tackles the complexities of technology integration and addressing human needs by analyzing the potentials of Service Design methods. First, it examines the potential service design offers for new technology integration for global challenges. Then it analyzes the user research approach, the use of customer journey maps, and integration of system maps along with the case study of Renova to understand the decision-making and design processes.

A. The new field of service design

The new field of service design Service Design is an upcoming design discipline that follows the core principle of design thinking: human centricity [4]. This principle can significantly help when designing human-machine, or as in this case, human-technology interactions, because it focuses on human needs and the values these technologies can bring into our everyday life [5]. Another aspect of service design is mapping each step of human interactions with technologies and other artifacts or people, called *touchpoints*. This mapping in service design is called a customer journey map, which helps create more granular and wellthought- through solutions by considering each step and the infrastructure around it [4], [6]. The bottom-up approach for tackling complex challenges has the highest potential of being successful, especially in the context of sustainable cities and communities [7], [8]. It refers to the cities' inhabitants' perspective, the main actors of cities, which helps formulate a clear problem statement and address specific needs [7], [8]. Several top-down approaches failed because of

the complexities that cities have [8]–[10]. If tackling challenges from a more granular level, the user perspective developed in customer journey maps helps to better create and adapt new solutions into cities' existing infrastructure [4]. Furthermore, all stakeholders involved need to be considered in the design process of the service. *Service Blueprints and System Maps*, also key methodologies of the service design discipline, help identify all stakeholders, their relations, and background processes. These tools support the design of the whole service as seamlessly as possible [4], [6].

Ⅲ. Results

The Renova project followed all tools and methods that are mentioned above. Starting from the human-centricity, the designer of the Renova service conducted interviews in expert and focus groups in order to identify users' needs in the context of construction waste [3]. The primary outcome of these interviews was that a specific user group was identified for using a digital platform for salvaged products. Renovators needed to discard their items as quickly and effortlessly as possible. Buyers wanted to ensure that their product purchased via a web platform was in good condition [3] . Given this, the Renova designers used the customer journey maps to map the needs of both users (the renovator and the buyer) to go through several ideas and future scenarios on how the needs could be addressed and technology could be implemented sinful. These technologies were included to fulfill the needs of both users:

(ⅰ) a measurement tool by using smartphone technology of newer generations [11]
(ⅱ) a digital certification of salvaged products
(ⅲ) a visualization tool using augmented reality

The measurement tool within the Renova app was designed for the renovator, so she could use a smartphone camera to hover over the item she wanted to sell, and it directly measured it. Using the technology of this measurement tool of newer generations of smartphones made it easy for the renovator to upload her products seamlessly on the Renova selling site [3]. Furthermore, the designers of Renova created a certification for salvaged products, so the buyer was sure about the quality of the product. Additionally, they implemented an augmented reality tool that helped the buyer visualize products within spaces by creating digital 3D models of the salvaged products. The Service Blueprint and System Map of Renova helped make the service feasible by analyzing the infrastructure. Warehouses and pick-up vans and the collaboration with larger construction firms were implemented to create a realistic and potentially working service [3].

IV. Conclusion

Renova does not solve the whole problem of construction waste, but it is one example of how it can be solved in an integrated way and is leading in the right direction. Service design tools, and methods help tackle these challenges on a granular and human-centered level, which is more resilient and feasible than big top-down solutions. Every interaction between the user and service was planned in detail so that each touchpoint was welldefined. This service design process helped clarify specific construction waste challenges and address them with clearly defined solutions.

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Disaster-Resistant Hydropower Microgrid Construction and Smart Conservation Initiatives in Nagano Prefecture

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1. Introduction

The "Management Strategy" [1] formulated by Nagano Prefecture in FY2015 was completely revised over a twoyear period starting in 2019 to reflect lessons learned from the response to the 2019 East Japan typhoon, the emergence of domestic and international trends toward a decarbonized society, and the spread of the new coronavirus. In the energy strategy, which is synchronized with the national policy of "Challenges for Energy Transformation and Decarbonization" toward 2050, the basic policy is to "expand the supply of renewable energy" by building a hydroelectric power generation microgrid that takes advantage of Nagano Prefecture's abundant water resources to achieve a decarbonized society, and to invest aggressively in the future to realize "energy independence and decentralized, disaster-resistant regional development" and to ensure a stable supply of electricity. Based on this, this report introduces the disaster-resistant hydropower microgrid construction and smart conservation initiatives being promoted by the Public Enterprise Bureau (PEB) in Nagano Prefectural Government.

2. Overall Picture of the Project

(1) Background of Hydropower Introduction

In the "Shiawase Shinshu Creation Plan 2.0", Nagano Prefecture has set a target of increasing the self-sufficiency rate of renewable energy from 8.0% in 2010 to 12.9% by FY2020. In addition, the "Nagano Prefecture SDGs Future City Plan," which was formulated as an effort to address the SDGs, aims to create an energy independent and decentralized region that takes advantage of the abundant natural energy resources, and targets to achieve an energy self-sufficiency rate (power generation capacity) of 169.2% in FY2030, compared to 91.0% in FY2016.

Also, in response to the frequent occurrence of large-scale wind and flood disasters such as the 2019 East Japan typhoon disaster, Nagano Prefecture became the first prefecture at the prefectural level in Japan to declare a "Climate Emergency" in December of the same year, and the governor declared his determination to achieve zero carbon by 2050, and presented Nagano Prefecture's efforts at COP25 related events [2].

In response to these, the "Nagano Prefecture Climate Crisis Breakthrough Policy" was formulated in April 2020, and in October of the same year, the "Nagano Prefecture Ordinance for the Creation

of a Decarbonized Society" was promulgated, which stipulates the establishment of energy independent regions. Then, the "Nagano Prefecture Zero Carbon Strategy" was formulated in June 2021.

According to the "Renewable Energy Installation Potential Survey" conducted by the Ministry of the Environment in FY2010, Nagano Prefecture ranks first in Japan in terms of installation potential (number of sites) in river areas, and there are many sites where new power sources can be developed.

(2) Hydropower Microgrid Construction in the Prefecture

PEB manages 23 hydroelectric power plants in the prefecture (1 in Eastern Shinshu, 16 in Southern Shinshu, 2 in Central Shinshu, and 4 in Northern Shinshu), including the Yokogawa-Jaishi Power Plant, which started operation in FY2020 [3]. The total maximum output of these power plants is 101,197 [kW], making it the ninth largest among the 25 prefectural corporate offices that provide public electricity services nationwide. The amount of electricity sold in FY2019 has reached 354.83 million [kWh], equivalent to about 13% of the prefecture's households (about 102,000 households).

In order to accelerate the development of new power sources for the creation of a decarbonized and disasterresistant society, PEB is making steady progress at the four sites under construction (upstream of the Yodagiri River, Yunose Dam, Yukawa Dam, and Akiyama) selected through the "Project to Identify New Power Sources" with the goal of increasing the number of sites from the current 23 to 36 by FY2025 (including the start of development).

3. Promotion of Smart Conservation by Introducing Advanced Technologies

(1) Establishment of Smartification Promotion Center

As part of Nagano Prefecture's DX strategy, PEB newly opened a "Smartification Promotion Center" in April 2021, in which they are building a next-generation monitoring and control network system to collectively monitor power generation facilities, developing a crisis management system for disasters and other emergencies by strengthening cooperation with municipalities, and maintaining and passing on expertise to continuously provide high-quality services.

(2) Construction of the Next Generation Monitoring and Control Network System

Assuming that there will be a shortage of staff and specialists with knowledge and experience due to retirement and population decline, PEB is actively working on "Smart Conservation" to expand remote monitoring functions and automate maintenance of power generation facilities, etc., using advanced technologies such as AI and IoT, and aiming to establish and upgrade an integrated management system using a next-generation monitoring and control network system. In order to achieve this, new sensors are being introduced to make maintenance more labor-saving and sophisticated, and a rainfall and dam inflow forecasting system and failure prediction system using big data are being constructed. In the past, field workers have adjusted water levels based on weather forecasts and experience, but with the new system, AI will learn dam inflows from past data and achieve highly accurate predictions from weather forecasts. In addition, AI automatically creates an optimal power generation plan based on the predicted inflow, which not only reduces

the burden on field workers, but also maximizes the amount of electricity generated, with the aim of improving profitability.

(3) Risk Management through Collaboration with Local Communities

On the other hand, considering that disasters of unexpected scale have been occurring frequently in and outside the prefecture in recent years, PEB is also investigating the supply of power from hydroelectric power plants to local communities in the event of a large-scale disaster. Making the most of the characteristics of hydropower plants, they are working to develop a "community-coordinated hydropower microgrid" that will enable us to supply electricity to local disaster prevention centers by establishing at least one power plant in each municipality that can operate independently even during power outages.

4. Conclusion

In this report, we introduced the disaster-resistant hydropower microgrid construction and smart conservation initiatives using advanced technologies such as AI and IoT, which Nagano Prefecture is promoting in cooperation with local communities to achieve zero carbon by 2050. In order to develop and operate the new power sources needed by local communities, PEB, the driving force behind the project, is also actively providing support to municipalities, companies, and other organizations that want to engage in power generation projects by utilizing the expertise and technology they have accumulated over the past 60 years. The electricity generated by PEB has been supplied to some companies and organizations in the prefecture and in Tokyo, Osaka, and Nagoya under the name of "Shinshu Green Denki" with added environmental value since the renewal of power sales contracts in 2020. Through these initiatives, Nagano Prefecture is aiming for an energy-autonomous decentralized and disaster-resistant region and economic circulation within the region.

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Functional Verification and Structural Evaluation of a transfemoral prosthetic knee mechanism for running

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Abstract

The function of the existing transfemoral prosthetic knees for running is simple. Therefore, transfemoral amputee runners who are not sufficiently skilled, particularly beginners, face the risks of falling down owing to unintended knee flexion during the stance phase. We had designed a passive mechanism for the prosthetic knee to address this concern and developed a rough first prototype. The purpose of the present study was to verify the function and evaluate the strength of the proposed mechanism. The mechanism of the proposed knee mechanically limits only flexion during the prosthetic stance as the gear teeth around the knee axis and stopper are meshed by the ground reaction force. The function of the mechanism was verified by a gait experiment with an intact subject. The subject who used the prototype and simulated thigh socket performed a level walking. The motion tracking data of the links of the mechanism indicated that flexion of the prosthetic knee was limited during the stance phase. Structural analysis was performed with the prosthetic knee alone using a three-dimensional computer-aided design system. The von Mises stresses on the mechanism were obtained by input loads and moments. The structural analysis revealed the strength of the mechanism. Moreover, it was shown that the present structure of the housing for the mechanism did not have sufficient strength for the internal/external moments. Strength for such rotation is important for practical use including curve running. These results may lead to the redesign of the proposed mechanism such as miniaturization and weight reduction.

Soft capacitive tri-axis tactile sensor based on level sensing

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Ⅰ. Introduction

Recently, soft tactile sensors have been developed to integrate into soft robots or wearable devices. However, most conventional soft tactile sensors have stiff materials embedded in soft materials, reducing flexibility and durability [1]. In this study, we propose a soft capacitive tri-axis tactile sensor. The proposed tactile sensor has four chambers and channels in a silicone rubber body and encapsulated air and water in the chambers and channels. An applied force to the tactile sensor causes the displacement of the interface. The interface displacement is measured as the capacitance change of the sensor detection part using level sensing. Also, the capacitive tactile sensor based on level sensing does not require ohmic contact between a contact part and detection parts and contributes to improved flexibility and durability. The proposed tactile sensor has four capacitances at the detection part. The combination of the four capacitance changes depends on the direction of the applied force. Thus, the proposed tactile sensor can detect the direction of applied force using a combination of the four capacitance changes.

Ⅱ. Implementation & Operation Principle

Figure 1 shows the implementation image of the proposed tactile sensor. The proposed tactile sensor consists of a soft contact part using silicone rubber and a detection part. Four chambers and channels are formed into the soft contact part and are encapsulated air and water. The detection part consists of 3D printed components to which copper electrodes are attached. The detection part is attached, sandwiching the channel and detecting the air-water interface's displacement as capacitance change by level sensing. Figure 2 (a) represents the state in which no force is applied to the sensor. When the normal force is applied to the sensor, the chambers deform, and the water in the chambers flows into the channels because of its incompressibility, as shown in

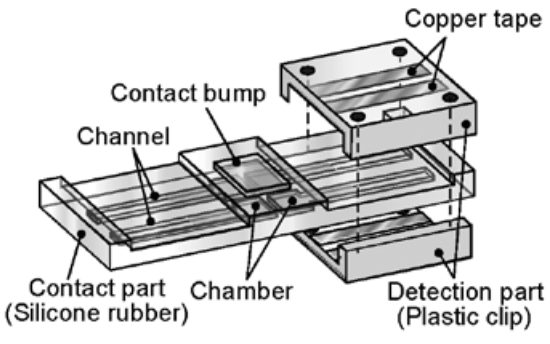

Figure 1. Implementation image of the sensor

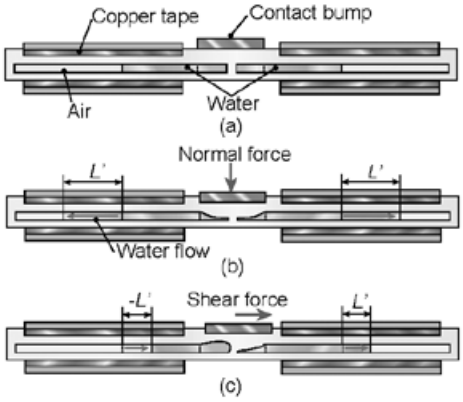

Figure 2. Operation principle of the sensor; (a) without force, (b) applied normal force, and (c) applied shear force.

Figure 2 (b). Then, the air is compressed, and the interface between air and water is moved. The four capacitances of the sensor increase equally the interface between air and water position is displaced equally in all channels. On the other hand, when the shear force is applied to the sensor, one side of the chamber is compressed, and the other side is expanded. The displacements of the interface between air and water are different depending on each channel. Therefore, each of the four capacitance changes depends on the direction of the applied force. The proposed sensor can estimate tri-axis applied force using a combination of four capacitance changes.

Ⅲ. Conclusion

We proposed a soft capacitive tri-axis tactile sensor using displacements of the air-water interface. The proposed tactile sensor forms four capacitances and measures capacitance changes caused by the applied force. We will evaluate the response characteristics of the proposed sensor under an applied force in future works.

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Challenges and concepts for the evaluation of usable and satisfying VAs according to DIN EN ISO 9241-11 and -110

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Ⅰ. Abstract

AI Systems are built to increase efficiency, productivity, and reliability from an economic perspective. Assistance systems like voice assistants (VAs) belong to this kind of interactive technology; yet based on the Intelligence Augmentation approach, they should primarily support the users' capabilities and allow them to continue acting with self-determination. Nevertheless, those systems are usually perceived as a black box. Thus, on the one hand, VAs can be seen simply as a tool for fulfilling a task, although on the other hand, the conversational interaction always raises expectations and needs for humanlike interactions. According to the international norm ISO9241-11, a *usable* system is one that can be used to achieve specified goals with effectiveness, efficiency, and satisfaction. We use this definition of usability to delineate a framework for the design and evaluation of VAs, based on current literature and international norms. Our aim is to provide guidelines that move the development of VAs towards enhanced usability and human-centeredness. Considering each usability level in turn, we discuss first, how to fulfill context-based *user needs* and requirements in order to ensure effectiveness of the VA interaction. To address the efficiency level, we develop evaluation guidelines for VAs based on the *interaction principles* according to ISO9241-110. Regarding user satisfaction, we posit that certain human values like trust and welfare are crucial for a satisfying user experience with VAs. Specifically, the system should support psychological *human needs* in order to ensure the users' self-determination – for practicing design and evaluation of VAs in a wholesome manner.

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Workshop 7
Human Security and Sustainability

Chairperson
Dr. Lars Vargö, Director Japan Center, Institute for Security and Development Policy (Sweden)

AI and HCI come together for the Digitalization of the Maritime Industry to Foster a Sustainable, Innovative and Safe Work Environment

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Ⅰ. Digital Transformation in the Maritime Industry

The maritime industry is facing serious challenges due to an aging crew, the risk of human errors (MacLachlan, 2017; Popkin et al., 2008) and growing concerns for sustainable shipping. Optimization and digitalization of processes is needed to increase safety, efficiency and sustainability of everyday tasks on vessels. However, our preliminary analyses found that crew members of all age groups have very mixed digital literacy and different experience levels when it comes to the usage of software and hardware devices. Not only is the work environment of crew in the maritime industry a challenge, but we also need to take the diversity of the crew members into account when developing for their user experience.

Ⅱ. Supporting the Crew and Towards Autonomous Vessels

Human-Computer Interaction (HCI) and Artificial Intelligence (AI) are slowly making their way into the different workplaces. However, the workplace on a vessel is different from common office workplaces and therefore comes with new challenges. The basic principles are the same. With a digitalization of processes, work tasks also change as we have to regard the socio-technical system on a vessel as a whole (Popkin et al., 2008). Task management, the need for an integrated overview of information (gathered by automated systems and sensors), the need for help to increase productivity or optimization and support for collaboration as well as the requirement to cope with overload must be taken into consideration when designing new systems for the workplace (Colbert et al., 2016). A highly iterative and user-centred approach is recommended to foster the best possible outcome (ISO, 2019; JIS Z 8530:2021, 2021). Workplaces on vessels differ a lot. E.g., the environment of the engine room as a workplace is very different from the bridge. Therefore, we include all different user groups into our analysis, development and testing (Figure 1).

Towards autonomous vessels, many different aspects of the system have to work seamlessly together. These systems include, e.g., video streaming, computer vision and ML for the recognition of objects on the sea (and shore), vessel integrated systems including sensors, alarms, and vessel controls.

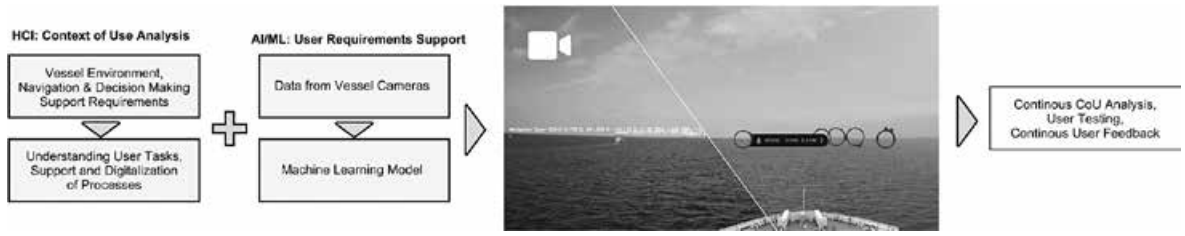

Figure 1. HCI process based on ISO 9241 – 210 (ISO, 2010) including the integration of ML to support areas such as decision making for routing with vessel recognition on the sea. Left side shows the recognition of vessels from the video material and the right side shows the visualization within the interface showing vessel name, speed, distance and direction.

Ⅲ. Conclusion

For the future of autonomous vessels and optimized, sustainable shipping, an interdisciplinary approach is necessary to cover all aspects for the safety of the crew and vessel. Continuous analysis, testing and user requirements refinement as well as development for sensors, connectivity and AI/ML models is required.

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JIS Z 8530:2021 人間工学―人とシステムとのインタラクション―インタラクティブシステムの人間中心設計

Sustainable Mobility Scenario Modeling, Evaluating Future Resilience of Modular Concepts for Electrified Trucks

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Ⅰ. Abstract

Facing a myriad of megatrends such as sustainability, digitalization, electrification, and automation one of the greatest concerns for companies is ensuring their fitness for future markets. Predicting how the future will unfold is impossible yet failing to timely prepare organizations and products for the future may cause substantial losses for businesses, societies, and the environment. Consequently, many companies have drawn their interest to flexible product development strategies to cope with rising complexity, risks and changing requirements. Research has highlighted modularization as one such strategy. But how does one modularize against the uncertain future? Guided by this question our research aims to apply futures studies and scenario techniques along innovation and modularization processes from product planning to modular system and product platform development. The system-of-interest and case for this paper is electrified trucks including power infrastructure. Dialogues with key industry expert-, research- and management stakeholders guided the creation of a model to evaluate modular truck configurations against multiple scenarios and design pathways. Aiming to close the futures studies to modularization method gap, we replaced needs-based market segmentation input to modularization with both qualitative and quantitative data based on mobility scenarios. The main conclusions to date are two-fold. One: such model may provide insight to improve future resilience of modular concepts and product platforms in the early stages of platform development. Two: such model can support recurring assessments of modules and system architecture, guide optimization of module variants to and product configurations to prepare towards multiple and evolving future scenarios.

Key words: scenario modeling, modularization, product planning, platform development, electric vehicles, sustainability, digitalization, conceptual design evaluation

For use in the EJEA-2021-Conf key note presentation and publication in the journal "Frontiers in Artificial Intelligence"

Character Development for Artificial Intelligence

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Ⅰ. Abstract

Artificial intelligence (AI) engages with humans and affects us emotionally like a movie character. Film Characters have nuanced personalities with a production team managing the character's impact on audience emotions. Today AI is trained by data scientists as a continuous learning system using data to improve its predictive algorithm models without any consideration for its character evolution over time. There is no clarity on what are the core ethical values of the AI as a character and who manages the personality evolution of the AI to build a relationship of trust with the people it serves.

Our proposed approach is to engage the user experience (UX) designer throughout the AI lifecycle and utilize the user interaction data to define the AI's character with tenets of trust, transparency and fairness that represent the core ethical values of the AI and develop these tenets into behaviors and personality that adapts to the change in relationship between the AI and the human.

Ⅱ. Results & Discussion

Our paper will build on prior researchers' work on trustworthy AI and AI ethics to create a framework to engage the UX designer throughout the AI lifecycle to ensure that AI has character development that ensures that the AI remains ethical.

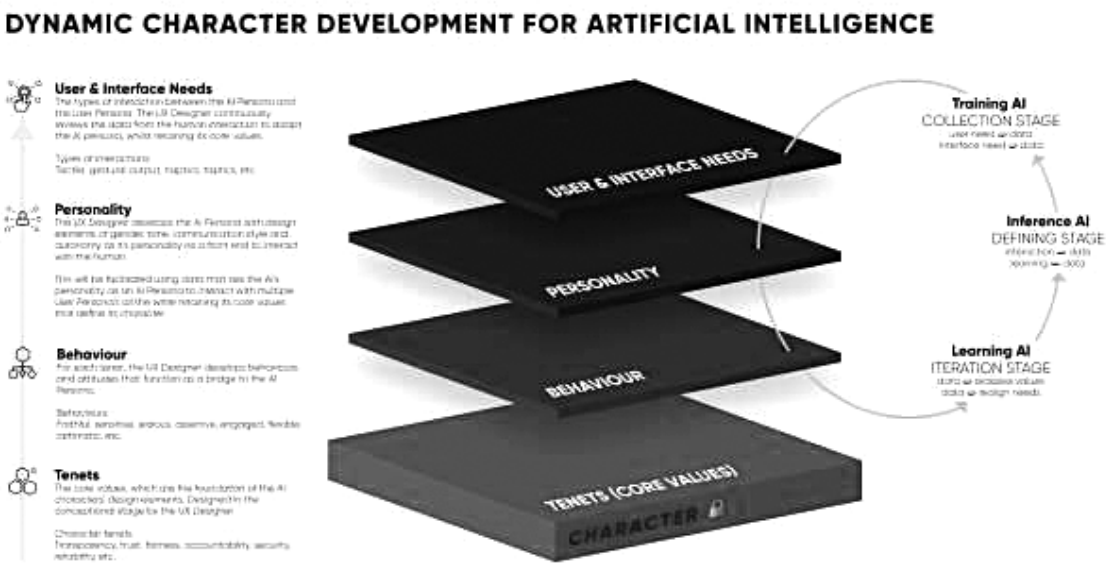

Figure 1: Proposed character development approach for AI

Ⅲ. Conclusion

We proposed an approach that engages the UX Designer all through the lifecycle of the AI product and their role is to collect user interaction data for AI that informs the user's mental model (for context) in shared spaces and to iterate and refine the AI Personality AIX elements to ensure that the ethical values remain fixed throughout the AI Lifecycle. Further research is proposed to test this concept using quantitative approaches to separate the data used to train the AI as two streams to be used by the data scientist and the user's evolving relationship with the AI to be used by the UX designer. This will then be validated using a qualitative approach by defining the AI's core values and personality in the design process and test that the personality can be adapted while keeping the character fixed using data from industry. We will measure our proposed hypothesis by surveys, interviews, shadowing and desk research.

SDGs in the Anthropocene: A Gandhian Critique

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Abstract

Today many people across the world wear 17-colour badges to support the SDGs. Their good will should never be denied, as the badges express their compassion for others on the globe. Governments, NGOs and corporations are so eager to promote the goals that they appear to have almost become the agendas of the whole humanity. In the pursuit of that development, however, are we not plunging into the planetary boundary and causing the Anthropocene, the era when humans have completely transformed the earth into an unlivable place for species?

Mahatma Gandhi, who thought as ideal a village-based India, advocated that we need to spontaneously reduce our material want. From that viewpoint, the argument of SDGs might be insufficient, if we only invite people, both in the present and future generations, to participate in global development. We also have to question about material abundance provided for a small number of people in the present global society. It is indeed the rich that should fundamentally reduce their material wants, at the same time as we talk about enhancing living standards of the poor. In this presentation, I would like to indicate a small critique of the SDGs from a Gandhian viewpoint. (199 words)

A Proposal of Numerical Approach of Quantitative Verification of Check List to Support Human Digital Security through Kansei Engineering

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Ⅰ. Background

Internet access is now an integral part of everyday behavior for many users. This access certainly provides convenience to the user. However, at the same time, there are many cases where the personal information of the user is absorbed by the Internet and the information becomes "hostage".

The reason is that, rather than improving the personal environment of users, it is used by companies hidden behind the Internet to formulate near-future strategies based on the personal information obtained. Therefore, the more such personal information will be obtained, the better the quality of the strategy will be distilled, and this composition that drives companies to acquire more information will be expanding.

Frankly speaking, it would not be asserted that it had been harmful to be the basic information of the near future strategy. It is also a fact that an environment is provided in which the individual user feels "comfortable" as one of side effects of the above behavior. Paradoxically speaking, however, it can be said that "virtual comfort" and "intervention in decision-making and imposition of values" are probably proceeding at the same time.

Specifically, the purchasing behavior should not be "virtual comfort" that is arbitrarily guided in a specific direction but does not make one aware of it. Historically and ironically, it is reminiscent of the dangerous similarities between imperialism and colonial policy. Sorry but these would be terrible images to sell opium and refer to slave trafficking. Of course, we wish that it should be our overstatement.

The idea of taking countermeasures against "virtual comfort" by preparing some code of conduct on the user side may be considered. For example, in the simple and easy-understandable case, if you buy furniture, you normally don't want to buy such furniture of extra luxury, unnecessary storage capacity, acceptance of colors you don't like, and so on. In the case of shopping that seems unnecessary, it is considered that it can be avoided by presetting the "evaluation items" that regulate the purchasing behavior.

In this research, we would like to propose some numerical scheme of evaluation that contributes to avoiding excessive theft of personal information by being confused by "virtual comfort".

Ⅱ. Discussion

Our approach is based on how we discuss, point out, and protect our daily but sometimes-harmful decisionmaking/behavior towards Internet access (namely providing personal information as

"hostage" due to "virtual comfort").

Previously we have researched "collaborative design" process and visualization of its process by means of numerical scheme together with Kansei Engineering [1]. The key idea is based on classification of reserved keywords and priority specification for decision-making criteria. Since some of many processes may involve complex decision-making variables, traceability and confirmation are very important to validate the consistency of decision making toward results.

We will describe our approach and its trial solution to demonstrate confirmation of consistency in evaluating behavior in Internet access based on priority-specified criteria using the AHP-based calculation for confirmation [2]. And we are sure that we will be able to apply our previous approach and solution about utilization Kansei Engineering-based decision-making process and quantitative verification of designed results through AHP methodology to show some good example how to protect daily but sometimes-harmful decision-making.

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Workshop 8
Educational Change: New Models and New Thinking in Intercultural Concepts

Chairpersons
Prof. Dr. Toshihiro Hayashi, Kagawa University (Japan)
Prof. Dr. Anders Törnvall, Linköping University (Sweden)

Extended mind as a way for education in the networked world

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Ⅰ. Abstract

Changing the school's principal education parameters takes the necessary advent of modern technology (AI, big data), though it often prevents schools. We must abandon the idea that knowledge, learning, the ability to solve problems is a matter of the isolated individual, and we must attach knowledge to a dynamic structure of interactions.

These interactions are not just an only human phenomenon; we must include all information agents, entities capable of information interactions and forming one mutual information space - the infosphere. The usual way to model the extended mind is to consider the cooperation between the individual and the paper notebook, which serves as his extended memory. These two entities can then be thought of as one cognitive system.

However, we need a significantly more robust model – a model that replaces a paper notebook with a smartphone with an Internet connection, which can use a large amount of available information, own analyses and other services, and a person who can be in touch through this device, with many other actors. It is precisely this newly grasped system of extended and distributed cognition, which will significantly influence how we will solve problems, communicate, cooperate.

This paper aims to explore and describe this topic in terms of the impact on education, its importance, character, and the fundamental values emphasized in it. To show that technology is not just a passive tool in human hands, but an active element that co-creates our reality.

Ⅱ. Introducion

The traditional model of cognition (and thinking) in antiquity was based on the primacy of the individual, which is separate from the environment in which he cognizes. In Aristotle, we can see the manifestation of this approach in the subject-object model (Mensch, 1991). The cognitive and cognitive are clearly separated from each other. Their mutual interaction has only a superficial character. What was perceived as intensely social in antiquity was ethical behaviour ("let everything be for the benefit of the community") - a virtuous person must behave in such a way as to promote the interest of the polis, not his private goal. Scholasticism and occidental thinking continued in this model, including the discourse of analytic philosophy.

Peter Berger and Thomas Luckmann (1966) transform this model and say that ethical behaviour and knowledge are socially determined. A man knows through and within the community, he cannot be excluded from this ecological epistemic structure. It is precisely the society that structures his thinking, ways of solving problems, understanding the world. Society shapes institutions and language as two specific tools for modelling human existence. The basic epistemic

unit in social constructivism is not the man himself but man as part of society.

Andy Clark and David Chalmers (1998) extended this model when they claimed that the basic structure of cognition does not have to be an individual but a particular system. The so-called Otto problem (Rupert, 2009) illustrates this model. Otto does not have long-term memory, he can remember only a few minutes, but he can quickly write information to a notebook and read from it quickly. Notes thus play the role of his long-term memory, so Otto may manage life in the world because his memory has an external character. It is impossible to determine whether Otto is thinking or interacting with the notebook. We must adopt the epistemic model that thinking and cognition are integral to the Otto system and the notebook.

However, the reality of today's world is more complicated. Otto will not only have to use a notebook but a smartphone connected to the Internet. What does it mean? Cognition, search, evaluation, structuring of knowledge is not just a matter of Otto and the notebook but of the whole intricately interconnected structure of a million other actors. Solving a specific problem, learning, working on a project is never an atomic process but a complex structure of reality. Every knowledge changes us, but at the same time, we change the structure and essence of what we know by our being. Reality no longer has sharp boundaries between online and offline, between the individual and his environment, between technology and human.

This fact forces us to re-structure the whole foundations of the Western way of thinking. In our case, Otto integrates Berger and Luckmann's ideas into the concept of an expanded mind. At the same time, we must emphasize that the smartphone uses systems and tools that are not just deterministic algorithms but work with artificial intelligence. While the notebook Clark and Chalmers worked with was a passive, isolated object that only Otto could read, the current situation is that the notebook is connected to other information and cognitive sources, has its autonomy, and actively enters into the interaction process. Therefore, the use of technology differs fundamentally from Martin Heidegger's model of the zuhandenes (Heidegger, 2010) in that it has its own (albeit limited) autonomy.

This fundamental epistemic and ontological, and ethical change will mean a lot - among other things for the very foundations of what we understand as the goal and meaning of education. We would therefore focus briefly on two general tendencies in philosophy and education is analysed to explore new character.

Ⅲ. Culture of copying and culture of creativity

In the school environment, we can identify two fundamental cultures, as certain ideal pure types (according to Webber), which are applied to varying degrees in real school - the culture of copying and the culture of creativity. The culture of copying is based on the idea that the school aims to pass on to students a particular predetermined structure of knowledge, knowledge and skills. We work here with textbooks that pass on the correct procedures that students learn and with the help of which they can solve problems that appear before them. Assessment is summative in this culture and assesses how the student has approached the learning outcomes outlined above.

The limit of this approach is that it assumes certain immutability (Bauman (2013) would use

the word "fortress") of the world while everything around us changes. We live in a time of liquid modernity when many professions disappear or arise when the contents of work and their structure change. The automation of work leads to the loss of easily automated jobs (Frey & Osborne, 2017) based on a copying culture because repetition of procedures is not adequate.

Therefore, the school as an institution must transform - from a culture of copying to a culture of creativity. This culture reckons that learning is a way of achieving dynamic balance in a constantly changing system. The school cannot teach only or dominantly standardized procedures but must lead students to find these solutions in cooperation with others. Who is the other one? No longer just a classmate or colleague, but also to a system with artificial intelligence.

The culture of creativity is an approach that seeks to teach students to recognize not in the categories of atomic objects and tests but a broader context. He works with formative assessment, which seeks to develop the ability to achieve balance, problem-solving as a general, incomprehensible process. Students are thrown into situations where the path is not the implementation of procedures or autonomous, isolated work but the diligent search for ways (with the expectation of failure and success) in hybrid teams.

We believe that the school will either go in this direction or, as an institution, disappear entirely (Seufert et al., 2018).

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Extracting learning path data from learning history

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Ⅰ. Abstract

E-learning is a tool that is used by both educational institutions and private companies. There is a tremendous amount of content on e-Learning platforms such as Udemy 100000 courses. learned. Developing a way automate design of learning plan for e-Learning is the purpose of this research. To achieve this, we use learning history collected using survey to identify skill mismatch. The learning path (Jih, H. J., 1996) of ICT professionals informs on skill mismatch (EU commission, 2020) when confronted to an academic learning path. People have a finite amount of time to achieve as much as possible. Learning path adaptation allows saving time on training. This gain of time allows people to seek the balance between skills diversification and specialization.

Ⅱ. Results & Discussion

Our first step was to collect through surveys the learning history of information technology graduates. We collected data on what do professionals have to learn between graduation and the end of their first year of employment. With this information we can identify skill mismatch. Professionals will have during their school to work transition to undergo training and acquire extra skills. Their purpose is to adapt better to their new environment. In 2019 Japan corporate training expenditure was over 529 billion Yen. This represent a tremendous investment. It also shows that retraining is occupying a great deal of time for countless people. By relying on professionals' experience the need for retraining can be reduced. But also reduce skill mismatch. The goal is to simplify as much as possible the learning path. To build by addition of selective content a short yet personalized learning path. As can be seen in table one while skills learned in school are critical some skill such as Debugging cannot be easily discarded.

Table 1: a professional in ICT learning path

	Skills
In School	Logical thinking, problem solving, fundamental engineering, ability to reach consensus.
Inhouse	Programming skills (development, debugging, test), Critical thinking.

This data can be complemented by using information in resume and curriculum vitae. The data generated by these operations may prove to be valuable to the content providers to see if the learning path generated through this data can affect the conception of curriculum (P. Stabback, 2016). As they would bring the learning institution closer to the market they prepare students for. Using the survey, Professionals can express their learning history in terms of skills learned. Based

on this history undiscovered or expressed learning path can be deduced. Some disadvantages come with the survey method. First is memory, we do not necessarily remember the details of our learning history mainly some main points. Second is time industries change, in order to provide useable data, we need to maintain up to date information on market requirement.

Ⅲ. Conclusion

In conclusion in order to improve the quality of education, identifying the skills required for learning path generation is critical. As an additional source off data consulting professionals is a viable method. If we can account for what is forgotten.

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Online Japanese Language Education for Elementary Level Learners

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Ⅰ. Background

Foreign language education is important in the sense that it is a prerequisite for students to communicate with one another. However, due to COVID-19, it is not easy for educators to provide in-person opportunities to learn a language.

There are several possibilities to overcome this situation: 1) students use self-study materials and learn by themselves, 2) students use on-demand materials and learn by themselves, and 3) students take online real-time courses. The materials in 1) are typically books. This presentation will focus on 3) because the other two are generally difficult and less effective for most students and 3) is a practical alternative to an in-person class.

1) and 2) are the same in that these are basically self-study, even if there are differences between them: through traditional means or online, or, with or without supervision by a teacher. Self-study is difficult or less effective for many learners. In contrast to these two, online real-time courses are much closer to "normal" classes. However, there are several challenges in order to provide effective real-time courses.

Ⅱ. How to Overcome the Challenges

In this presentation the presenter will show what was/could be difficult and how to overcome these challenges in Japanese language online education in detail, especially for elementary level learners. Just replacing all elements with online alternatives results in an inferior version.

	Difficulties	Suggested means
Basics of writing	It is not easy to recognize "what is wrong" and interactive instant feedback is impossible	By using a portable visualizer, interactive feedback is possible
Reading practice	Reading together does not work because of latency	Following means are able to solve the problem ・reading short sentence (s) one by one ・giving up or reduce "reading together" practice in class: instead, use more time for role playing ・alternatively, giving students "reading (and recording) assignments"
Feedback on submitted reading assignments	It is not easy to understand points that an instructor is discussing	Combining written feedback with real-time model reading helps students understand and improve easily

By introducing these suggested means, online courses worked in a proper way. The learners could experience effective alternatives made possible by technologies and techniques.

Ⅲ. Conclusion

Because the Japanese language has its own unique properties, it is not easy to teach online, especially to elementary level learners. However, by some adjustments, providing desirable opportunities for learners is possible, and students could master the elementary level and proceed to the next level.

It is easier for intermediate and advanced learners to learn online compared to elementary learners when in-person courses are not available. However, the technologies and techniques discussed above could alleviate the situation and these means can be partially applicable to wide range of language education. These means are not too difficult to purchase or introduce. In addition, the courses can be switched to in-person ones and vice versa depending on the situation because experiences that these means provide do not change fundamental elements of a class.

More opportunities of in-person courses will be available in the future even if nobody can predict when the impact of COVID-19 will be gone. Educators are required to provide alternatives and improve them.

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The Transition from Traditional to Online Learning: what are the new approaches and challenges for higher education during the pandemic?

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Ⅰ. Abstract

Many universities have moved from traditional forms of 'in-person' lecture-based teaching to other modes, utilising online, distance or electronic learning (Moran et al., 2018) during COVID-19 outbreaks. Online learning helps to minimise disruptions in teaching and compromising students' learning outcomes (Tuah & Naing, 2020). The most commonly used approaches in distance learning (DL) consist of blended learning (BL) (Sajid et al., 2016); (Kiviniemi, 2014), live teaching (tele-teaching) (Mian & Khan, 2020), flipped classroom (flipped virtual classroom), online practice questions, video conference, teleconference and telehealth (Chick et al., 2020; Tuah & Naing, 2020). BL is a current teaching method and is considered vital to education in the context of pandemic COVID-19. BL refers to a combination of two instruction modes: e-learning and didactic (face-to-face) teaching (Kiviniemi, 2014; Sajid et al., 2016; Tuah & Naing, 2020). It offers flexibility, a student-centred approach and a collaborative learning atmosphere (Kiviniemi, 2014; Sajid et al., 2016). Nonetheless, it may aid or impedes active learning, technological use (challenges with information technology), support (due to stress in managing worklife balance) and communication (between students and teachers) (Jowsey et al., 2020) while practising social distancing measures during COVID-19 pandemic. Educators may consider the critical factors when designing and implementing BL: interaction and communication rules, the teacher's role, careful selection of collaboration tools, and technical preparation (de Jong et al., 2014). Educators must examine the nine practical approaches before transitioning from traditional to online learning during the COVID-19 pandemic. Educators must account for the availability of internet access (using broadband, mobile phone) on sites, teaching and learning online platforms that are freely available (such as CANVAS) and free video conferencing software (for example, skype, zoom) which individuals widely use when setting up the virtual classroom (VC). Also, educators need to choose appropriate pedagogy, including using flipped classroom (FC) approach to facilitate students' collaboration, communication, building and applying the concepts during learning. It helps increase student engagement with content, increase and improve faculty contact time with students, and enhance learning (Rotellar & Cain, 2016). Besides, educators need to plan teaching/learning activities for pre-class (lecture MS PowerPoint slides, notes, articles, videos, quizzes) and post-class (online discussion and feedback) using pages, links, and file features in CANVAS. The purposeful design of teaching plans for courses covering only useful information and estimating ample time to complete assigned tasks to achieve the learning outcomes. These approaches can influence how students engage with content during online learning (Jowsey et al., 2020).

The teaching methods to enhance active learning can promote collaboration, interactions and participation among students (e.g. small group work and discussion, quizzes, case-study). Then, educators can set online discussions, case studies, and short answer questions (SAQs) after VC. Also, students can use online discussion to enhance their experiences in blended learning (Sajid et al., 2016). The assessment options include quizzes, assignments, writing reports, and voiceover slide presentations (using readily available software such as Microsoft PowerPoint and ShareX). The typical online assessment methods used at higher education institutions (HEIs) include online quizzes, continuous feedback, multiple-choice questions, and automated assessment for essays. The online tools for formative assessment in higher education include feedback, self-test quiz and discussion forums. The critical strategies recommended managing online examination, setting up online questions using freely available software and utilising free video conferencing tools such as mobile phones for invigilation purposes. Educators must consider readiness among students and teachers, cheating practices and student diversity when employing online assessment at HEIs. Also, educators must evaluate the methods and their impact on students' learning outcomes. (Tuah & Naing, 2020). At the end of the workshop, the participants will learn practical approaches for educators transitioning from traditional to online learning during the COVID-19 pandemic, using freely available software and resources.

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Poster Presentations

- 12 poster presentations including 4 presentations of high school students were presented.
- Face-to-face presentation: Olive Square Multi-purpose Lounge of Kagawa University on 23 October 2021
- Online presentation using SpatialChat: 22-24 October 2021

Education Support System for Newcomer Nurses at Visiting Nursing Stations

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Ⅰ. Background and Purpose

By 2025, Japan will become a super aging society with a low birthrate: approximately one in four people will be 75 years old or older. Visiting nursing stations (stations) are expected to play an important role in the community for supporting people's lives and medical care. Most newcomer nurses are expected to be effective at their tasks immediately. Most are mid-career nurses with various degrees of clinical experience[1]. However, about 60% of newcomer nurses feel difficulty in their duties[2]. About 30% of their educators feel difficulty in educating them according to their individual careers[3]. Therefore, we propose an educational support system for newcomer nurses at the station and discuss its contents.

Ⅱ. Analyses of Current Situation, Challenges, and Proposed System Functions

Most stations are micro-enterprises. Education of the newcomer nurses is left to each station. Only about half of the stations use educational tools[1]. Some problems arise when using them, such as being "too busy to spend time" and "difficulty in tailoring training to different experience levels." To resolve these difficulties, an educational support system based on experiential learning theory[4] and instructional design (ID)[5] that uses experience and promotes independent learning is examined. This system can enhance education at the stations.

Ⅲ. System Specifications

The target audience is the educators of newcomer nurses. This educational support system uses an information and technology communication tool (Microsoft Teams®) to connect educators mutually and to provide a mutual learning function. Through system Function 1, educators acquire knowledge and skills in experiential learning theory and ID-based education methods. They learn in advance by viewing links and videos on Teams, and learn skills through online meetings and face-to-face training. Function 2 allows participants to practice education using personnel training tools. A link to application

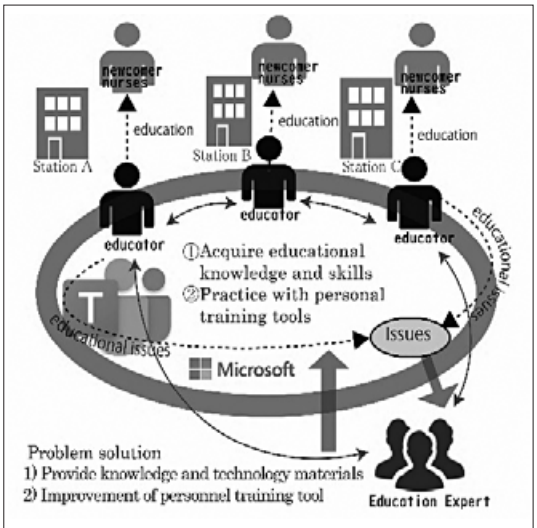

Figure 1. Educational Support System Overview.

of the tool is provided. To address issues arising in educational practice, the team chat function is used to promote mutual learning by allowing educators to exchange opinions and receive opinions of educational experts.

Ⅳ. Summary, Future Issues and Developments

Using the system, educators at the station can learn basic educational methods. A community of educators will be formed for mutual consultation and sharing of necessary information for system development.

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Proposal of a System Enhancing Self-affirmation Using LINE Chatbots for Elementary School Students

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Ⅰ. Introduction

"Self-affirmation" is "self-assessment that one's attitude is favorable". In recent years, young Japanese people have been found to have a significantly lower sense of self-affirmation than other countries such as the United States [1]. In Japan, many lesson-style educational practices reportedly increase the self-affirmation of elementary school students. Nevertheless, no method other than the lesson format exists. Reportedly, no educational practice can be characterized as an effective method for all children [2]. Therefore, for this research, we developed and proposed a system that enhances the self-affirmation of elementary school students using a method other than the lesson format.

Ⅱ. Proposal System

The authors have developed, evaluated, and verified LINE chatbots that enhance self-affirmation by introducing "Three Good Things," which lists three good things every day for university students. [3]. Results demonstrate that self-affirmation was higher after system introduction than before system introduction. In recent years, more than 50% of elementary school students use smartphones [4]. The use of LINE increases as the grade level increases. One in three students use it in the sixth grade [5]. Therefore, we decided to introduce a similar system for elementary school students.

To make it easier for elementary school students to accept the icon, we used an image of a cat and appended "Meow!" to the end of the word. I set it to send a message urging "Three Good Things" every day before going to bed (20:00) . If you reply to this, then you will get a random reply selected from the following three. "Thank you for telling me! Let's do our best tomorrow!" "Great! Can you tell me tomorrow?" "Meow, I heard good things! Tell me tomorrow!" In addition, if one talks to the chatbots, then one can enjoy the conversation from the TALK API provided by Recruit.

Ⅲ. Experiment Outline

The evaluation plan is described next. This system will be introduced into the upper grades of elementary school students who have a high LINE usage rate. Self-affirmation is evaluated using the Japanese version of the Rosenberg Self-esteem Scale (RSES-J) by Mimura et al. [6]. Twice before and after the introduction, after 10 items are evaluated on a four-point scale, they are compared. Additionally, we will investigate the good points and improvement points of the system from the questionnaire survey. Furthermore, by analyzing conversation logs, one can expect to

discover factors that increase self-affirmation and characteristics of younger elementary school students.

Ⅳ. Conclusion

This study presents a system for elementary school students to increase self-affirmation using LINE chatbots. In the future, based on the evaluation plan, we will evaluate the upper grades of elementary school students.

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Development of the second prototype of a half drone inverted pendulum transportation robot to improve the safety and the controllability

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Ⅰ. Abstract

In recent years, the labor shortage due to the increase in demand in the delivery industry has become a problem. To solve this problem, drones and vehicle-type transportation robots have been developed [1]. In our laboratory, a half-drone inverted pendulum type transportation robot that integrates a drone and wheels has been developed. This is a robot that uses a new mobile mechanism that can overcome the short cruising range of the drone, the small load capacity, and the difficulty of raising and lowering the steps of the wheeled vehicle. This paper proposes a second prototype designed based on the findings obtained from the primary prototype developed for theoretical research [2].

The appearance of the second prototype is shown in Fig. 1, and the system configuration is shown in Fig. 2. In the second prototype, two rotors are placed at the bottom of the loading platform to prevent contact with the outside of the rotors. Although safety can be ensured by this, the balance of the loading platform cannot be controlled by this alone. So, a DC servomotor is attached to the rotating shaft of the loading platform.

Figure 1. Half drone inverse pendulum transportation robot Second Prototype

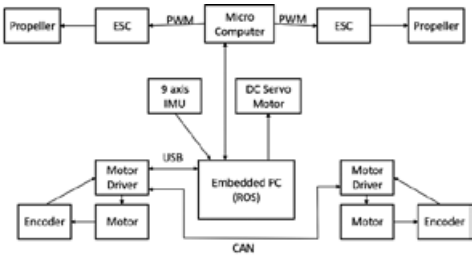

Figure 2. System configuration for Prototype2

Ⅱ. Results & Discussion

Several experiments were conducted to verify the validity of the structure of the second prototype. First, in this robot, it is thought that the air flow is obstructed by the bottom surface of the loading platform and the thrust of the rotor is attenuated, so the degree of the effect was measured. As a result, it was confirmed that the thrust of the rotor used in the selected actual machine had a damping of at least 24%.

Next, the thrust of the rotor was measured in a state close to that of the actual machine, using a device that reproduced the tilted state of the machine. As a result, it was found that the thrust of the rotor was further attenuated by about 8%. At this time, the sum of the thrusts of the two rotors satisfies the required thrust, but the counterrotating rotor does not simply add the thrusts,

and the thrust is further attenuated. Therefore, it is necessary to design in detail in consideration of these. Since the control of the inverted pendulum robot is the same as that of the primary prototype, the control of the loading platform is integrated with it.

Ⅲ. Conclusion

This paper described the second half-drone inverted pendulum type transportation robot and the verification of the validity of the design of the loading platform drone section. Future goals are the development of the control system for the loading platform drone and the integration of the control system.

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Location of wells and groundwater distribution in Teshima Island, Japan. Environmental humanities approach and hydrological simulation

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Ⅰ. Introduction

The islands of the Seto Inland Sea are prone to water shortages due to low rainfall amount and small isolated spaces. However, Teshima Island (14.4km^2, Fig.1), Tonosho Town, Kagawa Prefecture, is an unique place in terms of its water environment because it has a spring called "Karato-no-shimizu," which does not run out even in the period of extreme drought, and has a lot of rice paddy fields. Based on the relatively abundant water resources, people in the island have been utilized the tube well. For this, the well might have an important role but these characteristics have not been described in detail in previous studies.

Ⅱ. Method

This study focuses on the wells, which have been used as a source of water for daily life, and aims to elucidate location of wells and changes in their use in Teshima Island. In addition, the use and location of wells are also related to the hydrological cycle such as precipitation, infiltration, underground storage and river runoff. In this study, both of environmental humanities and hydrological approaches were demonstrated. As an approach to environmental humanities, we conducted field surveys and interviews to the people live in Teshima Island about the distribution of wells and the changes in their use. As a hydrological approach, the hydrological cycle in Teshima Island, especially the groundwater distribution, which is strongly related to wells location, is estimated by using the two hydrological models: RRI (Rainfall-Runoff-Inundation) Model and GETFLOWS (GEneral purpose Terrestrial fluid-FLOW Simulator).

Ⅲ. Results & Discussion

We showed the distribution and usage of wells in Teshima Island, which were found by the field surveys and interviews. The field survey was conducted twice in September and December 2020, and a total of 57 wells were identified (Fig.1). Most of the wells are used as the household well, except the common-use well, and electric well pumps are used to pump up the water (Fig.2). Currently, the piped water supply coverage ratio is over 95% in Teshima Island, and most of households do not use the well water for drinking. Before the construction of the piped water supply system, the well water has been used as a source of water for domestic use including drinking, but it seems to have been gradually out of use due to problem of the water

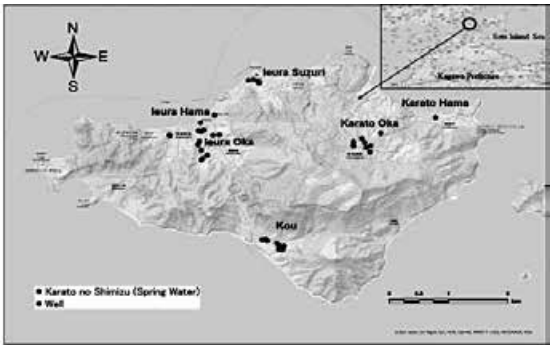

Figure 1: Locations of "Karato-no-Shimizu" and wells in Teshima Island

Figure 2: Household well and wash place at Ieura-Suzuri (2021.12.13)

quality. However, some households still use the well water for the purpose of watering plants and vegetable, removing mud, and other outdoor uses.

Ⅳ. Concluding Remarks

The field survey partly revealed the distribution of the wells, their uses, and their change in Teshima Island. Even now, after the construction of the piped water supply system, some households still use the wells on a daily basis, and this gives possibility that the well water can be used for different purposes, such as drinking and outdoor uses as it used to be. Though, this study does not investigate all wells and there are many unknowns, including the timing of changes in the well pumping methods and the seasonal fluctuations of the well water levels. We will continue to investigate not only the well's characteristics but the hydrological cycle in the island, including the estimation of groundwater distribution using the hydrological models. We will show some preliminary results of the hydrological simulations at the poster presentation in October.

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Verification of human resources development methods for continuous disaster prevention and crisis management unique to local governments

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Ⅰ. Introduction

In Japan, large-scale disasters such as the Great East Japan Earthquake, the Kumamoto Earthquake, and the heavy rain disaster occur almost every year. Local governments will be at the forefront of disaster response. However, in disaster response, there are disasters in which past experience is not always utilized in local governments that have little experience of disaster. In recent years, there are systems that can analyze data on past disasters caused by the development of AI and give advice, but it is humans who make the best use of that data, and it is also humans who make the final decision. In addition, the on-site response should be done also by human. Therefore, human resource development is an important issue because it is necessary for AI to entrust data aggregation and analysis, and for humans to make decisions and respond, collaborate, and coordinate on-site.

Therefore, in this study, the local government staff training system was developed. In the training system, first, the local government trained disaster prevention / crisis management specialists as instructors of organization itself for a year 1). In the next step, the specialists trained other members who belong to the organization through 10 hours training program, which is prepared by the specialists. In this paper, the effectiveness of the training program was verfied in Sakaide city Hall.

Fig1.New education system image

Ⅱ. Results

In this study, local governments independently train specialists within their own organizations, and the specialists provide disaster prevention and crisis management specialized training to all staff. It is a circular training system. There are two points in this training system.

This is a sound-cycle training system in which specialists are trained within their own organization and the specialists continue to provide specialized

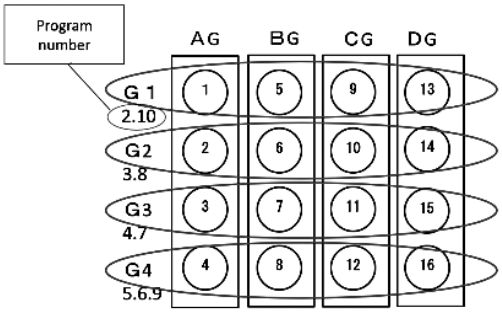

Fig2. Grouping of specialists

training to all staff (Fig1).

This is a guidance system in which the specialists who provide guidance are divided into a group in charge of managing each training and a group that examines the preparation of materials and standardization of teaching methods (Fig2).

In the event of a large-scale disaster, lectures, workshops, and exercises were used with the aim of raising awareness and improving disaster prevention and crisis management capabilities so that all offices could respond. The content of the training is "disaster prevention knowledge", general disaster prevention, damage estimation / hazard map. The "plan" is the operation, support and support system of the disaster countermeasures headquarters. As a "training / workshop", there are simulation training, Satasen, action card, and crossroads on the map to imagine disaster response. As a "system," we conducted training on the handling of the prefectural disaster prevention information system and the earthquake and tsunami observation and monitoring system (DONET).

Regarding verification, we exchanged opinions after the training with the instructed specialists, conducted a questionnaire survey, and conducted a questionnaire survey with the participants.

Specialists (16 people). In the exchange of opinions, there was no particular problem with the guidance, but there was an opinion that it was necessary to change the contents and order of some programs in progress. From the results of the questionnaire, 69% of the respondents answered that the system for rotating the group that is mainly in charge of training is generally good. However, 12% gave a negative answer. Regarding the guidance system that divides the program in charge, 100% answered that it is generally good.

Participants (total of 88 people in the two training sessions). Regarding the sound material-cycle training system, 89% answered that it was generally good. Those who take it negatively not in.

Ⅲ. Discussion.

The exchange of opinions by specialists raised issues for progress, but as a result of immediate consideration and reflection in the second program, all responded that the exchange of opinions after the second training was good. It is possible to respond immediately to issues by having the instructor plan and manage within the organization. In addition, from the results of the questionnaire, there was a negative opinion from 12% about the system that rotates the group that is mainly in charge of training, which is considered to be anxious to be mainly instructed (Fig3). Considering the teaching method based on this, 100% of the methods for standardizing materials by dividing and examining the programs in charge are positive (Fig4), so each group considers it positively. By standardizing materials and teaching methods, it is considered that a system that allows mutual follow-up is good even if there is little teaching experience. Until the guidance of each specialist gets used to it, the group in charge of each program will respond flexibly.

Specialist questionnaire

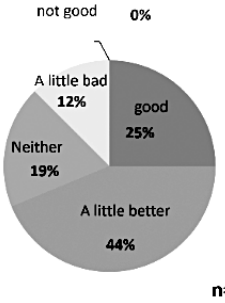

Fig3.Do you think that the method in which one group is mainly in charge of each training is good.

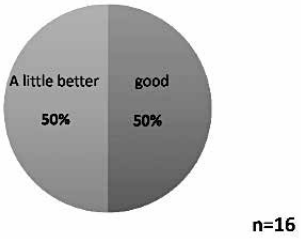

Fig4.Do you think it's a good idea to group your programs and review them to standardize your material

From the results of the questionnaire from the participants, it can be said that the system that trains specialists in the organization and provides disaster prevention / crisis management training to all staff is understood within the organization regardless of age and position (Fig5).

Questionnaire for trainees

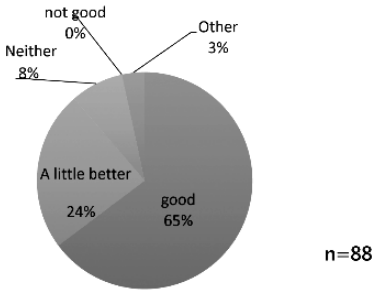

Fig5.Is this training system good.

Ⅳ. Conclusion

Based on the above results, the method of a cyclical training system in which specialists who provide guidance within their own organization are trained and the specialists instruct all staff, and a group system in which the specialists divide the training into groups and programs are in charge. By planning, operating, and instructing the specialists themselves, it is possible to directly feel the training that the participants are interested in or the training that is low in the questionnaire results and directly, and there is an advantage that any problems can be corrected immediately. In addition, the style of dividing the program, dividing the specialists into groups, narrowing down the programs in charge, creating materials, and standardizing the teaching method is such that specialists with little experience and anxiety about teaching receive support from specialists in charge of the same program. You can gain experience. In addition, since the training content is standardized even if the specialists instructing are changed, it is possible for the trainees to take the same training with a certain level of quality, so it is considered to be an effective training system.

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Development of human resource development methods for local disaster prevention and crisis management. JSNDS, Vol 40,No.1,pp67-79,2021

NO_x reaction analysis of ammonia flame burner with hydrogen stabilizer

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Ⅰ. Abstract

Ammonia is considered ideal fuel that does not emit greenhouse gases (i.e., CO_2, CH_4 etc.). However, if ammonia is forcibly combusted, a large amount of NO_x (toxic substance) will be generated. For fuel utilization of ammonia, the low-NO_x combustion is required (Kobayashi, 2019, pp.109-133). In this study, NO_x formation/reduction area formed in flame and the rate of reaction are especially identified by using numerical simulation. This study aims to develop a turbulent burner that can simultaneously achieve NO_x reduction.

Ⅱ. Equipment & Calculation method

The burner has a structure of triple tube (Figure 1). In an experiment, a stable flame was obtained by separately supplying ammonia, hydrogen, and air in central, duplex, and triple tubes, respectively (Figure 1). The burner developed in this study can supply a high-velocity airflow (<10 m/s), the velocity could be changed. For the coaxial diffusion flame, another coaxial high-velocity airflow was added to the space between the central fuel jet flow and the surrounding airflow. This additional airflow produced strong turbulence to the flame front area.

Turbulent flows were investigated using Reynolds-averaged Navier-Stokes (RANS) and the Chen model, which was suitable for determining the rapid changes in turbulent flow energy (k) and its dissipation factor (ε). CRECK mechanism (31 species, 203 reactions) (Stagni, 2020, pp. 696-711) is employed to calculate oxidation of ammonia and hydrogen.

Ⅲ. Result & Discussion

Figure 2 shows profiles of temperature and rate of reactions by numerical simulation. The maximum temperature of flame is approximately 2200 K and the low-temperature area formed at inner flame where fuels are not combusted. Figure 2 (c) shows the distribution of NO_x reduction rates reacting with N, NH, or NH_2 radicals. Simultaneously, Figure 2 (b) shows the reaction rates of NO_x formation. When the right and left phenomena are simultaneously examined, the reduction reaction of NO_x is found to intensely generate on the slightly inner side of the high temperature region (i.e., NH_3-fuel rich region), thus inhibiting NO_x increase. NO_x formed by the NH_3 combustion is decreased in the reduction region and the net NO_x formation is prevented since NO_x reduction area

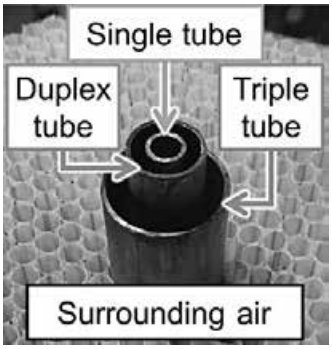

Figure 1. Burner structure (center tube: NH_3, duplex tube: H_2, triple tube: air with high velocity).

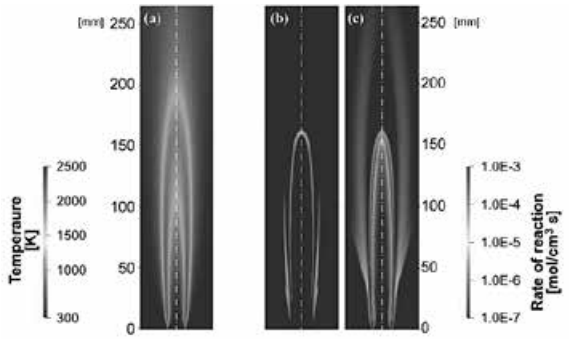

Figure 2. Calculation results. ((a) temperature, (b) rate of NO_x formation, (c) rate of NO_x reduction)

Ⅳ. Conclusion

(1) NO_x formation/reduction areas in flame of ammonia burner with hydrogen stabilizer are identified by numerical simulation.

(2) NO_x formed by the NH_3 combustion is decreased in the reduction region and the net NO_x formation is prevented since NO_x reduction area locates on NO_x formation area. A reduce mechanism by which NO_x is reacted with NH_3 works simultaneously to inhibit increase in NO_x formation.

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Effect of reaction scheme on the structure of ammonia turbulent flame

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Ⅰ. Abstract

In recent years, global environmental problems, particularly global warming due to carbon dioxide (CO_2), have become substantially evident. It is therefore necessary to investigate novel and efficient energy utilization methods, to significantly suppress CO_2 emission, and thus preserve the environment. Ammonia (NH_3) is a fuel that does not emit greenhouse gases. However, the burning velocity of NH_3 is below 0.06 m/s, which is much lower than that of conventional hydrocarbon fuels (oil-based fuels), making it difficult to achieve stable combustion of NH_3. If NH_3 is forcibly combusted, a large amount of NO_X (toxic substance) will be generated. In this study, the calculations were performed using three chemical kinetic mechanisms (GRI Mech 3.0, Okafor Mech, Creck Mech), and the best mechanism was selected by comparing the experimental and calculation results. The GRI Mech 3.0 (Smith, et al) has a common reaction that has been used for the combustion calculation of many hydrocarbon fuels. The Okafor Mech (Okafor, et al, 2018) was improved NH_3 reactivity based on GRI Mech 3.0 and Tian Mech. The Creck Mech (Stagni, et al, 2020) was a newly created mechanism and the mechanism for promoting the NH_3/H_2 reactions was added to the conventional scheme. By comparing the experimental and numerical data (i.e., flame structure and laminar burning velocity), it is found that that the Creck Mech was judged to be the most suitable chemical kinetic mechanism for ammonia burner with hydrogen flame stabilizer.

Ⅱ. Results & Discussion

The analysis object of ammonia burner is shown in Figure 1. A stable flame was obtained by separately supplying ammonia, hydrogen, and air in central, duplex, and triple tubes, respectively (Figure 1). The burner developed in this study can supply a high-velocity airflow (8m/s). Figure 2 shows the comparison of flame structure between experimental and numerical result. In particular, NH_3 consumption height from burner rim well agreed, and the distributions of temperature and chemical species by Creck Mech well agreed with experimental result. Figure 3 (a), (b) shows laminar burning velocities S_h of NH_3-H_2 (50-50:vol%) /Air flame, and stoichiometric NH_3-H_2/Air flame, respectively. X_{H_2} represents the ratio of H_2 in NH_3-H_2 mixture fuel. From Figure 3 (a), (b), the Creck Mech can takes account of the improvement of burning velocity and reactivity when H_2 is added to NH_3.

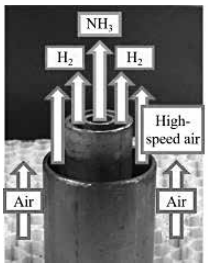

Figure 1. Ammonia burner

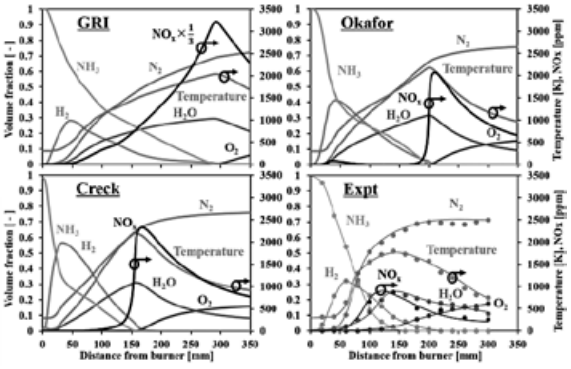

Figure 2. Flame structure at central axes of flame

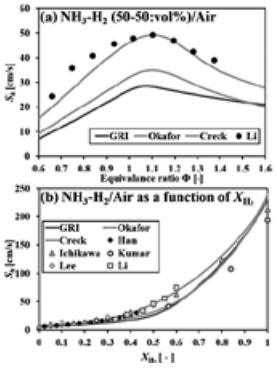

Figure 3. Laminar burning velocity S_h

Ⅲ. Conclusion

(1) From a point of view with the flame structure and laminar burning velocity, the calculation results obtained using the Creck Mech well agreed with the experimental results.

(2) In GRI Mech 3.0 and Okafor Mech, the flame length became longer because the burning velocity (NH_3/H_2) due to the addition of H_2 was not taken into consideration. Then, the GRI Mech 3.0 and Okafor Mech are underestimate reactivity when H_2 are added to NH_3.

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Combustion characteristics of NH_3/H_2 premixed flames and mechanism of NO_x formation

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Ⅰ. Abstract

Recently, ammonia fuel which doesn't emit CO_2 is being developed to reduce global warming and to realize a sustainable society. However, the burning velocity of NH_3 is below 0.06 m/s, which is much lower than that of conventional hydrocarbon fuels, making it difficult to achieve stable combustion of NH_3. If NH_3 is forcibly combusted, a large amount of NO_x (toxic substance) will be formed. To improve the flame reactivity of NH_3, cofiring NH_3 with H_2 has been elucidated. The characteristics of NH_3/H_2/air flames is clarified by experiment and numerical analysis.

Ⅱ. Results & Discussion

Figure 1 shows the effect of the equivalence ratio on the blow-off gas velocity for each fuel. The area below the lines for each fuel represents the stability region, and the area above lines is the blow-off region. We selected the flame (NH_3(50%)/H_2(50%)/air) which has a same burning velocity as hydrocarbons. In Figure 1, NH_3 (50%)/H_2(50%) /air flame is hardly blow- off compared to hydrocarbons (CH_4, C_3H_8), because the H_2 contributes the selectivity of molecular diffusion and sustainable radical supply. Figure 2 shows the effect of H_2 fraction and equivalence ratio on NO_x emissions calculated by Creck-mech (Song, et al., 2019). T_{ini} represents the initial temperature of mixtures (298K), P shows pressure (1atm), and X_{H_2} is the volume fraction of H_2 in blended fuels in Figure 2. The NO_x emission level increased with the increase in X_{H_2} . The reaction rate of $NH_3 \rightarrow NH_2 \rightarrow HNO \rightarrow NO$, which is the main pathway of NOx formation increases as X_{H_2} increases. In addition, the increase in adiabatic flame temperature due to H_2 addition has a positive effect on NOx formation. The equivalence ratio greater than 1.0 (ϕ>1.0) contributes the reduction of NO_x, because the NO_x reduction rate promotes by the NH_2, NH, and N radicals produced from rich NH_3 in the mixture.

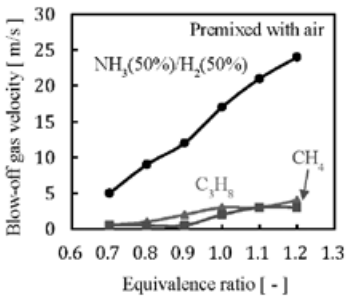

Fig. 1 The effect of the equivalence ratio on the blow-off gas velocity.

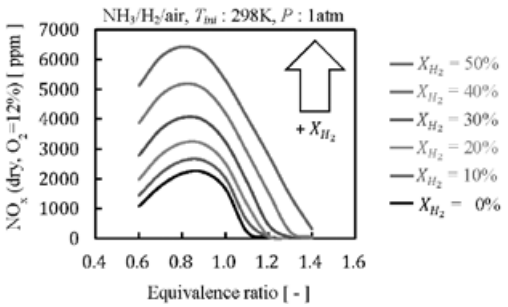

Fig. 2 The effect of X_{H_2} and equivalence ratio on NO_x emission level.

Ⅲ. Conclusion

(1) NH_3(50%)/H_2(50%)/air flame has a wider range of stability region than that of hydrocarbons due to the high molecular diffusion of H_2.

(2) The H radicals play an important role in the formation of NO_x in NH_3/H_2/air flames. In order to reduce NO_x emissions, it is required to reduce the volume fraction of H_2 in the fuel.

(3) In NH_3/H_2/air flames, NO_x emissions can be controlled by the equivalence ratio. The equivalence ratio greater than 1.0 (ϕ>1.0) contributes the reduction of NO_x.

IV. References

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Study about relationship between walking habit and lack of exercise

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1. Motive

In 2016, WHO published a result of a study that more than one hundred and forty people in a group of adults older than 18 in the world is regarded as lack of exercise. And they can have high risks to infect second type of diabetes, cardiovascular disease, cancer, and dementia.(1) As one of the reasons, the development of transportation. In this time, we can go anywhere with only sitting, and a family have at least one car. So, more and more people do not feel like walking. Thinking about what I can do to solve the present conditions, I came up to the recommendation of walking, most of people can do. There are three actions called X, Y, Z, in human's movement. "X" explains the motion of right and left. "Y" is the motion of level turn. If there is a single error of these, we would have stress on our body. The error of X occurs by shaking our upper body with dissymmetrical. Y occur by that of twist of upper body. Z occur by putting our weight on the foot we step forward [sliding one's feet]. (figure1) I think the goal of this study is improving these errors.

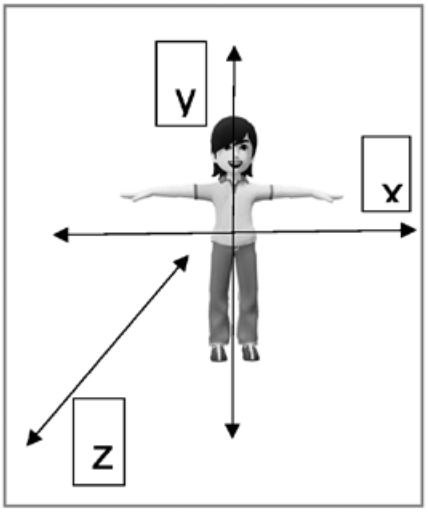

Figure1. Three pivots when we are walking

2. Importance

By improving the habit while we are walking, like posture, and how to put our weight, the people who do not willing to walk will be able to do it more easily and voluntarily. This way affects the problem, lack of exercise. And when I looked up diabetes, the disease occurs by disorder lifestyle included lack of exercise, and particular Japanese easy to suffer from, I found that in the case of women, the risks to get the disease will be higher after menopause because of lack of female sex hormone.(2) That is, I can also reduce the number of diabetes patient by targeting at menopause women.

3. Question

1. Is it possible to search the parts of body put the stress related in our habit on and promote natural improvement?
2. Is it possible to prevent establishment of our form when we are walking by breaking women's habits when walking before menopause?

4. Hypothesis

1. It is hard to promote improvement by only the force of human because menopause women may have already established their habit. A S I C S developed new machine to grasp our motion when we are running, called [MOTION SENSOR].
   When the machine put on our west, it calculates more than 20 kinds of indexes about our form. This mechanism may be able to use to improve walking form.(3)
2. Improvement of habit before menopause is certain easier than that of habit in menopause. And, it will also affect lack of exercise. I think the young we start, the more effective we can prevent establishment of habit when walking.

5. Reference

(1) www.seikatsusyukanbyo.com

(2) style.nikkei.com

(3) www.watch.impress.co.jp

To increase the recycling rate of Marugame city

Anna MIMURO
Kagawa Prefectural Marugame High School

Ⅰ. Research Background

The reason I chose recycling is because I watched "Zero Waste "in Kamikastu on TV. Residents sort trash into 45 types and recycling rate reached 80% in 2019. Marugame city's recycling rate reached 12% (population100,000-500,00) in 2019 and the figure was low in municipalities. (Figure1)

Although Marugame city works attempts on recycling, it doesn't seem to be rising percentage.

I wondered why don't recycling rate rise, the difference between Marugame and Kamikatsu. That's why I tried to investigate the factors that work of Kamikatsu works well and get hints from it.

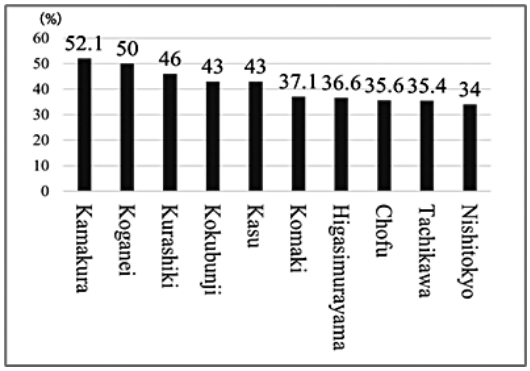

Figure1. Top10 recycling initiatives municipalities (Population 100,000-500,000)

Ⅱ. Research method

✓ Study tour of Zero Waste Center
✓ Hearing to staff in Zero Waste Center

Ⅲ. Research purpose

① How did Kamikatsu town get residents' approval
② Necessary points to sustain work

IV. Research result

① At the start of it, there were many residents that disagreed the initiative and flied tipping staff researched opinions from residents and pursue the convenience of residents such as increase opening day of center, resident staff.

② There is system that residents can get knowledge on recycling and through sorting residents can communicate each other such as sorting with staff, use center as a place of relaxation.

Figure2. Income and expenditure related to the trash

Ⅴ. Consideration

Through this research I consider that the difference of Kamikatsu is less opportunities to

encounter recycling. That's why I want to suggest that we conduct education of recycling from childhood and the city is display sing about income and expenditure related to the trash we take out on the garbage collection boxes. (Figure2)

Also, I think it good if we can combine existing facilities and staff to create something new system. For example, we install the system that children can separate their garbage themselves at nursery school in Marugame city. Through the experience get children to make it daily routine or I make picture book about recycling and ask nursery schoolteachers to put on the book there.

VI. References

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- Ministry of the Environment HP : Waste treatment technical information/Discharge and treatment status of general waste (as of 18, 3rd year of Reiwa) 〈https://www.env.go.jp/recycle/waste_tech/ippan/r1/index.html〉
- KAMIKATSU ZERO WASTE CENTER HP: WHY KAMIKATSU ZERO WASTE CENTER 〈https://why-kamikatsu.jp/〉
- Public relations pamphlet : KAMIKATSU ZERO WASTE CENTER & HOTEL WHY

Investigating the Mechanism of the Marsilea Mutica's Nyctinastic Movements

Kokoa Shirakawa, Yuna Tao, and Sora Kondo
Kanonji Daiichi High School

Ⅰ. Abstract

It is known that Marsilea mutica shows nyctinastic movements, however, we haven't figured out the reasons. The reasons for nyctinastic movements of land plants similar to Marsilea mutica are related to turgor pressure and growth movements. Pore opening and closing movements are also likely affected. First, we counted the number of stomas in a specimen of Marsilea mutica. More stomas were observed on the tops of the leaves than the under sides of the leaves, both outside of and under the water. In the water, the difference of the number of stomas is very large and it is not related to whether or not it shows nyctinastic movements. From these results, it seems that decreasing the amount of water in the leaf and the heat of vaporization caused by rising temperature affect the number of stomas. In the future, we plan on researching our hypothesis and investigating the relationship between the turgor pressure and growth movements.

Ⅱ. Results and Discussion

The factors of nyctinastic movements seem to be (Ⅰ) the number of stomas, and pore opening and closing movements, (Ⅱ) Growth movements, and (Ⅲ) Turgot pressure movements. In experiment (Ⅰ), we use both Marsilea mutica both under and above the water, and apply a nail polish to the top or bottom of each leaf.

We let them dry and stick cellophane tape to the leaves and peel it off with the nail polish. We then place it on a slide glass and observe it with a microscope.

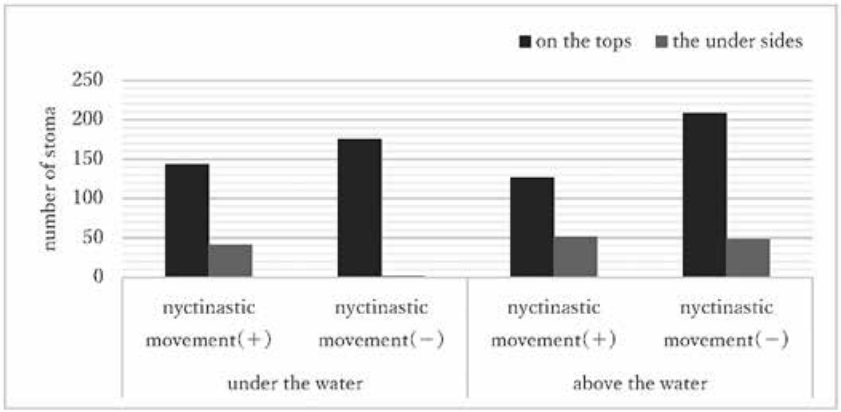


Figure1. Nyctinastic movements of Marsilea mutica under the water and above the water

Ⅲ. Conclusion

Marsilea mutica can't exchange gases under water so the stomas are degenerated. Marsilea mutica (grown above the water) contains more stomas and shows more pore opening and closing

movements. The factors for an increased number of stomas are: A decreased amount of water in leaves, and heat of vaporization caused by rising temperature.

Ⅳ. References

Suzuki M, Maruyama Y, and Nagaoka K(1994) *Opening and Closing of leaves for the teaching material*

The Relationship Between the Crystalline Lens and Vitreous Humor's Quality in Fish Freshness

Haruchika Onishi, Natsuki Koyama, Airi Toyoura
Kanonji Daiichi High School

Ⅰ. Abstract

In general, the freshness of fish is often judged by the turbidity of the crystalline lens. In our study, we're going to investigate the relationship between the crystalline lens and vitreous humor's quality in the freshness of fish, because they haven't been focused on so much in previous research. In our research, we investigated whether we could see a difference in the size of the crystallizations depending on the freshness in fish. First, we took out the crystalline lenses from a mackerel and put them on a slide. Second, we dried them with a high temperature dryer (30℃) for20 minutes, and then observed it with an optical microscope. (magnification 40X).

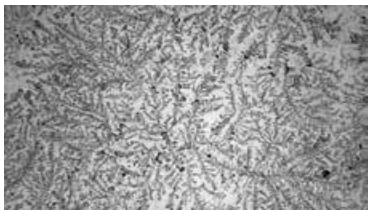
Ⅱ. Results and discussion

The results are as shown in Fig1 to Fig6 below.

On the day of death	three-dimentional radical crystallizations are observed clearly
1st day after death	almost no change from the date of death
2nd day after death	the quality of crystallizations got worse
3rd day after death	crystallizations became smaller
4th day after death	the quality of crystallizations got worse and the size of them became smaller
5th day after death	the size of the crystallization became much smaller and almost couldn't be found

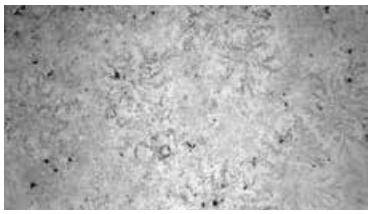
(Fig.1) On the day of death

(Fig.2) 1st day after death

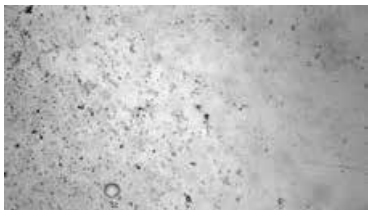


(Fig.3) 2nd day after death

(Fig.4) 3rd day after death



(Fig.5) 4th day after death



(Fig.6) 5th day after death

From these results, it seems that the freshness of trout affects the quality of crystallization. On the 5th day after death, we observed that the crystalline lens became cloudy, so it seems that the freshness of the fish, the number of its crystallizations and the size of its crystallizations are related to each other.

Ⅲ. Conclusion

We believe that vitreous humor's quality is something to do with the freshness of fish. To further investigate the relationship between the freshness of the fish and the crystalline lens's quality, we plan on researching how much the amount of bacteria on the gills affects the quality of crystallizations and what materials make up the crystallizations. In addition, we are going to research the difference in crystallizations among different kinds of fish.

Ⅳ. References

魚の眼球硝子体の結晶像と鮮度との関係について：1968-07｜書誌詳細｜国立国会図書館サーチ（ndl.go.jp）PPTX ファイル ビューアー | Microsoft Teams

【 Proceedings 】

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EJEA Conference 2021 in Kagawa on

Human-centered Sustainability and Innovation for an AI-assisted Future: New Interdisciplinary Education & Research for the Next Stages in Japan and Europe

AIが支援する未来に向けた人間中心のサステイナビリティとイノベーションを考える：
新たなステージへ導く日本とヨーロッパの学際的な教育と研究の紹介

PROCEEDINGS

List of accepted proceedings

The Journal of Kagawa University International Office invited all presenters to submit manuscripts of conference proceedings and 13 submissions were made and accepted.

Author name	Title of manuscript	Workshop presented at EJEA Conference
Kaisei Harada, Daisuke Sasaki, Hayato Yase, Jun Kadowaki	Development of Air Supply System for Wearable Robot -Effectiveness of Hollow Cylindricalshaped Variable Volume Tank	3: Innovative Technologies for New Industry Creation
Takaki Nishimura, Tatsuya Kodama, Genta Sakane, Tomohiko Ishii	Theoretical research aiming at highefficiency hydrogen production using solar thermochemical energy for the goal of sustainable energy supply	
Satoshi Murayama	Environmental humanities: a long-term local history approach to living space	4: Environmental Humanities: Water, Air and Land for Sustainable Living Spaces
Nazmul Huda, Toru Terao Atsuko Nonomura, Yoshihiro Suenaga	Remote sensing spatial analysis of waterlogging due to natural hazards in Bangladesh	
Gaurav Vikash Bhuyan, Deepa Pradhan, Barasha Rani Das, Manash Jyoti Bhuyan, Sourav Saha, N. Deka, P. Bhattacharya, A.K.Bhagabati	Community Response to Local Environment: Reflections in Certain Micro- Landscapes of the Brahmaputra River Valley in Assam, India	
Lena Bruch, Elisabeth Stein, René Reiners	Towards an Integration of Sustainability Efforts in the HCD Process	6: GRANITE - Human-Centered Research and Transfer to Application
Dominik Pins, Dennis Paul, René Reiners	Challenges and Concepts For the Design and Evaluation Of Usable and Satisfying Voice Interfaces According to DIN EN ISO 9241-11 and -110	
Colin de Kwant, Rikard Bodén, Arne Erlandsson	Sustainable Mobility Scenario Modeling, Evaluating Future Resilience of Modular Concepts for Electrified Trucks	7: Human Security and Sustainability
Kazuya Ishii	The SDGs in the Anthropocene: A Gandhian Critique	
Khalifa Sy, Naka Gotoda, Rihito Yaegashi, Toshihiro Hayashi	A method to convert learning history into data for learning path study in Sub- Saharan Africa	8: Educational Change: New Models and New Thinking in Intercultural Concepts
Toru Takamizu	Online Japanese Language Education for Elementary Level Learners	
Masataka Yatsuzuka, Masahide Ishizuka, Satoshi Murayama, Toru Terao	Study on wells distribution and water balance in Teshima Island. Environmental humanities approach and hydrological simulation	Poster Session
Kasai Takeshi, Atsuko Nonomura	Verification of human resources development methods for continuous disaster prevention and crisis management unique to local governments	

Development of Air Supply System for Wearable Robot -Effectiveness of Hollow Cylindrical-shaped Variable Volume Tank

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Ⅰ. Abstract

Recently declining birthrate and aging population have been causing serious labor shortage. In order to reduce the burden on workers and improve productivity, devices such as wearable power assist robots have been developed. Pneumatic actuators are used in various wearable power assist devices because of their high power-to-weight ratio and flexibility [1]. To drive the actuators, air supply systems are required. The air supply systems are composed of air compressors, tanks, valves and various sensors in most cases. For usability and maneuverability in practical use, the air supply systems are expected to be portable as well as the wearable power assist devices themselves.

Okui *et al.* proposed a portable power source using chemical reaction of sodium bicarbonate and citric acid [2]. Kitagawa *et al.* suggested an air source by using dry ice [3]. The authors have developed a portable air supply system for retrieving and re-compressing exhausted air using a variable volume tank [4]. Conventional air supply systems have employed constant volume tanks. If a small constant volume tank is used in order to downsize the system, inner pressure of the tank drops significantly when compressed air is supplied to the actuator.

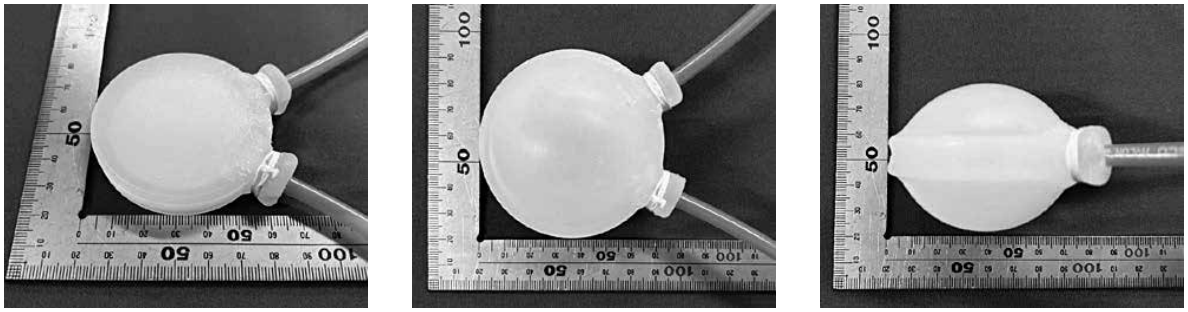
In contrast, the variable volume tank expands when compressed air flows in, and by storing part of the energy of compressed air as elastic energy, it decreases the amount of pressure change. This effect is called pressure relaxation characteristics. However, physical properties of elastomer affect the characteristics of the variable volume tank. Therefore, to increase relaxation-pressure, the tank became thick and heavy. Although a double layer variable volume tank [5] was developed to increase storable pressure without increase in thickness and weight, it became large.

In this study, a hollow cylindrical-shaped variable volume tank is developed as a solution to this issue. This paper describes the effect of decreasing pressure drop based on the pneumatic energy characteristics when compressed air is stored in the developed hollow cylindrical-shaped tank. We also explain the feasibility of achieving the desired energy characteristic at high pressure by multi-layering the tanks to increase outer pressure.

Ⅱ. Hollow cylindrical-shaped variable volume tank

The variable volume tank expands and converts compressed air energy into elastic energy. This effect decreases pressure change. Large internal volume requires high energy to reach the desired pressure for driving the actuator. The spherical-shaped variable volume tank in the previous study has large initial internal volume. If the internal volume is reduced, required energy to increase

pressure can be reduced. Also, it contributes to downsizing of the tank as much as reduced internal volume. In order to provide a solution to reducing the internal volume, we have developed the hollow cylindrical-shaped variable volume tank. Figure 1 shows the overview of the hollow cylindrical-shaped variable volume tank. This proposed tank is made of silicone rubber (Shin-Etsu Chemical Co., Ltd.: KE-1316) diluted by adding diluent (Shin-Etsu Chemical Co., Ltd.: RTV-thinner) of 10 percent of the mass of the silicone rubber. The tank has an outer diameter of 60 [mm], a height of 13.2 [mm] , and a thickness of 6 [mm].



(a) Initial state. (b) Pressurized state (Top view). (c) Pressurized state (Side view).

Figure 1. Hollow cylindrical-shaped variable volume tank.

To measure stored energy characteristics of the hollow cylindrical-shaped variable volume tank, an experiment was conducted. Figure 2 shows the experimental setup. First, the three-port solenoid valve (KOGANEI: 100E1- LF) on the inflow side was opened. And the outflow side was closed. In that state, the tank was pressurized with the servo valve (FESTO: MPYE-5-M5-010B) at 0.6 [L/min] until the internal pressure of the tank reaches 65 [kPa]. The inflow energy was measured with the flow sensor (KEYENCE: FD-A1) and pressure sensor (KEYENCE: AP-43A) on the inflow side. Then, the three-port solenoid valve on the outflow side was opened. And the inflow side was closed. The internal air was exhausted at 0.6 [L/min]. The outflow energy was measured with the flow sensor and pressure sensor on the outflow side. Figure 3 shows the measurement results of the energy characteristic of the hollow cylindrical-shaped variable volume tank. For comparison, Figure 4 shows the energy characteristics of the constant volume tanks, of which volume are 0.1 [L] and 0.75 [L], respectively.

We set a hypothetical condition of driving an actuator by applying 40 [kPa]. As Figure 4 shows, the 0.1 [L] constant volume tank reaches the target pressure of 40 [kPa] with small energy. However, pressure keeps rising after it reaches the required pressure. That is, in order to store the same amount of energy as the 0.75 [L] constant volume tank, the 0.1 [L] tank is required to store higher pressure than the 0.75 [L] tank. The 0.75 [L] tank demonstrates smaller pressure change, but after it supplies air to the actuator, the remaining energy that is unusable for driving the actuator is large.

On the contrary, the initial internal volume of the hollow cylindrical-shaped variable volume tank is small. Therefore, as Figure 3 shows, it reaches the target pressure with a small amount of stored energy. After that, by storing part of the energy of compressed air as elastic energy, it decreases the amount of pressure change. Therefore, the pressure drop in the tank that occurs

when the tank supplies air to the actuator can be decreased compared with the conventional constant volume tank.With this effect the compressor does not need to compress air higher than the actuator requires. Since the initial volume is small, remaining air in the tank after supplying air to the actuator can be also decreased. That is, remaining energy is small. These characteristics of the hollow cylindrical-shaped variable volume tank lead to low energy consumption of the entire air supply system.

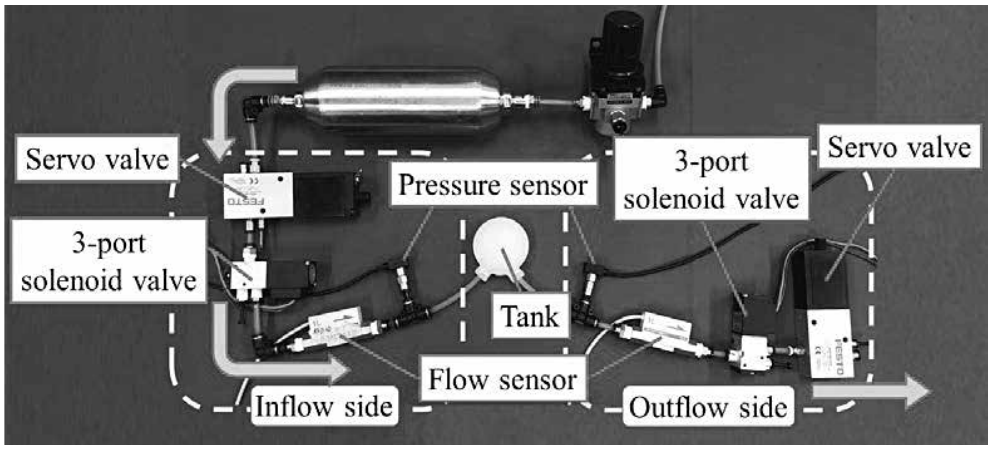


Figure 2. Experimental setup of hollow cylindrical-shaped variable volume tank.

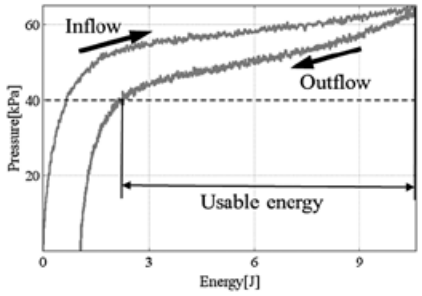


Figure 3. Energy characteristic of hollow cylindrical-shaped variable volume tank.

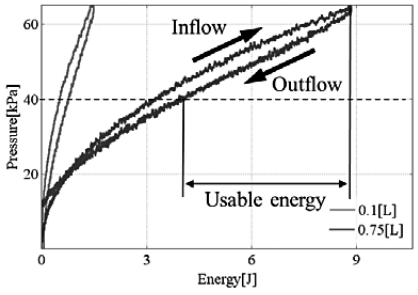


Figure 4. Energy characteristics of constant volume tank.

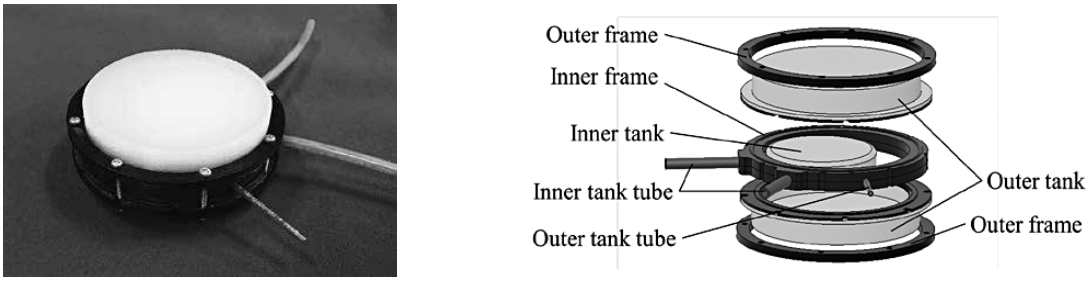
Ⅲ. Multi-layered variable volume tank

In addition, we propose the multi-layered variable volume tank to improve energy characteristic. In the previous study, the double layer spherical-shaped variable volume tank was developed to increase storable pressure without increase in thickness and weight, but it had large volume. The hollow cylindrical-shaped variable volume tank has small initial volume, as a result, multi-layering the hollow cylindrical-shaped variable volume tank can be smaller than the double layer spherical-shaped variable volume tank. Figure 5 shows the multi-layered hollow cylindrical-shaped variable volume tank. The hollow cylindrical-shaped variable volume tank shown in Figure 1 is used as the inner tank. The inner tank is inserted between two outer tanks. The outer tank has an outer diameter of 92 [mm], a height of 12.6 [mm], and a thickness of 6 [mm]. The expansion of the inner tank is restricted by applied pressure between the inner and outer tanks. As the inner tank expands, pressure between the inner and outer tanks increases. However, pressure change is limited because the outer tank is also a variable volume tank. So, the outer tank presses the inner

tank keeping the applied initial-pressure.

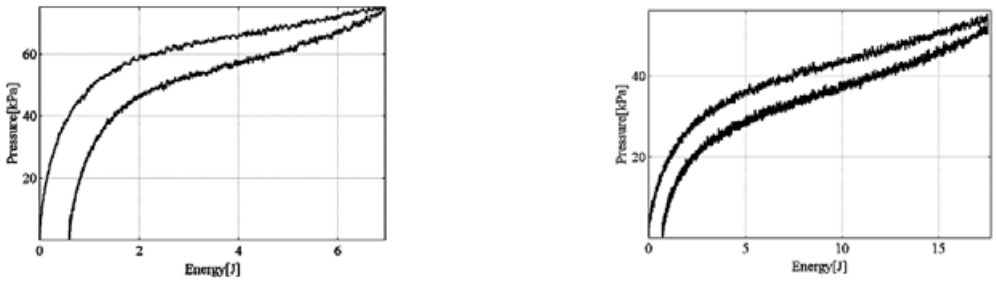
We conducted an experiment to measure the energy characteristics of the multi-layered variable volume tank. Prior to the experiment, we measured the energy characteristics of the inner and outer tanks, respectively, using the experimental setup shown in Figure 2 for measuring the energy characteristics of the hollow cylindrical-shaped variable volume tank in the previous chapter. As shown in Figures 6 (a) and (b), we observed that the inner tank demonstrated pressure relaxation at approximately 60 to 75 [kPa], while the outer tank demonstrated pressure relaxation at approximately 35 to 55 [kPa]. If the tanks are pressurized exceeding the upper limits of 75 [kPa] for the inner tank and 55 [kPa] for the outer tank, it may cause permanent damages to the rubber material of the tanks. Therefore, we set the pressure values as the upper limits.

Figure 7 shows the experimental setup of the multi-layered variable volume tank. In the experiment of the energy characteristics of the multi-layered variable volume tank, first, compressed air was supplied to the outer tank using the electro-pneumatic regulator (CKD: EVD-1100-008AN). The outer tank was closed with the manually operated valve. Then, in the method similar to that of the experiment conducted on the hollow cylindrical-shaped variable volume tank, the inner tank was pressurized and exhausted with the servo valve at 0.6 [L/min]. The inflow energy and outflow energy in the inner tank were measured with the flow sensor and pressure sensor. The pressure change of the outer tank, which was generated by expansion of the inner tank, was measured with the pressure sensor.



(a) Overview. (b) Structure

Figure 5. Multi-layered variable volume tank.



(a) Inner tank. (b) Outer tank.

Figure 6. Energy characteristics of inner (left) and outer tank (right).

We tried two experimental conditions in applied pressure. To get the difference of 75 [kPa] between the inner tank and the outer tank, which is the upper limit of the applied pressure to the inner tank, 20 [kPa] was applied to the outer tank and air was supplied to the inner tank until it

reached 95 [kPa]. 50 [kPa] was applied to the outer tank and air was supplied to the inner tank until it reached 125 [kPa]. Figure 8 shows the energy characteristics of the multi-layered variable volume tank measured under the two conditions. The figure includes the energy characteristic of single hollow cylindrical-shaped variable volume tank as well. As the figure shows, the value of relaxation-pressure and the amount of stored energy improves by multi-layering the tanks. Moreover, the results indicate that the value and amount improve when higher pressure is applied to the outer tank. Figure 9 shows the relationship between pressure in the outer tank and stored energy in the inner tank. As Figure 9 shows, the outer tank keeps the pressure as high as initially applied due to the effect of limiting pressure change. Because of the effect, the pressure of the outer tank does not exceed the outer tank upper limit of 55 [kPa].

Ⅳ. Conclusion

In this paper, the structure and characteristics of the hollow cylindrical-shaped variable volume tank were described. By reducing the internal volume, the tank was downsized and energy characteristics of the tank improved. The results suggest that the hollow cylindrical-shaped variable volume tank leads to low energy consumption of the entire air supply system. We also proposed the multi-layered variable volume tank composed with hollow cylindrical-shaped tanks. The hollow cylindrical-shaped variable volume tank has small initial volume, as a result, the multi-layered hollow cylindrical-shaped variable volume tank can be smaller than the double layer spherical-shaped variable volume tank. The experimental results indicated that the value of relaxation-pressure and the amount of stored energy in the tank increased. These results confirm that the multi-layered hollow cylindrical-shaped variable volume tank will enable us to realize portable air supply systems which can provide high pressure. We will develop the portable air supply system which retrieves and re-compresses exhausted air using the multi-layered variable volume tank.

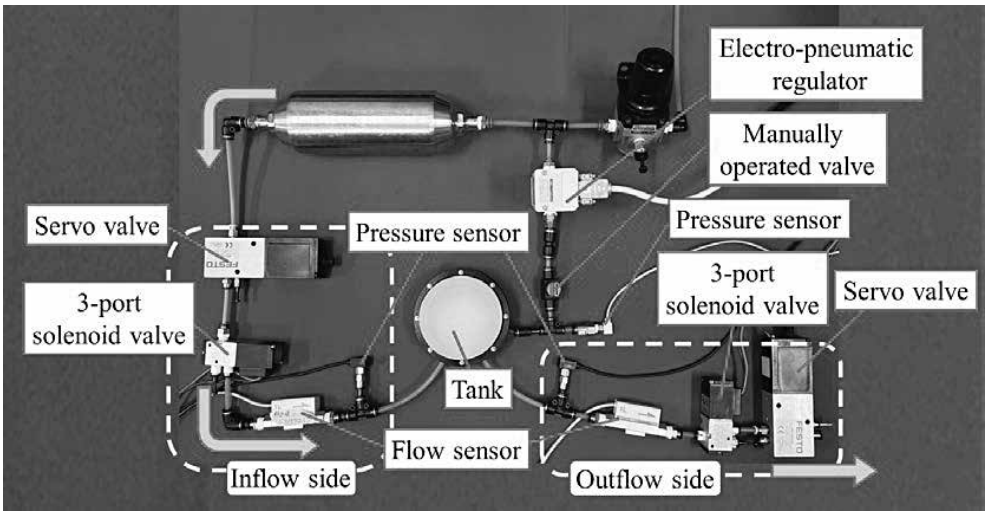


Figure 7. Experimental setup of multi-layered variable volume tank.

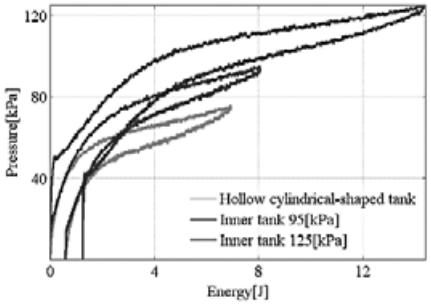


Figure 8. Energy characteristics of multi-layered variable volume tank.

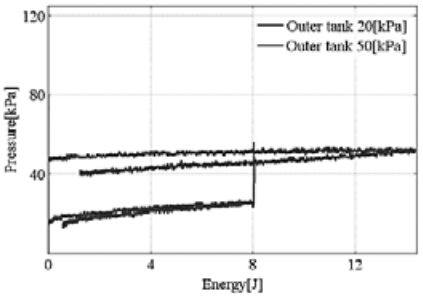


Figure 9. Relationship between pressure in the outer tank and stored energy in the inner tank.

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Theoretical research aiming at high-efficiency hydrogen production using solar thermochemical energy for the goal of sustainable energy supply

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Ⅰ. Abstract

This study aims to theoretically explain the experimental facts of the thermal redox reaction by means of the first principle calculation called Discrete Variational X α (DV-X α) molecular orbital calculation. It is indicated that the relation between the effects of the transition metal doping into cerium oxide (CeO_2: ceria) and the hydrogen gas production in the thermal redox reaction. The calculation results showed that the bonding between the metal ions and the oxygen ions in the doped ceria is stronger than that shown in the non-doped ceria. In addition, the Mndoped ceria showed the most robust bonding among the transition metal (Mn, Fe, Co, Ni) doped ceria. These results suggested that the magnitude of the crystal structure stabilization affects the redox reaction efficiency in each doped ceria. We summarized that the bonding strength in the doped ceria is one of the critical points considering the redox reaction efficiency.

Ⅰ-1. Introduction

Novel energy styles and energy productions are so required, hydrogen energy has been much attraction from the viewpoint of the environment. Many utilities of the hydrogen energy have been studied, and industry studies of the hydrogen have also been done [1-4]. In Fig. 1, it is shown that the hydrogen production facility in Jülich, Germany. The "Green hydrogen technologies" project has been demonstrated [5-7], and the hydrogen gas has been sourced continuously from solar heat [8-10]. It has the advantage of storing sustainable "solar energy", which can be irradiated from the sun to the earth in the form of "hydrogen energy". So, it makes good sense to convert intermittently solar energy (clean energy) to hydrogen energy (clean energy). Considering these points, Kodama et al. have studied new energy production of the solar thermochemical production by an oxidation-reduction reaction of the cerium oxide (CeO_2: ceria) [11-12]. In

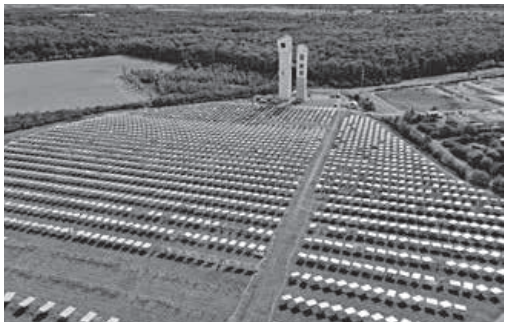

Figure 1. DLR concentrated solar thermal test site at Jülich image@DLR (Ref: SolarPACES)

Fig. 2, the hydrogen gas production facility uses the solar thermochemical process at Miyazaki University in Japan [13]. The flow of the hydrogen production is shown in Fig. 3. Then, the sunlight can be concentrated by many heliostats and converted to thermal energy. The thermal redox reaction can generate a hydrogen gas with control of the reaction temperature. Moreover, the redox reaction is the cycle reaction that consists of twostep reactions, which makes it possible to produce the hydrogen gas efficiently. If the solar energy can be supplied stably, we can get hydrogen energy continuously.

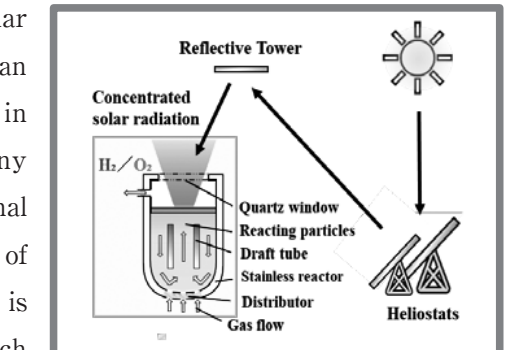

Figure 3. Floor plan of solar reactor concept for a circulating reaction measure.

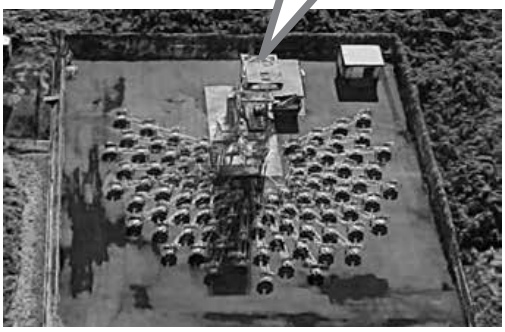
Figure 2. The solar thermochemical production at Miyazaki University. (Ref: Google map.)

The two-step thermal redox reaction is used for the hydrogen gas production; much research has been done up to now [11-14]. The two-step thermal redox reaction has the reduction reaction (1st step: eqn.1) with oxygen desorption at high temperatures (>1,000℃)and the oxidation reaction (2nd step: eqn.2) with oxygen adsorption at low temperatures (< 1,000 ℃). In the thermal oxidation reaction (2nd step), water molecules gas can be decomposed under high-temperature steam, and the hydrogen can be produced efficiently [15-16].

$$\text{1st step: } M_xO_y \rightarrow M_xO_{y-\delta} + \delta/2\ O_2 \text{ (eqn.1)} \cdots \text{Thermal Reduction (TR) reaction}$$
$$\text{2nd step: } M_xO_{y-\delta} + \delta\ H_2O \rightarrow M_xO_y + \delta\ H_2 \text{ (eqn.2)} \cdots \text{Water Decomposition (WD) reaction}$$

In the experimental results, Kodama *et al.* reported that the thermal redox reactivity and cyclicality increase in the case of the Mn or Fe-doped ceria [17-18]. It was suggested that the transition metal doping would cause electronic state change into ceria. Theoretically, it is crucial to clarify the difference in the hydrogen production activity in the thermal redox reaction due to the transition metal doping.

The thermal redox reaction is the oxygen adsorption/desorption reaction. The hydrogen and oxygen gases production is associated with the oxygen absorption reaction (WD reaction) and the oxygen desorption reaction (TR reaction). These reactions indicate the bonding state changes between the metal ions and the oxygen ions in the ceria. The thermal redox reaction can be referred to as the oxygen adsorption/desorption reaction. Therefore, it was considered that the effect of doping transition metals into ceria could be explained theoretically by clarifying the differences in the bonding states between metal ions and oxygen ions. The Discrete Variational X α (DV-X α) molecular orbital calculation method was used for evaluating the bonding strength.

I-2. Calculation method

The DV-X α molecular orbital calculation (DV-X α method) was developed by D. E. Ellis and H.

Adachi [19-22]. The electronic potential of the DV-X α method is proposed as "X α potential" by J. C. Slater. It is one of the advantages that the DV-X α method has numerically evaluated a substance's electronic state. Therefore, the *d* or *f*-orbitals of metal ions can be accurately calculated. This study focuses on the bonding state between metal and oxygen ions. The accurate calculation of the metal's *d* or *f*-orbitals is critical.

The calculation model is the $M@Ce_{12}O_8^{36+}$ cluster model composed of 12 cerium tetravalent ions (Ce^{4+}) and 8 oxygen ions (O^{2-}), in which the central ion is substituted with another metal ions (M^{4+}), M = Ce (non-substitution) and M = Mn, Fe, Co, and Ni (substitution). The reported experimental data determined the cluster models [17-18]. The cluster model ($M@Ce_{12}O_8^{36+}$) has the fluorite type structure (Fm-3m) with the lattice constant of 5.411 Å. It has the substituted central metal ions (M^{4+}), the 8 oxygen ions around the central ion, and additional 12 cerium ions located outside each oxygen ion.

Moreover, the oxygen ion defect models are also prepared. The prepared models are the $M@Ce_{12}O_7^{36+}$ cluster models. The cluster model ($M@Ce_{12}O_7^{36+}$) corresponds with an oxygen ion desorbed from the previous cluster models ($M@Ce_{12}O_8^{36+}$) after taking two electrons into calculations. The lattice constant is assumed to change with the oxygen adsorption/desorption reaction (WD/TR reaction) processes. Therefore, calculations were also performed for the two cluster models ($M@Ce_{12}O_8^{36+}$ and $M@Ce_{12}O_7^{36+}$) with varying the lattice constants around 5.411 Å (5.250 Å to 5.600 Å). On the computational run of the DV-X α method, the atomic positions are not to change comparing between before and after calculating the cluster models. Taking advantage of this calculation condition, we considered it helpful for examining the effect of the oxygen desorption for each metal-doped model.

The calculations are performed self-consistently until the difference in orbital populations between the initial and final states of the iteration is less than 0.0005 electrons. The calculations were also performed considering the Madelung potential in each cluster model.

Ⅱ. Results & Discussion

In this study, to discuss the stabilization of the metal-doped crystal structure, we considered the bonding strength between the doped central metal ion and the surrounding oxygen ions in the cluster models ($M@Ce_{12}O_8^{36+}$ and $M@Ce_{12}O_7^{36+}$). We discussed the stability of the crystal structure in the doped ceria by comparing it with the BOP values, as explained below.

It was evaluated that the magnitude of the bonding strength between the central metal ions and the oxygen ions by means of calculated parameter called the Bond Overlap Population (BOP). The BOP means how much electrons are occupied in bonding orbitals. If the BOP value becomes larger, there is more overlap in the wave functions between the two atoms, which becomes a strong bonding.

Ⅱ-1. The $M@Ce_{12}O_8^{36+}$ cluster models without oxygen defect (before TR reaction / after WD reaction products)

In this part, it is shown the calculation results without the oxygen defect models. The models

correspond to the sample obtained in the experiment, before TR reaction / after WD reaction products. In Table 1, the BOP values are shown in each $M@Ce_{12}O_8^{36+}$ type cluster model, M = Ce (non-substitution) and M = Mn, Fe, Co, and Ni (substitution). The horizontal cells show the type of the doped metal, and the vertical items show the lattice constants (Å). The lattice constant of the doped metal was varied from 5.250 Å to 5.600 Å.

Table 1. The BOP values for the $M@Ce_{12}O_8^{36+}$ cluster models (M = Ce, Mn, Fe, Co, Ni).

Bond Overlap Population Value (BOP) for the $M@Ce_{12}O_8^{36+}$ cluster models												
Lattice Constant (Å)	5.250	5.300	5.350	5.400	5.411	5.420	5.425	5.430	5.435	5.450	5.500	5.600
M = Ce (pure ceria)	0.261	0.409	0.541	0.679	0.681	0.681	0.712	0.722	0.733	0.763	0.857	1.011
M = Mn (Mn-doped)	1.456	1.460	1.459	1.463	1.463	1.463	1.461	1.460	1.459	1.456	1.445	1.413
M = Fe (Fe-doped)	1.400	1.401	1.399	1.401	1.400	1.400	1.398	1.397	1.396	1.393	1.380	1.346
M = Co (Co-doped)	1.317	1.321	1.321	1.325	1.324	1.324	1.322	1.322	1.321	1.318	1.307	1.277
M = Ni (Ni-doped)	1.185	1.190	1.191	1.196	1.196	1.196	1.194	1.194	1.193	1.191	1.182	1.156

In Table 1, the BOP value changes are shown in the doped metal with the lattice constant changes. The lattice constants between 5.400 and 5.420 (Å) resulted in higher BOP values. On the other hand, as the lattice constant increased, the BOP values also increased in the undoped ceria. It is probably that the 4*f* orbitals of the cerium outermost shell orbitals do not overlap well with the 2*p* orbitals of oxygen. Therefore, when the lattice constant was expanded, the interelectron repulsion between the cerium and the oxygen ions decreased, and the BOP values increased.

The BOP values were large in transition metal-doped ceria than that in undoped ceria. Remarkably, the bonding strength was determined by the doped metal species from Table 1. It meant that the transition metals doping into ceria would stabilize the ceria crystal structure (space group: Fm-3m). It was apparent that the bonding between the Mn ion and the oxygen ions becomes stronger than the Fe, Co, and Ni-doped ceria. While such results were obtained, it also suggested that even in those of the Mn-doped ceria, when the metal doping amount was a few moles, the oxygen ions around the Ce ions are easily defected rather than that around the Mn ions. This is because the BOP values are lower in the undoped ceria. The bonding between the central cerium ion and the oxygen ions can easily deviate.

Moreover, Kodama *et al.* reported that the Mn or Fe-doped ceria shows the stoichiometric thermal redox reaction, whereas the Co and Ni-doped ceria shows the nonstoichiometric thermal redox reaction [17]. The BOP values are compared with the experimental results of each metal-doped ceria (doped with M = Mn, Fe, Co, Ni). The calculated BOP values of Mn and Fe-doped ceria had larger than that of Co and Ni-doped ceria. From this fact, it was assumed that the doped ceria crystal does not easily collapse while maintaining the oxygen adsorption/desorption capacity. When the bonds are weak, the doped ceria crystal easily collapses. The BOP values suggested that the contribution of doping to the stabilization of the crystal structure of ceria.

II-2. The $M@Ce_{12}O_7^{36+}$ cluster models with the oxygen defect (after TR reaction / before WD reaction products)

Next, it is shown the calculation results with the oxygen defect models. The models correspond to the sample obtained in the experiment, after TR reaction / before WD reaction products. In Table 2, the BOP values are shown in each $M@Ce_{12}O_7^{36+}$ cluster model. Other calculation conditions are the same in the $M@Ce_{12}O_8^{36+}$ cluster models.

Table 2. The BOP values for the $M@Ce_{12}O_7^{36+}$ cluster models (M = Ce, Mn, Fe, Co, Ni).

Bond Overlap Population Value (BOP) for the $M@Ce_{12}O_7^{36+}$ cluster models												
Lattice Constant (Å)	5.250	5.300	5.350	5.400	5.411	5.420	5.425	5.430	5.435	5.450	5.500	5.600
M = Ce (pure ceria)	0.099	0.228	0.344	0.447	0.457	0.474	0.484	0.493	0.502	0.529	0.612	0.744
M = Mn (Mn-doped)	1.257	1.262	1.261	1.256	1.248	1.247	1.246	1.245	1.244	1.242	1.229	1.193
M = Fe (Fe-doped)	1.179	1.180	1.178	1.171	1.163	1.162	1.161	1.160	1.159	1.155	1.142	1.105
M = Co (Co-doped)	1.098	1.096	1.090	1.080	1.072	1.070	1.069	1.068	1.066	1.063	1.048	1.048
M = Ni (Ni-doped)	0.995	0.994	0.988	0.979	0.973	0.971	0.970	0.968	0.967	0.963	0.949	0.913

From Table 2, the lattice constants between 5.250 and 5.350 (Å) resulted in higher BOP values. As the lattice constant increased, the BOP values increased in undoped ceria. Compared to the $M@Ce_{12}O_8^{36+}$ cluster models, the overall values of the BOP were found to decrease in the case of the $M@Ce_{12}O_7^{36+}$ cluster models. This result indicated that the bonding between the doped ion and the surrounding oxygen ions is weakened due to one oxygen ion defect.

It was also found that similar trends as the calculation results of the $M@Ce_{12}O_8^{36+}$ cluster models. The BOP value changes were also remarked at the difference of the doped metal species. The difference in the BOP values was obtained in that the BOP values were large in the transition metal-doped ceria than that in the undoped ceria. The Mn-doped ceria had a stronger bonding than other ceria. These points were the same pattern for the $M@Ce_{12}O_8^{36+}$cluster models. It indicated that the transition metals doping into ceria could stabilize the crystal structure even with an oxygen ion defect. If the crystal structure is unstable and its fluorite structure easily collapses after the TR reaction, the reaction efficiency would show less reactive because it will have small cyclability in the undoped ceria. On the other hand, if the crystal structure is stable without collapse, the reactivity and the cyclability will be enhanced in the metal-doped ceria.

When the transition metals are doped into ceria, the crystal structure becomes more stable. The redox reaction is more likely to proceed without crystal deformation. However, the oxygen adsorption/desorption reaction is considered less likely to proceed when the crystal system becomes excessively stable as the doping amount increases. In other words, it is considered that oxygen elimination is difficult to progress due to the crystal system being excessively stabilized. This correlated with a decrease in the efficiency of the thermal redox reaction when the metal was doped by 30 mol% in the experiments [17-18].

The calculation results showed that the interatomic bonding in Mn or Fe-doped ceria becomes stronger than that in undoped ceria. It makes the crystal structure stabilization more suitable in the thermal redox reaction. Although it may seem contradictory, metal doping contributes to the

thermal reduction reaction while maintaining its oxygen-deficient capacity.

In the oxygen adsorption/desorption reaction, the crystal structure of oxygen-desorbed ceria should remain intact without interfering with the entry and exit of oxygen ions as much as possible. The metal doping into ceria plays a role in both the oxygen desorption and desorption reactions and the stability of the crystal system.

Ⅲ. Conclusion

We have mentioned the theoretical discussion of the two cluster models $M@Ce_{12}O_8^{36+}$ and $M@Ce_{12}O_7^{36+}$considering the doping effects on the ceria. The BOP values between the doped metal ion and the surrounding oxygen ions can predict the bonding stability. From the theoretical calculation results, the Mn-doped ceria has the high ability to maintain the fluorite-type crystal structure among the transition metal doping (M = Ce, Mn, Fe, Co, and Ni). The stabilization of crystal structure also leads to the improvement of the cyclicity and efficiency of the thermal redox reaction. Moreover, the theoretical calculation results are compared with the demonstration experiments. The following correlations were derived.

(1) The large BOP in the Mn and Fe doped ceria relates to the stoichiometric thermal redox reaction.
(2) The small BOP in the Ni and Cu doped ceria relates to the nonstoichiometric thermal redox reaction.

It can be understood that when the bonding is strong, the doped ceria crystal structure does not readily decay, but when the bonding is weak, the doped ceria crystal structure readily decays. We have shown that the BOP values help evaluate the stabilization of the metal-doped ceria with the process of the oxygen adsorption/desorption reaction.

Acknowledgement

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Environmental humanities: a long-term local history approach to living spaces

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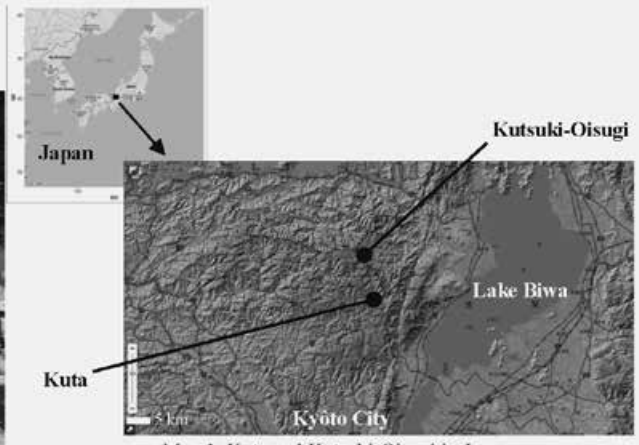
Ⅰ. Introduction: changing cultural landscapes in Japan

At a time when we urgently need to respond to climate change, the most important thing is to make the most of the power and resilience of nature. However, Japan's current situation is not heading in that direction. Japan's cultural landscape is in a period of rapid reorganization. The population decline is especially pronounced in mountainous and remote areas: many fields have been abandoned, forests are no longer cared for, and the old plantation landscapes are a thing of the past. Of course, there are still some fields that have survived, and agriculture, forestry, and fisheries are still being maintained. However, small-scale farmland in mountainous areas will remain abandoned if no one lives there as the population ages. Rural landscapes that have been in existence since medieval or even ancient times are now becoming a thing of the past.

Photo 1. An abandoned house in Kutsuki-Oisugi
(Taken by S. Murayama on August 15, 2017)



Map 1. Kuta and Kutsuki-Oisugi in Japan
This map is a reproduction of the digital elevation map by the Geospatial Information Authority of Japan.

Photo 2. Abandoned rice fields in Kutsuki-Oisugi
(Taken by S. Murayama on August 15, 2017)

Photo 3. Well-reserved rice fields in Kuta
(Taken by Murayama on August 16, 2015)

This essay is based on my recently published article regarding a farming village near Kyôto City. It is a long-term local history of the village of Kuta from medieval times to the present day. Kuta, located about 40 km from the center of Kyôto, still retains its traditional paddy rice farming landscape, but in Kutsuki-Oisugi, a village more than ten kilometers over a several passes from the center of Kuta, most of the paddy fields have been abandoned in recent years. Each of these villages has a long history, but in the case of Kuta, even though the village is mostly populated by elderly people, agriculture was maintained because their relatives live in Kyoto City. In the case of Kutsuki-Oisugi, it was necessary to travel along narrow mountain roads, and the distance from the city seems to have been decisive.

In Japan, a country that relies on foreign countries for most of its basic resources, the living spaces that existed when the country was not involved in the global economy are likely to disappear. Most of the old living spaces relied on the capability of organic economies of the land inherited from generations of ancestors. Even today, there is still the customary ritual of welcoming the ancestors in the middle of August. Nevertheless, can we really let everything disappear? Let me introduce you to the writings of Amartya Sen, Nobel laureate in economics:

> "The demise of old ways of living can cause anguish, and a deep sense of loss. It is a little like the extinction of older species of animals. This is an issue of some seriousness, but it is up to the society to determine what, if anything, it wants to do to reserve old forms of living, perhaps even at significant economic costs." (Sen, 1999, p. 241.)

There are the big differences between Asia and Europe in living spaces due to the distribution of precipitation and temperature. The spread of human settlements differs greatly. In Asia, the living spaces are composed of a wide range of regions, from low to high temperatures and low to high precipitation. In Asia, only a small part of Japan and other countries has a climate pattern like that of Europe. Japan has a climate pattern that is extremely favorable for paddy rice cultivation, with relatively high temperatures and moderately high precipitation from around May to October. It would be a shame if we were to abandon these conditions for the most part.

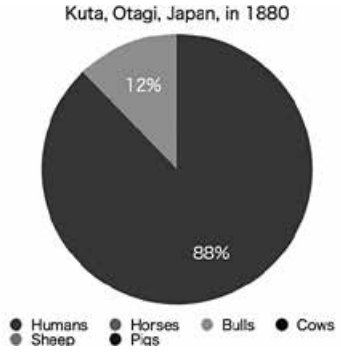


Figure 1a
Source: *Kyôto-Fu Chishi*

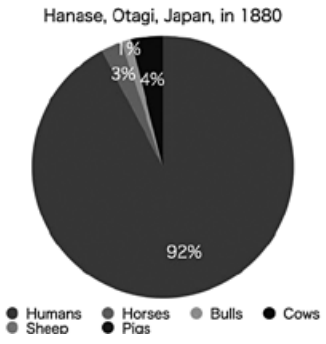


Figure 1b
Source: *Kyôto-Fu Chishi*

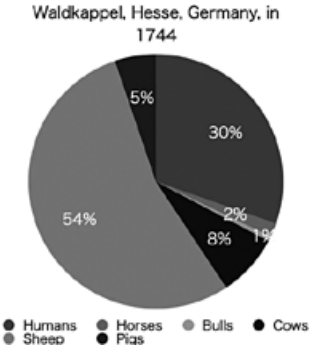


Figure 1c
Source: *Waldkappel 1744*, bearbeitet von Heinrich Albrecht, Hessische Ortsbeschreibungen 7, Marburg/Lahn und Witzenhausen: Verlag Trautvetter und Fischer Nachf.

Table 1: Number of humans and livestock in Amakusa

Year	1768	in%	1868	in%
Humans	97,336	95.5%	157,677	92.6%
Horses	4,385	4.3%	9,184	5.4%
Bulls and Cows	226	0.2%	3,418	2.0%
Sheep	0	0.0%	0	0.0%
Pigs	0	0.0%	0	0.0%
	101,947	100.0%	170,279	100.0%

Source:
- Year 1768: Amakusa-Gun Meisai-Chô [A detailed account book of Amakusa County], Ueda House Archive.
- Year 1868: Amakusa-Gun Mura-Mura Taka Kosû Jinkô sonohoka Torishirabe-Chô [An investigation report of productivity, household numbers, population of villages in Amakusa County, Nagasaki Museum of History and Culture.

In addition, even if it is not only due to these climatic patterns, a comparison of pre-modern villages in Japan and Germany shows a very clear difference in the size of animal populations, including humans. It may come as some surprise, but both humans and livestock are counted here without distinction. In Japan, the number of humans is relatively overwhelming (88% of an agricultural village, Kuta (population of humans: 480) and 92% of a forestry village, Hanase (population of humans: 775), for a comparison) (Figure 1a/b), while in Waldkappel (population of humans: 758) in Hesse, Germany, the number of sheep is much higher (54%) as a percentage of humans in 30% (Figure 1c). Around 1880, only cattle were recorded in Kuta in terms of livestock. The fact that only bulls were recorded in Kuta is also unique compared to other villages, and it is highly likely that the cattle were used for farming and the main labor force in agriculture.

The villages around Kyôto are referred to in *Kôkoku Chishi* (The Imperial Gazetteer: Topography of Imperial Kingdom), which was compiled and submitted to the government by the Kyôto Prefecture and covered the eight counties of Yamashiro Country, an administrative unit of early modern Japan. The data for Otagi County are an example of remaining manuscripts. Unfortunately, the exact year cannot be traced for the data for Otagi County, and thus, I speculate that they are from the early Meiji period, around 1880. The present research used the data of 56 villages derived from the documents regarding the *Kyôto-Fu Chishi* (topography of Kyôto Prefecture) that are archived by the Kyôto Prefectural Library and Archives. In Hanase, also belonging to Otagi County, horses were also kept. This record is from around 1880, but the condition of the animals before that time is not considered to have changed much. In Amakusa County, Kyûshû, in southwestern Japan, where the human population increased from less than 100,000 to more than 150,000 between 1768 and 1868, the percentage of humans was still 95.5% and 92.6%, respectively (Table 1). This kind of population growth was rare in early modern Japan, but we can assume that the proportion of all domestic animals in the population did not change significantly. While it is not possible to examine these differences in detail here, I will now briefly introduce some of the issues that have emerged from a long-term local history analysis of the village of Kuta, Japan.

Ⅱ. Historical evidence derived from a long-term local history of Kuta, Kyô-Otagi, Japan

Let me begin by setting up the central question for this essay's discussion: 1. The world, with its vastly different climatic patterns and natural conditions, now seems to be operating under a unified economic system, but is that really the right choice? 2. Can artificial intelligence help the people who live at a place to maintain their living spaces? Although we are already using this term, let me briefly explain the concept of living spaces. "Living Spaces" is a term devised by my research group to represent a holistic spatial concept that includes all life forms living in a certain environment. It embraces the spatial relationship and organic interactions between humans and nature (Murayama and Nakamura, 2021, pp. 117-8 and Notes 22, p. 119).

Kuta first appeared in historical documents in Kôhei 7 (1064), when it was described as a temple territory of the Hôjô-Ji Temple in Kyôto. Furthermore, in Heiji 1 (1159), Kuta had 15 chô (1 chô = about 10,000 square meters) of paddy fields, which were under the jurisdiction of the temple, whereas the development of other fields was free. There was also a "soma" mountain, which was positioned as a soma site for the repair of Byôdô-In Temple and Hôjô-Ji Temple. The word soma means timber forest. Twelfth-century sources on the taxes shouldered by the inhabitants of Kuta show us a unique but possible story; they were entrusted with the preservation of majestic temples, such as Byôdô-In and Hôjô-Ji, and at the same time, were given the freedom to develop the land. In other words, they were guaranteed, in exchange for their contribution in maintaining cultural buildings, the economic freedom to survive.

This can be considered the starting point of village autonomy, or a communal village system in Kuta, which was a multidimensional regional representation that existed over a long term, and simultaneously the origin of the accelerated administrative power that reached its heights in World War I (the "administrative revolution" of John Hicks) (Hicks, 1969).

A land survey ledger, Kenchichô, was compiled in Keichô 7(1602), the year before the start of the Edo period(1603). At this time, Kuta was made up of five villages: Nakazaichi, Kami, Kawai, Shimo, and Miyanotani. The land survey of 1602 provides a clue to the birth of the territorial fiscal state, which determined all the village boundaries in Japan. The total tax amount for these five villages was calculated to be 389.65 koku (amount of koku = putative rice yield: one koku was enough yield to feed one person for one year in the Tokugawa period). The *muradaka* (village productivity) was almost unchanged at the end of the Tokugawa period, more than 260 years later, amounting to 391.21 koku.

Some villages during the industrialization in Japan specialized in forestry and distribution and formed new supply areas of living resources. Kuta became one of the multiple suppliers of firewood and charcoal, without experiencing any decisive change; as a result, it appears to have maintained the rural landscape of the Edo period (early modern times). Until the 1970s, almost every farmer

in Kuta kept a bull for cultivation, and the women's memories of Kuta, compiled in 1993, tell of the life in Kuta and their diligence.

Fumi Shimizu (born in the 1930s) "A Mountain of Memories" (Murayama and Nakamura, 2021, pp. 116-7.):

> When the world awoke from its long winter sleep and the nightingale began to sing, everyone became busy in the rice fields, in the crop fields and in the mountains. I would go into the woods to collect tree branches from very early in the morning to help make charcoal and to prepare bundles of firewood. I would till the land, getting blisters on my hand until the end of April. They were very challenging days.
>
> Now that I think of it, the one or two days a month that we got off were a long time coming for the young bride. When we had finally finished planting rice in the wind and rain, the next day would be another early morning starting with cutting grass for the bull [draft cattle: the house cattle played an important role in farming, so they were well cared for and fed. People used to say that one looks at the bull and you could see what a hard worker the wife was.]. I would spend the afternoons cutting grass in the mountains. After a while, I would go into the barn [which was often a part of the main house] to take the bull dung out. Day after day, the hot weather would continue. As the weather got a bit cooler, we would start reaping the rice. When it rained, I would gather chestnuts and horse chestnuts, so there was no time for me to rest my shoulders. On sunny days, I would spend the evening carrying the harvested rice under the stars.
>
> There were many hardships, such as hanging the rice on wooden racks to dry and dealing with the elderly. I would stay up until very late each night threshing the rice. This work would go on and on until the end of autumn, in November. Then, we would begin preparing for the winter, gathering firewood, and carrying charcoal in a bicycle-drawn cart to Ume-no-ki (in the neighboring prefecture Shiga).

Since the mid-1970s, cultivators, tractors, and power threshers were introduced; therefore, the rice harvested by combine harvesters could be hulled and packed into bags on the spot. The month-long process of hanging rice on wooden racks to dry could now be done in a single night. Until the 1960s, the traditional role of rice, wood, and charcoal suppliers did not change so dramatically. Today, the mountainous living spaces are only made use of for leisure facilities, such as campsites, and the processing of wild vegetables. In order to save living spaces that are losing their countless productive realities, which are not recognized as a grand heritage like those featured in the Globally Important Agricultural Heritage Systems, it is necessary to have regionally original representations that reflect the realities of each region, such as those seen in Kuta's past.

Ⅲ. Artificial intelligence for environmental humanities?

It is thought that humanity has faced environmental problems at every stage of its history since ancient times. In other words, if we do not consider environmental problems to be unique to our time, there are a variety of relationships between humankind and nature that have always been problematic, and when faced with these environmental problems, how do we make decisions, in

what contexts do we make decisions, in what relationships do we make decisions? What kind of social institutions do those decision-making processes produce, or do they result in economic stagnation, decline, or constant economic growth? Or can we find optimal solutions to, for example, contemporary energy problems?

Is one universal system, such as an economic system, the right choice for a climatically and ecologically diverse world? The evidence from a long-term local history of Kuta is as follows: in medieval times, free environmental decision-making of the inhabitants; in early modern times, proper fiscal management and austerity; in modern times, sustained economic growth that continues to produce the weak.

After nationwide capitalist economic and public policies reorganize living spaces in every corner of Japan, what is crucial, however, is that the long-term history of locations such as Kuta may end sooner or later. A new multidimensional regional representation in the future will be needed as an alternative to maintain local living spaces. Can artificial intelligence (AI) help the people who live there to maintain their living spaces? All tools should be useful, but the question is which kind of living spaces are to be chosen. Could AI help us for such a decision-making? How does AI directly relate to future economic or public policy, which has dramatically changed living spaces in Japan?

The time has come to fundamentally rethink economic policy, the economy of local living spaces, and administrative power. The question is whether it is possible to minimize the loss of local living spaces by creating new multidimensional representations of the region through the mobilization of experience, knowledge, and new science and technology, including AI. It may be that I am assuming a task that is impossible and improbable, such as the restoration of the local economy defined by the environment: the "environmentally local economy." However, it is certain that the current economy is based on a more insecure foundation than, for example, that of Kuta in medieval times, which was of 500 years' duration.

This is because we have lost sight of the local organic economy. In this respect, the historical data that can be extracted from the most spectacular experimental sites of the past, digitized, and quantified, may become a treasure trove for future AI applications. What is the meaning of freedom in human decision-making in an administratively highly controlled society? Is the organic economy, which uses photosynthesis as its core to generate sources of energy resources, limited only to the supply of food resources? Can AI have any effective relationship with the fundamental problem of human reproduction in a hyper professionalized society of the "division of labor"?

Kuta's case study shows how the sustainability of human life forms as a group is possible over a long period of time in specific local living spaces. Viewed from the perspective of long-term local history and economy in Japan, Kuta's inhabitants have experienced the long medieval leap in transition to the tragic 19th century in a prolonged term:

"The industrial revolution is usually depicted as a success story… however, the industrial revolution may come to be regarded not as a beneficial event which liberated mankind from the shackles which limited growth possibilities in all organic economies but as the precursor of an overwhelming tragedy—assuming that there are still survivors to tell the tale." (Wrigley, J. E., 2016, pp. 204-5.)

Ⅳ. Discussions on environmentally local "economy"

The era of workers marginalized by capital is not over. The situation is even more serious than in the 19th century when Marx and Engels lived. Climate change is becoming more and more apparent, and extreme weather events are becoming an everyday occurrence. If we divide nature into "water and air" (Nature A) and "land and resources" (Nature B) (see Figure 2/3), it is easier to understand the current climate crisis. The former, water and air, which should be considered public goods, are creating a critical climate situation for land and resources, while the latter, land and resources, because of the enforcement of property rights, are increasingly thrown into the movement of giant capital, which continues to reproduce a climate crisis through the emission of greenhouse gases. In other words, if we think of the problem of workers' alienation as the alienation of human beings from nature in this sense, it has become an ecological crisis common to almost all human beings.

There are two combinations of axes embedded in the following diagram (Figure 2). The first is a combination of the vertical axis of social technologies and science and technology, and the horizontal axis of the living spaces of the place (local living spaces) and the multidimensional regional representation by humans. The other is a combination of diagonal axes: The first axis of nature A of water and air and nature B of land and resources, and the second axis of natural sciences and the humanities and social sciences. People and all living creatures that live at the intersection of these axes, and a new practical-research group, called HAELE (to be explained in what follows) has its place there. The local living spaces are the material world, and the multidimensional regional representation is the cognitive world of human beings.

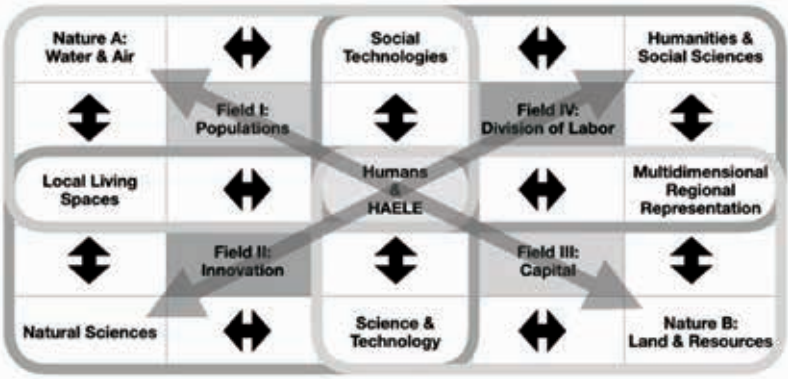


Figure 2. Place and aims of the HAELE among environmental, academic, and economic fields

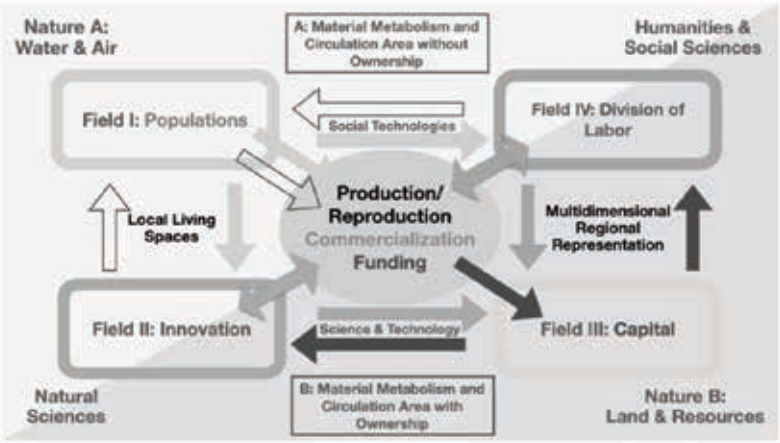


Figure 3. Two kinds of economic growth in pre-modern Eurasia: Nature A (water and air) and Nature B (land and resources)

The global economy, which is self-propagating, has made it almost impossible for humanity to produce in precise response to nature, and we continue to look to the fiscal stimulus generated by the collective selfishness of nationalism, which divides the global environment. A major part of the tax money taken from the people is spent on economic growth. However, the global economy, driven by the old-fashioned belief that economic growth enriches the people, will not be able to stop the tragedy of global warming. This is because it was the global economy of the Industrial Revolution that ended the era of the organic economy, which was unstable and at the mercy of nature, and created the geological age of the Anthropocene, which devours the fossil and mineral resources of the earth.

The Industrial Revolution was a regional economic movement that started in Britain, but its essence was the accelerated utilization of the earth's resources. It was a movement that quickly spread to neighboring countries and, in the long run, to the entire globe. As a result, humans, who can only sustain life through the medium of money, have been forced to live through an era of climate change that has destabilized the life-supporting roots of water and air. The nature in the lower right of the above diagram is land and resources, but the global economy began to erode the nature of water and air in the upper left, and humanity finally entered an era of population decline that would lead to its own extinction.

The setting of the four fields is based on the four factors of modern economic growth: capital, market, population size of humans, and technological progress and innovation. Originally, Joel Mokyr examined this typology of economic growth, which was reexamined by O. Saito especially for the division of labor in pre-modern times, as a Smithian growth (Saito, O., 2008, pp. 47-78). In Figure 2, these four fields of the factors of economic growth can be further divided into two categories of nature other than living organisms, creating four more fields, and then eight fields in total, which can encompass more issues than expected. This will depend on future discussions.

The future of the human species depends on how we rethink capital-led economic growth (Field

III) in the lower right (Figure 3) (See Moore, 2016, and Saito. K., 2016). I believe that the era of de-economic growth calls for a revolutionary shift that is linked to other factors of economic growth, such as technological innovation and division of labor. It is safe to say that we have entered an era in which we must move away from the lower right field of capital and address not only the population of the human species, but also the populations of all life forms. Ester Boserup's argument that population pressure has given rise to agricultural innovation needs to be extended far beyond the matter of humans' population. The division of labor (Field IV), in line with Adam Smith, and technological innovation (Field II), as discussed by Joseph Schumpeter, are also considered factors that generate economic growth.

I believe that the rethinking in this essay of ecologically diverse populations and humans' reproduction based on specific localities, e.g., local living spaces such as Kuta's, will lead to a new review of the "economy," which might lead to a future of an AI-assisted, human-centered sustainability of local living spaces. There is also a need to maintain "regional" autonomy, which can put a stop to the excessive global economy that is being led by capital. To achieve this, it will be crucial to construct a new multidimensional "regional" representation (see the right center of Figure 2/3) that takes both natural environments (A and B) and the relation between capital and divisionof labor into consideration. For this purpose, coordinated with the International Consortium for Earth and Development Sciences at Kagawa University, the Historical Association for Environmentally Local Economy (HAELE) (http://dlpweb.ed.kagawa-u.ac.jp/main/?page_id=462) was launched by the author and his research and educational colleagues on November 20, 2021.

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Remote sensing spatial analysis of waterlogging due to cyclones and storms in Bangladesh

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Ⅰ. Abstract

Ground impacts of seasonal natural hazards, such as cyclones and storms, are enormous in the Bengal delta. This remote sensing study aims to estimate the intensity of inundation on physical settlement generated from two cyclones and one storm between 2007 and 2019 based on 2,282 mauzas or villages between inland and coastal districts in the southwest of Bangladesh (SWB). Based on reliable secondary data such as Landsat observations, elevations, physical settlement, and mauzas, it appeared 348.8 km^2 of the coastal and 26 km^2 of the inland district was either high-risk or risk zone of waterlogging due to the cyclone in 2007. Similar waterlogging risks were observed around 399.6 and seven km^2 in the respective districts from the convective storm in 2012. The cyclone in 2019 generated the lowest risk compared to the others in both districts. For the cyclone, 891 and 395 mauzas in inland and coastal districts, respectively, were appeared without any surface water. The inundated area in the mauzas>50% water pixel was enlarged in the inland but reduced in the coastal by the cyclone in 2019 compared to storm in 2012. The study provided the credibility to investigate village-level waterlogging risks generated from cyclones and storms in the coastal area of Bangladesh.

Ⅱ. Introduction

The hydro-meteorological disasters generated over the Bay of Bengal during the post-monsoon (October-November, sometimes in May), defined as a cyclone, is considered one of the most destructive natural hazards in the Ganges-Brahmaputra delta that covers India, Bangladesh, and part of Myanmar. Among them, Bangladesh experienced the most severe ground impacts of the cyclone due to its geographical position. The country has a long history of such storms earliest recorded in 1584 according to Banglapedia (https://en.banglapedia.org). Moreover, future climate change such as global warming, sea-level rise (1) will accelerate the ground impact of cyclones and storms in Bangladesh because of the existing vulnerable socio-economic condition, high density of population, low elevated land, and lack of preparation and prevention mechanism. After investigating existing elevation, population change, and climate conditions, a study found that an estimated 0.9 million people may displace by direct flooding in 2050 from the coastal area of Bangladesh (2). The most recent fatal cyclones of the country were in 1970 and 1991.

The death toll increased by around 500,000 in the first and 138,958 in the latter. Though the number of fatalities decreased after 1991, damage to physical infrastructure and property is still in concern due to the frequency of the storms in Bangladesh (3). After the 1991 cyclone, a shift from response or recovery to preparedness has been observed in the disaster management cycle in the country that focused on empowering the community to be resilient against natural hazards (4). However, the preparedness phase of the cyclone demands accurate estimation and design for possible ground impacts even for a small area of interest where population density is high such as southwest of Bangladesh (SWB).

Although remote sensing data such as optical, thermal, and Synthetic Aperture Radar (SAR) can produce such risk assessment tasks in every phase of the disaster management cycle (5), an enormous interest observed in the prevention phase since 2005. These remote sensing studies often use before and after optical imagery of the most recent cyclone event to detect the changes in land use land classes (LULCs) where the dominant land class is vegetation (6). Such multi-class classification of land use through remote sensing method in the Bengal delta lacks the proper definition and estimation of the land cover area from a reliability and validity point of view. The Bengal delta, covering 60% of Bangladesh, is a highly populated wetland. The coastal area of the country is likely to be affected by cyclones where people experience the immense seasonality of waterbodies around their locality (7). The major livelihood option is Aquaculture (8). Thus, we selected our study area in the coastal area of the Bay of Bengal located in the SWB.

Previous remote sensing studies focusing on ground impacts of cyclones did not provide a clear definition of settlement (9) or built-up (10). Multi-classes land covers damage estimation, from heterogeneous land classes, based on satellite imagery remains a challenge (11). The 'physical settlement' denotes any built-up such as rural and urban housing, institutions, industries, parks, roads, etc. defined by the source. And the area of physical settlement was collected and processed from a reliable source. The present study will primarily estimate the expansion of surface water on the physical settlement area after cyclones and stormthat refers to as waterlogging in the study area. We assume physical settlement as the most crucial land cover in Bangladesh. Because recent modernization and urbanization may accelerate people to rely on physical settlements more especially where physical settlement land is scarce such as SWB. The study, hence, aims to estimate the waterlogging risk developed from two cyclones and one severe storm on the physical settlement area based on zonal statistical analysis. Although we assume that the elevation does not fluctuate much in the Bengal delta, the study will further report the causal association of elevation and its waterlogging spatial distribution on physical settlement.

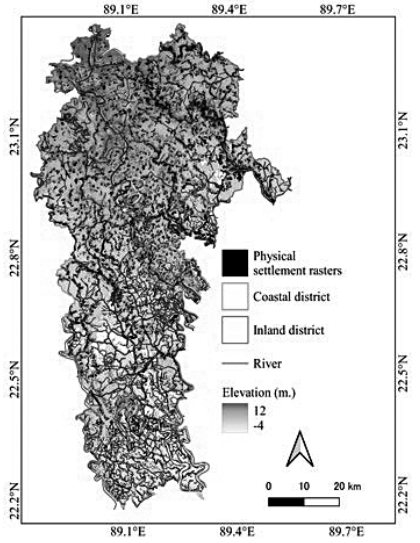

Figure 1. Location of the study

Ⅲ. Methodology

Study area: The study area has been selected purposively at SWB, the downstream coastal area of the Bengal delta, where seasonal cyclones and storms create huge ground impacts. Figure-1 shows that the study further selected two adjacent administrative boundaries of Bangladesh, intending to compare cyclone ground impact between inland and coastal land. The inland and coastal districts' names are Jessore and Satkhira. The geographical extent of the area is 88.84E–88.56E and 21.65N–23.37N, where the inland area is 2,578.4 km^2 includes 1,315 mauzas, and the coastal area is 2,306.5 km^2 with a total of 967 mauzas. The total population of the inland and coastal area is 1.8M and 1.3M, based on population census-2011, Bangladesh Bureau of Statistics (BBS) (http://www.bbs.gov.bd/). The highest elevation of the study area is 14.2m., whereas the lowest is -01.3m. The mean elevation is higher in the inland area than that of the coastal. Mangrove forest which occupies the southern portion of the coastal district was excluded from the present study due to the absence of physical settlement. The area is under a sub-tropical climate, and usually, cyclones develop during post and pre-monsoon. As a delta region, the area is open to numerous rivers, channels, and canals. The rivers and their distributaries have either direct or indirect connections with the Bay of Bengal. The coastal district of the study site is widely known for its aquaculture. And physical settlement is denser in the inland district than that in the coastal (Figure-1).

Case selection: According to historical natural disasters data emergency events (EM-DAT) – (1) a category-5 cyclone named 'Sidr' with a maximum wind speed of 260km/h and lowest pressure of 944hPa., landfall on 15 November 2007 in the SWB generated a 3m. surge around the coastal area. At least 4,234 people have confirmed the death, with 8.9M affected. Estimated damage from the Sidr is around $2.31B. (2) A convective storm transited through SWB on 6 April 2012 with a maximum wind speed of 56km/h. The total number of fatalities reported was 25, and around 55,121 people had been affected. (3) A category-1 cyclone named 'Bulbul' with a maximum wind speed of 195km/h landed on the Indian coast on 9 November 2019 affected SWB as well. The Bulbul caused 40 deaths. The total number of people affected by Bulbul was 251k. The estimated damage was $31.6M. The Bulbul also generated storm surges and flash floods (https://www.emdat.be/). The crucial reasons for selecting these natural disaster cases are (a) the availability of the LS data immediately after the disasters, and (b) EM-DAT data shows the disasters had significant ground impacts.

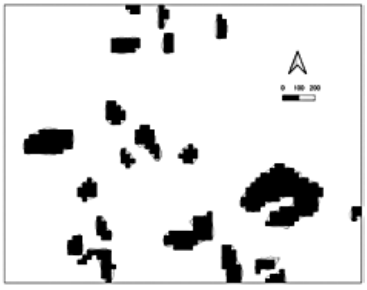

Figure 2. Conversion of vector data to (30 × 30) m raster

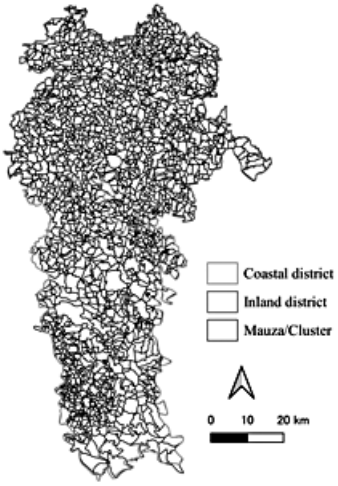

Figure 3. Mauza or village map

Data, and techniques of analyses: For estimating the surface water area, the study used three United States Geological Survey (USGS) archival level-1 collection-1 Landsat (LS) missions' satellite reflectance observations which have 30m. ground

resolution. The Satellite observations from LS-07 of 21 November 2007, 24 April 2012, and 22 November 2019, have been used to estimate surface water originated from 15 November 2007, 6 April 2012, and 9 November 2019 cyclones and convective storm respectively. The existing gap mask and radiometric rescaling were fixed to complete the full-scale images and for atmospheric correction of the LS file. Wavelength ranging from (0.52–0.60) μm and (0.77–0.90) μm for Green and Near Infrared (NIR) bands of LS-07 observations utilized to produce Normalized Difference Water Index (NDWI) image introduced by McFeeters (12). The NDWI>0.0 is considered as water pixels. Thus, binary layer legends, water, and no-value were finalized for all the images. The NDWI>0.0 equals water has already been proven a reliable threshold value between water and non-water pixels of LS image in SWB by our previous research method (7). The 30m. ground resolution elevation data of 2002 had been collected from the Shuttle Radar Topography Mission (SRTM), USGS. However, we used the high-resolution spatial map of physical settlement of the study area provided as GIS shapefiles compiled by the Local Government of Engineering Department (LGED), ministry of Local Government, Rural Development and Co-operative, Bangladesh in 2015 (https://www.lged.gov.bd/). The QGIS tool allows converting the vector shapefile into 30m. raster image data. Figure-2 shows the conversion of the vector data layer into a raster layer. The raster layer of physical settlement has been used as a reference layer.

Table 1: Inundation after the disasters

Natural Hazard	District	Surface water (SW)								
		SW >50%			SW > (10-50%)			No SW		
		No. of Vil.	Area in sq. km.	Pct. of land	No. of Vil.	Area in sq. km.	Pct. of land	No.of Vil.	Area in sq. km.	Pct. of land
Sidr	Inland	138	247.2	9.6	232	537.2	20.8	271	361.1	14.0
	Coastal	232	722.4	31.3	252	647.7	28.1	158	209.5	9.1
Storm	Inland	14	28.1	1.1	107	197.7	7.7	852	1479.0	57.4
	Coastal	205	642.4	27.8	222	543.2	23.5	334	643.5	27.9
Bulbul	Inland	93	178.2	6.9	79	156.1	6.1	891	1596.3	61.9
	Coastal	135	477.8	20.7	202	574.3	24.9	395	715.3	31.0

The physical settlement raster layer legends have been arranged in a binary manner like the water pixel layer of the LS. Change matrix tool used to overlap the water raster layer on the physical settlement raster. Finally, the water pixels that overlapped on physical settlement pixels were separated and considered as the waterlogging pixels. For zonal analysis, we used the small area atlas of mauza or village level shapefile of the study area developed by the statistics and informatics division of Bangladesh Bureau of Statistics (BBS) in 2012 published in 2016, which presented in Figure-3 (http://www.bbs.gov.bd/). The mauza or mahalla name and area are often alternatively used as a village name and boundary respectively in Bangladesh, which is considered as spatial zone. A total of 2,282 such villages was identified in the study area presented in Figure-3. We calculated the mean elevation, percent of physical settlement, percent of water pixels, and percent of waterlogging pixels from each village. The mauza containing >75% waterlogging

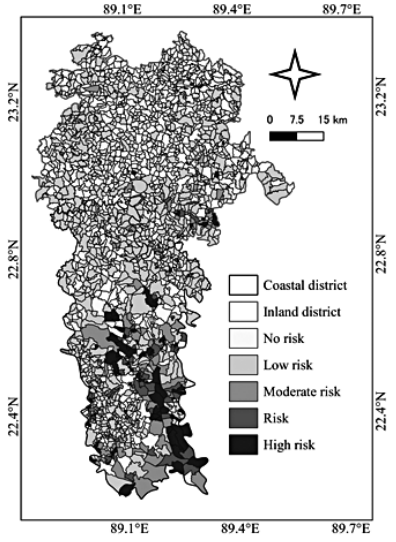

Figure-4. Waterlogging risk due to the cyclone Sidr in 2007

pixels, considered to very high-risk zone derived by cyclone or storm. Similarly, (>50–75)% as risk zone, (>25–50)% as moderate-risk zone, (>0–25)% as the low-risk zone, and the area without any waterlogging pixel as a no-risk zone were defined as waterlogging risks.

Ⅳ. Results

Physical settlement and elevation: We have already mentioned that the study area was divided into 2,282 mauzas or villages. A total of 1,315 villages covers the inland district, and the rest of them, 967, covers the coastal one. Around 198 villages covering 295.6 km^2 in the inland district and another 126 villages covering 178.7 km^2 in the coastal have no physical settlement raster. Hence, physical settlement exists in 1,958 villages of the entire study area. Furthermore, the mean elevation of each mauza was calculated that indicated the average value for the inland district is 7.7m. compared to 4.7m. in the coastal one. The maximum and minimum mean elevation of the villages in the inland district is 14.2m. and 1.0m., respectively. Similarly, the values are 12.7m. and -1.3m. for the coastal (Figure-1). Almost all the villages containing no physical settlement have relatively low mean elevation observed high intensity of water pixels in both districts in 2007, 2012, and 2019 NDVI images.

Surface water: Table-1 shows the nature of inundation after cyclones and storm. Three types of villages were observed and presented – 1. mauza containing >50% water pixels, 2. (10–50)% of water pixels, and 3. without any water pixel. It appears that cyclone Sidr generated the highest number of villages that contain over 50% of water pixels compared to the storm and the Bulbul both in inland and coastal districts. The Bulbul seemed a higher impact compared to the storm in the inland district. Because, after the Bulbul, similar villages increased in the inland district and decreased in the coastal. However, the Sidr produced the highest and the Bulbul produced the lowest number of villages that hold water pixels between 10 and 50 percent in both the districts. Although a lower number of similar villages was observed after the Bulbul compared to the storm, the percent of the area inundated appeared higher in the coastal district. Even so, the Bulbul developed the highest and the Sidr left the lowest number of villages without any water pixels in both districts. The area and percent of land follow the same.

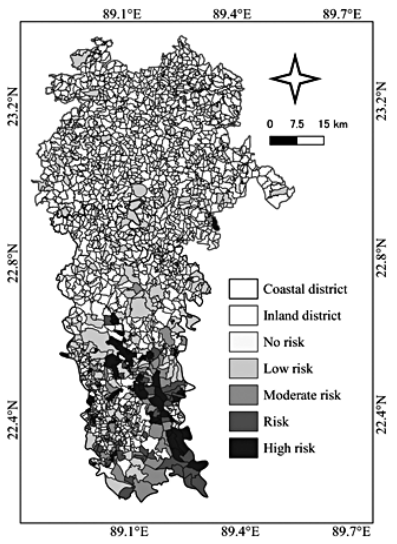

Figure-5. Waterlogging risks due to convective storm in 2012

Waterlogging risk: Th study found eight villages covering 12.7 km^2 and nine villages covering 13.9 km^2 in the inland district appeared as high-risk and risk-waterlogging villages, respectively, due to the Sidr presented in Figure-4. Around 54 km^2 containing 34 villages were identified as moderately-risk waterlogging. Again, around one-third of the land, which has 323 villages in total covering 862.3 km^2 in the inland district, has been observed as a low-risk zone. The waterlogging risk was not identified around 63.4% of the land covering 941 villages in the inland area after the Sidr. Figure-4 also shows that waterlogging risk is much more severe in the coastal district due

to the Sidr. A total of 70 villages covering 220.9 km^2, or 9.6% of the coastal district land appeared as high-risk villages, but only 5.5% of the area containing 45 villages categorized as risk villages. A total of 70 villages covering 321.9 km^2 appeared as moderately-risk villages. One-third of the coastal district land remained without any waterlogging risk after the Sidr. Figure-5 shows the waterlogging risk generated from the convective storm in 2012. It appears that only two villages in the inland district are categorized in both high-risk and risk zones accommodating, 4.6 and 2.9 km^2, respectively, due to the storm. However, only one mauza covering only around three km^2 is identified as a moderate-risk area, while 61 villages covering 179.7 km^2 as low-risk zones. A significant portion of the inland area containing 1,249 villages covering 92.6% of the district land remains without waterlogging risk after the convective storm in 2012. But the waterlogging risk is noticeably high in the coastal district. Figure-5 also shows that around 209.8 km^2, containing 79 villages, were identified as high-risk waterlogging zones in the coastal district. Again 62 villages cover 189.5 km^2 and 61 villages covering around 241 km^2 are distinguished as risk, and moderate-risk zones, respectively. However, nearly half of the coastal district land remained somewhat waterlogging risk in 2012. Lastly, Figure-6 shows that waterlogging did not widen in the inland district due to the category-1 cyclone in 2019. Only one and three villages in the inland district, both covering around two km^2 have been observed as highrisk and risk zone of waterlogging, respectively, due to the cyclone Bulbul. A total of nine villages covering 166.1 km^2 has been distinguished as a moderate-risk zone, while 58 covers 166.1 km^2 which is around six percent of the inland district observed as the low-risk zone. But over 90% of the inland district land remains without waterlogging risk after the Bulbul. But Figure-6 shows a significant waterlogging risk in the coastal district. Because 34 villages cover 169.6 km^2, and 14 villages covering 28.9 km^2 have been categorized as high-risk and risk zones, respectively, in the coastal district due to the Bulbul. Again, a total of 32 villages covering 120.1 km^2 has been observed in the moderate-risk zone. And one-third of the coastal district land cover 192 villages separated as a low-risk zone. However, more than half of the land in the coastal district covers 1265.6 km^2 remained without waterlogging risk after the Bulbul.

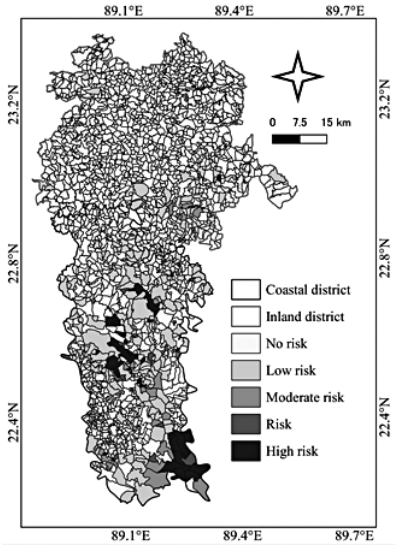

Figure-6. Waterlogging risks due to the cyclone Bulbul in 2019

V. Discussion

Zonal analysis: The study analyzed physical settlement that was compiled from a reliable source and considered mauza or village-level zones as a unit of spatial analysis. It defined the settlement pixel overlapped by water pixel from two cyclones and one severe storm between 2007 and 2019 as waterlogging. The data and result may not deliver for the whole scenario of waterlogging, but the investigation does not limit initiating an experimental method for future investigation considering more cases of natural hazards and other possible elements of waterlogging. The area of different

types of waterlogging risks in inland and coastal districts was compiled in Table-2. Different types of waterlogging risks were impacted differently depending on the districts. Sidr created the highest highrisk and moderated-risk zones in both districts. But the storm in 2012, created the highest risk zones in the coastal district and the lowest moderate-risk zones in the inland district. Area of low-risk zones for both the districts suggested that the waterlogging is widening for recent natural hazards compared to the previous. However, the spatial distribution of the study area analysis shows that cyclone Sidr of 2007 created the most severe waterlogging in both districts. And, both cyclones and convective storm generated significant waterlogging risks in the coastal area. However high-risk and risk villages of waterlogging appeared in the southeast region of both districts (Figure-4, 5 & 6). The physical settlement near the rivers appears the riskiest for waterlogging from cyclones and storm (Figure-3 vs. 4 & 5). Convective storm and the Bulbul created the least and almost similar waterlogging in the inland district (Figure 4 & 5). And cyclone Sidr and convective storm generated the most similar severe waterlogging risks in the coastal area (Figure 5 & 6). However, the villages without any physical settlement either have water pixels or no water pixels located mostly in the north and northwest part of the inland district. Similar villages are observed in the northwest part of the coastal district (Figure-4, 5 & 6).

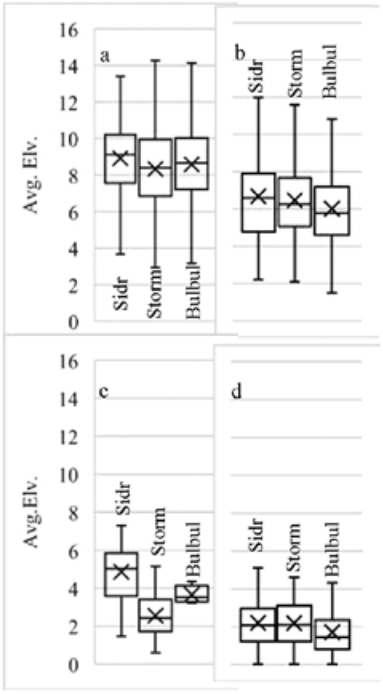

Figure-7. Average elevation distribution of each village; a. without water pixel in inland, b. without water pixel in coastal, c. with waterlogging percent ≥ 50% in inland, d. with waterlogging percent ≥ 50% in the coastal district.

Table 2: Waterlogging risks area

Natural Disaster	District	Waterlogging risks area (sq. km.)				
		High	Risk	Moderate	Low	None
Sidr	Inland	12.7	13.9	54.0	862.3	1635.6
	Coastal	220.9	127.9	321.9	890.0	746.3
Storm	Inland	4.7	2.9	3.0	179.7	2388.0
	Coastal	209.8	189.6	241.0	529.0	1137.5
Bulbul	Inland	1.9	2.3	22.0	166.1	2385.9
	Coastal	169.6	28.9	120.1	722.7	1265.6

Elevation and waterlogging: We assume that elevation may influence both the existence of surface water and waterlogging risks generated from natural hazards. Thus, the mean elevation from extreme villages was calculated separately. The villages have been selected based on two criteria 1. the mauza having no surface water after the hazards (Figure 7.a & b), 2. the mauza has ≥50% of waterlogging pixels (Figure 7.c & d). Figure 7 shows the comparison of the mean elevation for both districts in all three events. Data arranged in boxplot where marker and line-mark are for the average and median value, respectively. The upper limit of the box is for the 75th percentile, the lower limit shows the 25th percentile, upper whisker for maximum, and lower whisker for minimum value. It is perceivable that the higher elevation precludes surface water in both coastal and inland districts (Figure 7. a & b). The physical settlement in the lower elevation area has a much higher chance of waterlogging risk generated from cyclones and storm (Figure 7. b & c). However, cyclone Sidr accelerated more waterlogging villages in high-elevated areas in the inland district compared to the storm in 2012 and the Bulbul (Figure 7.c).

Ⅳ. Conclusion

The study described the waterlogging risks on physical settlement developed from two cyclones in 2007 and 2019, and a convective storm in 2012 based on 2,282 mauzas or villages analysis. The observed mauza analysis showed a higher chance of inundation where physical settlement is low in percentage and vis versa. Around 7% of the villages without settlement were found no inundation pixel in 2007, while 50% of the similar zones experienced at least 80% of inundation pixels. The chance of waterlogging risks is very high in the mauza when the percent of inundation is high, and the percent of settlement is low. The spatial distribution of the villages appeared that cyclones and storm generated significant waterlogging risks in the coastal district. High-risk and risk zones of waterlogging remained in the southeast region of the study area. The physical settlement near the rivers seemed riskier than the others located in the north and northwest part of the inland and the northwest of the coastal districts. The investigation provides credence that remote sensing research is workable even for the village-level ground impacts such as inundation and waterlogging caused by hydrometeorological hazards.

Nevertheless, the risk of inundation on physical settlement from cyclones and storms depends on other factors. Cyclone tracks, storm surges, precipitation, ground elevation are crucial indicators. This research rigorously considered inland and coastal administrative boundaries to compare the waterlogging risks. Future development for spatial analysis requires considering the cyclone and storm land tracks for presenting a holistic waterlogging risk. Existing SAR imagery penetrating the cloud might produce a better ground scenario than LS observation. The LS observation also limits timely and useable data to analyze the ground impacts of hazards due to the cloud. Present research only considered waterlogging risks in the aftermath of the events. Thus, the SAR imagery might be more suitable to check the existing waterlogging scenario before the natural hazards as well. Field surveys regarding existing socio-economic conditions of each region, and distance from river and emergency facilities may help develop other risks developed from natural hazards.

Acknowledgement:

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Community Response to Local Environment: Reflections in Certain Micro-Landscapes of the Brahmaputra River Valley in Assam, India

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Ⅰ. Abstract

With an area of 56,194 sq. km., the Brahmaputra river valley in Assam, India is an environmentally unique area characterized by the presence of a variety of micro-landscapes within its broad geographical framework. Endowed with various natural resources such as habitable lands, fertile soils, water bodies, fauna and flora, these micro-landscapes have attracted people of different ethnic backgrounds from around for settlement since time immemorial. These people have responded to their local micro-landscapes sustainably, and in course of time set good examples of harmonious living with nature. However, due to the rapid growth of population and growing external influences during the recent period, these landscapes have experienced remarkable change in their ecological and cultural characteristics.

The present study is an attempt to investigate the process and pattern of response of the communities to their local environment and how the micro-landscapes shared by them are getting modified in course of time. It has been observed that certain unconformities have already emerged in the process of nature-culture interaction leading to a number of environmental and socio-cultural problems in the concerned landscapes. The study is mainly based on field survey carried out in selected landscapes within the valley and systematic interaction with the targeted communities sharing the landscapes through generations. The landscapes are mapped using conventional and modern techniques in order to understand their environmental characteristics and modifications made by the associated communities.

Key words: Micro-landscape, ethnic communities, nature-culture interaction, Brahmaputra valley.

Ⅱ. Introduction

The nature-culture model is the representation of nature as the ecosystem physically integrated with human society (Bocking, 1994; Ignatow, 2006). Nature has always been effective in all aspects of human life and livelihoods and thus it plays a dominant role in shaping the associated culture (Salman and Munir, 2016; Thakur, 2018). The unique drama of existence is going on with changing socio-economic experiences over time. For man, no matter how he becomes aware of himself or exalts himself above, the world always draws the means of his existence from one and the same source-nature (Laptav, 1979). It is precisely labour, raising man above nature, that again unites him with it, realizing itself as "a process in which both man and nature participates, and in

which man of its own accord starts, regulates, and controls the material reactions between himself and nature" (Marx, 1975). More than 40 percent of the earth's surface is made of Arid and Semi-Arid Lands (ASALs) with its major inhabitants being pastoral and agro-pastoral communities (UNDP, 2013; Irungu *et al*., 2021). The structure and composition of different landscapes, as well as changes in them, influence the distribution, abundance and dynamics of different species or elements (Morris, 1995; Wiens, 1995; Andren, 1997). Landscapes of the Brahmaputra Valley of Assam are the outgrowth of interaction of different ethnic communities with the respective natural setup which is reflected in various land use patterns, settlement pattern, house type, diet and dress and mode of living in the Valley (Deka, et al., 2011). This study is an attempt to examine the processes and patterns of different communitys' responses to their microlandscapes.

Ⅲ. Study Area and Methodology

The Brahmaputra valley extends from $25^0$45' N to $27^0$55' N latitude and from $89^0$4' E to $96^0$2' E longitude. It accounts for 71.54 per cent of the total geographical area of the State of Assam with 26.4 million human dwellers (2011). Inhabited by several ethnic communities (Bharadwaj, 2016), the valley has at present 20,472 inhabited villages. Significantly, the ethnic communities of the Valley are different from each other in terms of their food habits, dress habits, worshiping, housing, customs and rituals, traditional skills and belief systems. Most of the rural people are considered as ecosystem people who sustain their lives and livelihoods based on the available natural resources.

The study is based on personal field observations, authenticated secondary data collected from Directorate of Census and Directorate of Economics and Statistics, Government of Assam. Participatory rural appraisal (PRA) and focus group discussions (FGD) were conducted to understand and analyze the village resources, spatial pattern of homestead design and community ecological practices. Oral interviews with some aged people were arranged to collect information about nature-culture interactions, their perception towards the change in practices and its impact on rural life and livelihoods. Maps were prepared using Google Earth Engine and Arc Map software.

Figure 1: Location of the study area

Ⅳ. Result and Discussion

Case-I: Northern Foothill landscape

The foothill zone of the Brahmaputra Valley covers a geographical area of 9688 Sq. km. with a population of 3,151,047 persons (2011 Census). The area is inhabited by different tribal and non-

tribal communities, mainly the *Bodo, Madahi, Nepali, Santhal, Rajbangshi, Assamese, Bengali*. Scarcity of water is the most common problem of the foothill landscape of the valley. Therefore, the local communities of this area have traditionally developed a unique irrigation system, locally known as '*Dong-Bandh*' to support their agriculture and livelihood. Despite various physical constraints, the local communities with their collective efforts, indigenous skills, and practical experiences have developed this traditional water management system befitting to their local physical situation. This is a diversion-based gravity flow irrigation technique where the river or natural spring water is diverted into the manmade irrigation canals by using gravitational force. The diverted water is flown through earthen canals called dong. The diversion *bandhs* are constructed by locally available building materials such as boulder, stone, sand, tree branches, creeper, bamboo, bushes and tree leaves. Depending upon the micro-variation in the slope pattern within the command area of major *dong*, the villagers designed the network of *dongs* befitting to the existing terrain conditions of the area. The *dong-bandh* systems are developed by the local communities through their collective effort and co-operation. The villagers have formed some water user associations called *Dong-Bandh* Committee for managing the common irrigation systems.

Figure 2: Diversion based *dong-bandh* irrigation system

The morphology of settlements in the foothill region of the valley is largely influenced by the network of *dongs*. The villagers of this area prefer to settle near the irrigation canal because of the easy accessibility of water resources. Therefore, the settlement patterns are mostly found to be linear along the irrigation canals and roads. Similarly, the other rural land use patterns of this area such as residential lands, water harvesting ponds, home gardens, kitchen gardens, agricultural lands, fallow lands, etc. are also largely determined by the accessibility to and availability of *dong* water.

Figure 3: Pattern of settlement distribution and its relation with water canal

Case-II: Magursila village (hill landscape)

Confining within 26 °03'12.20" N to 26°04'39.29" N latitude and 91°59'35.42" E to 92°02'8.64"E longitude, Magursila village is situated on the southern side of Kamrup metro district. Unlike other areas of the Brahmaputra Valley, where different communities live together, the village is solely inhabited by the Karbi people, who have adapted to the natural environment, and have evolved a cultural landscape based on the physical set up applying their ethnic knowledge, beliefs and age-old customs which are reflected in their land use pattern, house type, settlement pattern, land cover status, production system, homestead design, occupational structure, rituals, food habit, dressing etc. The linear type of settlement pattern of the village along its *kutcha* roads, *dongs* and nearby agricultural fields, source of water and means of livelihoods reflect man's adjustment with the hilly environment. For the easy pursuit of agriculture within the village, the people who earlier lived in the hilly parts have now moved to the plain areas within the village and they have started settling there permanently as the declining productivity of the *jhum* fields on the hills is now unable to support the ever increasing population of the village. Thus, without making much alteration to the natural setup, the villagers have developed settlement patterns which reflect their interaction with the local ecological settings.

Across the Brahmaputra valley, the spatial variation in physical setting has caused variations in house types. While the Mishings, living in the active floodplain of the valley, construct '*Chaangghor*' to cope up with the flood water, the people in the built-up areas, on the other hand, construct Assam type houses to get rid of earthquake damages and to accommodate with all peasant needs (Chetia, 2020; Das, *et al*., 2014) . However, the hilly environment in the concerned village has induced to opt for thatch roofed houses, tin roofed houses, wood fitted thatch or tin roofed houses, Assam type houses etc. Most of the housing materials including bamboo to construct house walls as well as boundary fencing along with few grass species such as *faalang kher* for roofing etc. are directly obtained from the hills and hillocks of the village which shows people's response and adoption to its natural settings. The people of the village are dependent on the agricultural activities as well as the hill resources to sustain their livelihoods. Though, at present, few modern inputs and implements like tractor, chemical fertilizer and insecticides have made inroad the agricultural system, the agricultural practice of the village is still characterized by traditional methods. The paddy fields of the village are traditionally irrigated by the *dong* water and are fully dependent on the monsoonal rain. Besides, broom cultivation, bamboo gardens, betel nut gardens, orange gardens, rubber cultivation etc. have been providing a good economic support to the villagers. Moreover, though, the villagers used to go to the nearby *beels for* fishing, due to the degradation of the *beels* by increased human encroachment, they now rarely visit the *beels*. They have now created some artificial ponds within their homesteads which provide them good economic support.

While going through an evolutionary process, every society gets transformed under the influence of modern social processes resulting in the changes in traditional socio-economic and cultural life. As a result, the ecological landscape of the concerned community also gets affected. Similarly, the ongoing modern socio-economic process has started transforming the socio-cultural

landscapes of the village, which is well reflected in the declining use of traditional tools and knowledge system. The assimilation of the Karbi people with the neighbouring Assamese society has resulted in remarkable socio-cultural transformation in traditional village life with respect to food habit, dress pattern, festivals and other socio-cultural practices (Phangso, 1989; Roy, 1999). Moreover, many modern inputs have also entered into the traditional village agriculture. While the various traditional agricultural tools have got replaced by modern tools, such as tractors, power tillers, etc. on the one hand, the use of pesticides has degraded the soil fertility on the other. The *jhum* fields are now being used for commercial cultivation of brooms, bamboos, rubber, betel-nuts, orange, etc. which provide a good amount of earnings to the local people. The traditional home gardens are also getting changed into plantation of economically valuable trees. Besides these, the traditional diet pattern which include boiled food items, dried fish, dried pork, *pahari aaloo, kosu, dhekia* etc. has also got transformed by the use of salt, oil and other market-based food items. The dependency on easily available market-based food items has decreased the visiting frequency of local people to the hills for collecting necessary food items. The traditional cooking process has also experienced some change. The use of *sunga* (a small part of bamboo) for cooking food items is now replaced by *kerahi* (a cooking pan) which is easily available in the markets. Apart from these, the traditional house building materials such as bamboos, woods, jute ropes, thatches, etc. are now getting replaced by modern materials, such as bricks, sands, cement, tin etc. The thatch-roofed *kutcha* houses have been gradually replaced by tin-roofed *pucca* houses. Besides, changes have also been observed in the traditional fishing gears, musical instruments, kitchen utensils and so on which are now replaced by modern tools and materials.

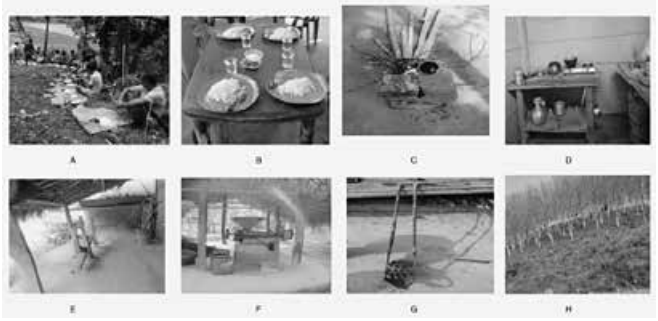

Figure 4: Recent transformation in various aspects of traditional socio-economic life of the villagers Note: A, B - Change in the use of banana leaf due to disposal plates and glasses in the village; C, D- transformation of traditional *chouka* to LPG; E, F- transformation of *dheki*- traditional rice pounder to rice mill machine; G- Joboka- a modern agricultural tool which has replaced traditional bamboo made agricultural tool used to remove weeds from ploughed lands; H- conversion of *jhum* field to commercial rubber plantation

Case-III: Sadiya region (riverine landscape)

The Sadiya region is the easternmost part of the State of Assam with an area of 790 sq. km. It lies between $27^{0}44'$N to $27^{0}57'$N latitudes and $95^{0}28'$E to $95^{0}54'$E longitudes. This region is a part of the Brahmaputra floodplain and is composed of old and new alluvium. The northern part of the area is bordered by the foothill zone of the Arunachal Himalaya, and the other three borders are marked by rivers, such as Balijan river to the east, Dotong or Gango river to the west, and Lohit river to the south. Along with these rivers, other streams like Kundil, Dibang, Jia, Ghurmura, and

Horu Balijan also drain the area creating an ideal riverine landscape. The natural landscape of the area is modified by the different ethnic groups living in the region leading to the formation of beautiful cultural landscapes.

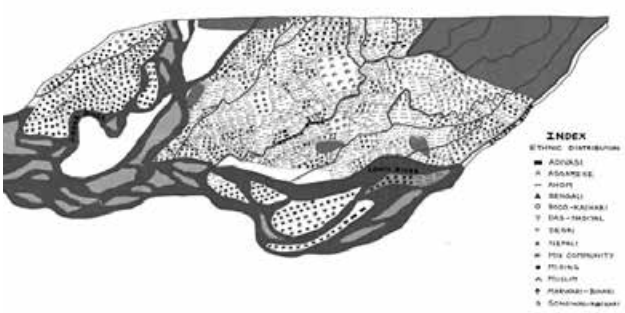

Figure 5: Ethnic distribution of population in Sadiya

The population of Sadiya is a mosaic of heterogenous communities which include Ahoms, Bodos, Kaibarts, Misings, Nepalis, Kacharis, Adivasis, Biharis, and Muslims, etc. These communities are mostly engaged in primary activities like agriculture, fishing, piggery, dairy farming, poultry, etc. From among the communities of Sadiya, the Mising population is taken into consideration for the present study. The Mising people reside in the active floodplains areas of the Dibang river and Dotong river in the Amarpur Gaon Panchayat of Sadiya. They build their houses one to two feet above the ground so that the floodwater doesn't flow into their households. The area was dominated by grasslands and sandbars with only 4 to 5 villages since the 1990s. It was only after the 2000s, when Mising people from Gohpur, Dhemaji, Tezpur, etc. have migrated and settled in the area. The migration took place in search of habitable active floodplain as their previous settlement was washed away by the river water. Economy of households is mainly dependent on piggery that is done on a commercial scale. Rabi crop cultivation is also one of the livelihood options which has been practiced as the soil quality of the area is very much suitable for crops like bag wheat, sesame seeds, black grams, maize, etc. Along with these two prime economic activities, the people are also engaged in dairy farming due to the availability of grasslands and grazing grounds in their habitat. The area is, however, having problems of connectivity as the road condition is not well developed and the commuters need to cross the Dibang river by ferry to visit the Sadiya town area. In the flood season, the areas become unreachable. However, low or moderate intensity flood is considered to be a gift of nature for eco-friendly agriculture and livestock rearing.

Case-IV: Hydrological environment in a mid-valley district- Nagaon

Nagaon district, mostly being a plain in character supports large number of population. The settlements have developed along the banks of the river Kolong, and then gradually radiated out. The houses are of the typical Assamtype in nature. Rice is the staple food of the people. Moreover, meat, eggs and the locally available fishes are common. The area, being mostly composed of alluvial soils with congenial climate, has enabled the farmers to grow a variety of crops e.g., rice

(major rice varieties are winter rice (*salidhan*), autumn rice (*ahu dhan*), summer rice (*boro dhan*), *Bao* rice, jute, mustard, pulses, vegetables, etc. However, most of the autumn rice fields (*ahutolis*) are now converted into built up areas, as a result of which, at present *ahu* rice is also cultivated in some moderately higher elevated winter rice fields (*salitolis*). On the other hand, *Bao* rice (a typical *Sali* rice variety) is cultivated in the lowlying areas. With the growth of population, the number of settlements is increasing, and in the process, the agricultural lands are getting converted into built up areas. Previously, for constructing a house, people usually used to dig a pond in their premises so that the excavated land can be used to pile up the foundation of their houses. With a pond at their premises, the people came up with the idea of integrated rearing of fish and duck. Notably, there has been a distinct decrease in waterscapes in the district as many of the wetlands have been filled up to build settlements and other infrastructures on them. However, the number of artificial ponds (*pukhuris*) has been significantly increasing. Thus, with increase in settlements, the number of *pukhuris* has also increased. Normally, all the fishes are not caught. Smaller ones are left to grow in size. However, in certain years, people catch all of them whenever they foresee the possibility of water level going down below 2.5 feet. Interestingly, there has been a general decrease in the depth of the wetlands due to a variety of factors like siltation, dumping of waste, etc.

Figure 6: Agricultural field (A), Traditional fishing (B)

Case V: The char landscape

The bed of the river Brahmaputra and its major tributaries in Assam are dotted with innumerable large and small sand bars and islands, locally called *char-chapari*. Agriculture and livelihoods of the *char* dwellers are mainly determined by the flood dynamics. Unlike the built-up and foothill plains of the Brahmaputra valley, cropping in the *char-chaporis* in monsoon period is very limited because of excessive flood. The hardworking *charland* farmers have developed a peculiar type of agricultural system, called 'sandbar cropping system'. It is noteworthy that the Brahmaputra valley, as a whole is a mosaic of diverse land use patterns and processes. This can be ascertained from the homestead systems that provide sustenance to the ecosystem people across the communities living in this unique river valley. In order to compensate the loss of agricultural produce in the summer season the *char*-dwellers used to cultivate a large variety of *rabi* crops during the winter season. Therefore, the *char* landscapes of the Valley have at present become the hub of vegetable products.

Figure 7: Agriculture in *charland*

Ⅴ. Conclusion

The study reveals that the same community living in the Brahmaputra valley exhibits different responses to its different landscapes. Contrary to this, the same ecosystem is also shared by different communities. While the northern foothill landscape portrays slope based *dong-bandh* system developed by local efforts and cooperation, communities in char landscape make fit themselves to the concerned micro-environment irrespective of flood dynamics. On one hand, communities adjust with their different traditional housing, food and other cultural patterns according to the nature of physiography; people transform traditional means of living to mechanization on the other. Conflict between human-induced activities and natural forces leads to ecological problems. Amidst the system of the common ownership, especially among the agrarian people and means of production with equity, the natural resources as well as environment as a whole is concentrated in the hands of people by common goal and nature-based belief system. In this aspect, the societies of the Brahmaputra valley are still in a position to offer examples of naturefriendly alternatives to other societies in different socio-spatial contexts.

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Towards an Integration of Sustainability Efforts in the HCD Process

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Ⅰ. Abstract

Today, it is the global challenges that play an important role for economic and political work. Especially sustainability has become a widely recognized topic raising global alliances, which develop frameworks such as the Sustainable Development Goals (SDGs) established by the United Nations. When it comes to production and consumption, they emphasize that more sustainable products and services must be designed. In the field of, mostly digital, product development one well-known approach promoted over the last years is the human-centered design (HCD) process. In this paper, we aimed at bringing together both, sustainability efforts and human-centered product development by integrating a specific SDG and related targets into HCD activities. To illustrate our approach, we used a fictive example to demonstrate what kind of practical implications this integration brings to light. The proposed outline shows that on a theoretical level it is possible to follow a specific target through the HCD process and could therefore be a practical asset to all designers' daily work. Further projects with industrial partners will show the practicability for the daily context and potential needs for adapted as well as new methods and process steps. In addition to practical implementation, we identified several research questions for the field of Sustainable Human-Computer Interaction (SHCI), e.g., concerning the connection between rebound effects and the HCD process.

Ⅱ. Introduction

Our society today consumes significantly more resources than our planet provides. This excessive consumption is already leading to ecological, social, and economic problems, and will continue to do so in the future (Stengel, 2011).

Moreover, effects of climate change that can be observed all over the world, demand new solutions in politics, but also society. The German Federal Ministry of Economic Affairs and Climate Action describes the protection of climate and environment, the changes brought by the digital transformation, demographic change, and the fight against COVID-19 as the major current challenges for Germany and Europe (2021). But these challenges are also seen as an opportunity to develop the economy in a more sustainable way and support individual industries. On a global scale, the United Nations formulated 17 Sustainable Development Goals (SDGs) (United Nations, n.d.). The Blueprint was adopted by all United Nations Member States in 2015.

The adoption of the sustainable development plan by all United Nation Member States highlights the political importance to take the topic of sustainability in account. However, not only politics but companies themselves have to deal with the issue of sustainability. On the one hand, Andrew J.

Hoffman from the University of Michigan claims, that today 90% of Chief Executive Officers (CEOs) say that sustainability is important to their company's profit and success leading them to e.g., adapting their linear business models to circular ones and by that, saving raw materials (2018).

On the other hand, Hernandez-Pardo et al. (2013) found a barrier of knowledge in small and medium-sized enterprises (SMEs). There is a lack of knowledge and awareness what kinds of implications might arise for the company when transforming their actions towards sustainability. The latter mean requirements for necessary technological invest but also positive effects after managing the change towards sustainability. Still, Shuaib et al. (2014) state that the improvement of product sustainability has become a global trend. They perceive the trend as a result of rapidly depleting global resources, continuing climate change and increasing environmental pollution, and the associated growth in customer awareness. Jawahir & Bradley (2016) explain that traditional design and manufacturing was until now based on a range of product characteristics, such as functionality, performance, cost, time-to-market, etc. The suggestion is that today's product designers should integrate not only economical components, but also numerous environmental and societal aspects in their solutions. Thus, to realize sustainable product development, it is therefore essential to integrate sustainability aspects intoproduct development activities.

For product development, Human-Centered Design (HCD) is an established approach that allows designers to focus on users' needs, the context of use and relevant stakeholders rather than the question what kind of technology can be used to realize a product or system. One of the most important advantages of following the HCD process is a high user satisfaction due to a good usability and user experience (UX) of a system (ISO, 2019). This allows companies to develop useable, useful as well as accepted products. In practice, there is still an ambiguity: Most interviewed experts (73 %) state in the annual UX Trend Report 2021 that UX is very important for the business success even though 51 % of those experts see the potential of UX exploited little (Youspi Consulting, 2020). This report suggests that, at this point, organizations still must find ways to integrate user satisfaction and a good UX more. This could be achieved by integrating a step-by-step approach like HCD in their strategic vision and practical work processes.

The paper is structured as follows: we will first introduce the concepts of HCD, SDGs and SHCI in more detail, which will be followed by presenting our approach to extend and adapt the HCD process by integrating SDGs and corresponding targets. After a methodological and content-related discussion we will close with a short conclusion.

Ⅲ. Related work

Human-centered design (HCD)

According to the international standard ISO 9241-210 (2019) HCD is an "approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques" (2019, p. 8).

In contrast to classical product and system design, in which the limitations of existing technologies drove design decisions, HCD (former: User-centered design) introduced a changed perspective:

The user, the context of use as well as the users' needs became crucial to design decisions.
There are multiple benefits for product and system development when following HCD activities, the ISO 9241-210 even states that HCD "has substantial economic and social benefits for users, employers and suppliers" (2019, p.10). First, the process improves the effective and efficient use of systems as well as the users' satisfaction with the product or system (ISO, 2019). Moreover, user acceptance of systems and products can be increased and costs of reworking the released product can be reduced (Bias & Mayhew, 2005). Another advantage is that core elements of HCD help companies to financially succeed as a study by McKinsey and Company in collaboration with Deloitte examined (Sheppard et al., 2018). In this study, 300 companies were analyzed over five years to investigate what economic value design measures have. Results show that investing in four key areas led companies to be more successful: UX, cross-functional responsibility, iteration and analytical leadership. In ISO 9241-210 (2019) the first three key areas are described as core elements of HCD.

Ⅰ Human Focus: HCD focuses on the behavior of humans in specific context situations and by getting to know them, designing useful and usable products and systems. But not only end users are the center of attention, it is the consideration of various stakeholders directly or indirectly affected by the use of the product or system and their needs that ensure the realization and acceptance of design solutions. This will lead to an overall good UX.

Ⅱ Interdisciplinarity: HCD integrates interdisciplinary teams in the design process and therefore brings together different perspectives developing a working and yet human-centered solution. A team across different disciplines helps to react to fast changing situations as stated in a report about accelerating innovation in companies: "If you think about how fast technology is changing and how fast customer expectations are changing, to deliver what the customers are looking for, you have to organize as cross-functional teams," (Kane et al., 2019, p. 10). This holistic view allows organizations to mature providing solutions that meet human needs.

Ⅲ Iteration: Fast changing markets, technologies and users' expectations require an iterative approach. This means insights from users and stakeholders have to be gathered and integrated in the development process as early as possible to avoid foreseeable mistakes.
The HCD process is described in four phases representing different kind of HCD activities (see Figure 1).

1. Understand and specify the context of use
2. Specify the user requirements
3. Produce design solutions
4. Evaluate the design

After planning the human-centered activities, the HCD process usually starts with the activity of understanding and specifying the context of use, in which the product or systems will be or is already being used. Building on this, user needs are identified to be used to specify user

requirements. Those describe capabilities or prerequisites that the product or system must fulfil or possess. With the help of the user requirements, further prototypical design solutions can be designed and implemented. In the fourth step, the design solution is evaluated by the user. The results of the user feedback form the foundation for the next iteration. The process ends when the designed solution meets the requirements and further iteration would not advance the product quality significantly such that the cost/benefit ratio is no longer given.

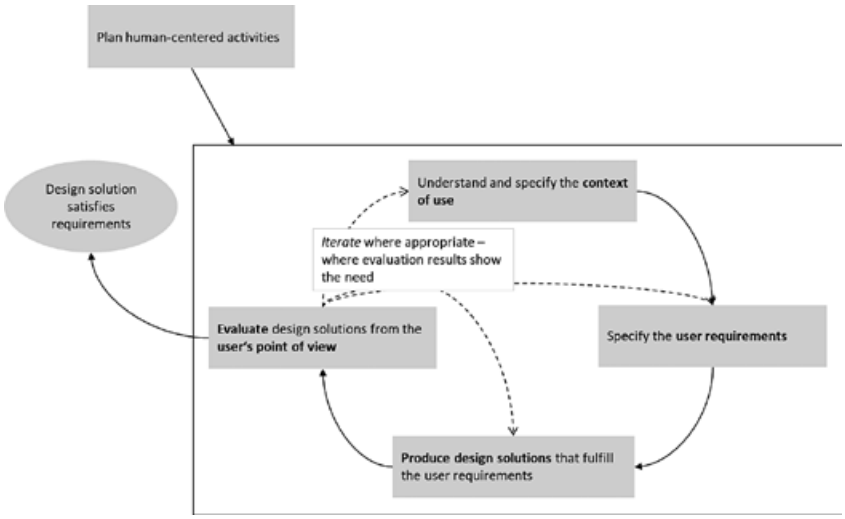

Figure 1: Human-Centered Design activities. Adapted from ISO 9241-210 (ISO, 2019, p. 18).

Sustainability Development Goals (SDGs)

The 17 SDGs (see Figure 2) are part of a blueprint to ensure peace and prosperity for people and the planet today and in the future (United Nations, n.d.) . They can be structured based on the three pillars "sustainability", "environmental" as well as "social and economic".

Figure 2. The 17 Sustainable Development Goals by the UN (United Nations, n.d.).

The development of the SDGs has a long history. Starting with the Earth Summit in Rio de Janeiro, Brazil, where more than 178 countries adopted a plan of action to build a global partnership for

sustainable development with the goal to improve human lives and protect the environment. The plans and goals were further developed and adapted. In the Year 2015, the General Assembly established the 2030 Agenda for Sustainable Development (United Nations, 2015) with 17 SDGs at its core (United Nations, n.d.).

The 17 goals have 169 sub-goals, the so-called targets. They include various aspects that have an impact on sustainable development. Amongst others these include the fight against poverty and hunger, the creation of more justice, sustainable consumption and production, sustainable cities and the preservation or restoration of the environment.

Sustainability Human-Computer-Interaction (SHCI)

Sustainable Human-Computer Interaction (SHCI) is a relatively new research field within Human-Computer Interaction (HCI). Hansson et al. (2021) describe the paper of Eli Blevis (2007) concerning Sustainable Interaction Design as a starting point for sustainability research within HCI. The term SHCI was established by Di Salvo et al. (2010). Hansson et al. (2021) consider the design and evaluation of eco-feedback technologies (Froehlich et al., 2010), emerging energy systems and trends in HCI (Pierce & Paulos, 2012) and how persuasive technologies can lead to unsustainable behavior (Knowles et al., 2014) as core topics of SHCI.

Moreover, Hansson et al. (2021) argue for the use of the SDGs as a framework because of their strong influence on policy development at the national, but also at the global level. In addition, the SDGs are relevant as guiding goals for work in the SHCI field because they cover multiple areas that influence sustainable development. To identify blind spots, they therefore analyzed the focus of SHCI by mapping the papers that have emerged in the SHCI field in the last decade to the SDGs. When mapping the SDGs on 51 papers from the field of SHCI (2010-2019) Hansson et al. (2021) found that 42 paper could be mapped on SDG 12 “Responsible Consumption and Production”. Five other SDGs that papers could be mapped on, where SDG 2 “Zero Hunger”, SDG 7 “Affordable and Clean Energy”, SDG 9 “Industry, Innovation and Infrastructure”, SDG 11 “Sustainable Cities and Communities” and SDG 13 “Climate Action”. One paper that was assigned to target 12.2 "By 2030, achieve the sustainable management and efficient use of natural resources" deals with shifting energy consumption to times when it is sustainably favorable. Jensen et al. (2018) conducted an experiment with four families over one month. The families could only use their washing machines, while regenerative energy was available. According time slots were presented on an additional box designed by the authors. If there was no regenerative energy available at a specific time families still could wash by pushing an override button. This project is an example for a humancentered evaluation of a design that helps achieve target 12.2 by creating awareness of regenerative energy consumption. For 11 of the 17 SDGs Hansson et al. (2021) could not find corresponding papers. We assume that the SDGs that will be integrated most into the HCD process in industrial projects are the ones that were mapped to SHCI papers. For some SDGs, the focus on humans is more obvious than for others. For example, SDG 14 "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" is further away from the usual implementations of the HCD process in product development than SDG 12 "Responsible

Consumption and Production."

The attempt to integrate SDGs in the process of HCD contributes concretely to the steps that Silberman et al. (2014) identify as next steps for SHCI researchers to promote sustainability. They state in one step the ambition to "specify and operationalize sustainability goals in [SHCI] work and articulate approaches to evaluating [SHCI] work in view of those goals" (p.68). Another step claims to "address the full diversity of sustainability issues" (Silberman et al., 2014, p. 68). The SDGs capture a very broad range of all the issues that contribute to sustainable development, which is why we chose them to be focused on in this paper.

Ⅳ. Outline of the HCD process extended by SDGs

In the following, we look at each of the four phases of the HCD process and identify adjustments or additional process steps to strategically change the perspective towards a sustainability-sensitive and yet human-centered process.

As mentioned before, SDGs are one global way of tackling sustainability efforts. In the HCI discipline, most papers were assigned to SDG 12 "Responsible Consumption and Production" (Hansson et al., 2021). 12 of the before-mentioned 42 papers were mapped to the particular target 12.5 "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse". To foster and evaluate our approach, we will follow target 12.5 to make it easier to measure all design decisions towards this target.

As guiding example illustrating our proposed SHCI design approach, we present the development of a specific, but fictive product idea for an online shop for products. The aim is to target waste reduction through prevention, reduction, recycling, and reuse. We chose this example because digitization in particular demands a high level of metallic raw materials. Initiatives like "AK Rohstoffe" (work group raw materials), that are publicly funded, claim that mining of these raw materials is questionable in the context of human rights violations and environmental destruction (AK Rohstoffe, n.d.). A change to more sustainable products, especially in this area, makes sense.

> *The process steps for the online shop will be shown in a different text style to help follow the adapted HCD process and corresponding implications.*

Planning phase

Before entering the HCD process, human-centered activities must be planned. This means, defining who is responsible, what kind of methods should be used and what kind of procedures must be developed to ensure communication (feedback, dependencies with other departments or processes) and good time management. Here, overall goals and milestones have to be addressed as well, in this paper including relevant SDGs.

> *Target 12.5 addresses specific opportunities when developing or reworking the concept of an online shop. Preventing, reducing, recycling, and reusing resources to in general reduce waste, likely will be a challenge that most online shops are facing in the future.*

Phase 1

In the first phase, the goal is to thoroughly understand and then specify the context in which potential users would use the system or product including the organizational, technical and physical environment (ISO, 2019). Characteristics of user groups or users are captured, which "can include knowledge, skill, experience, education, training, physical attributes, habits, preferences and capabilities" (ISO, 2019, p. 19). One common method to get to know relevant characteristics is to interview the potential user groups with qualitative interviews. For the goal of integrating SDG 12, we here see the opportunity to understand underlying assumptions and behavior of the users regarding the reduction of waste. Rather than only focusing on tasks and needs directly linked to the usage of the product, an interview guideline should involve questions towards understanding "needs, problems and constraints" (ISO, 2019, p. 19) when reducing waste. Like that, important insights to achieve the SDG can be considered when going to the next phase.

Questions usually belong to specific topics like "background", "context of use" or "the use of product". Typical questions in qualitative interviews to understand the context of use and typical behavior of the user groups are e.g., "What is a description of a typical day/week/month at your job?" or "What are the major tasks that you need to complete successfully to accomplish your goals?" (Wilson, 2013). In consequence one specific topic could be "sustainability behavior" aiming at collecting answers regarding situations that influence sustainable behavior.

> *In our scenario, understanding user habits towards an online shop, an example would be that interviewees could be asked about their needs upon other questions regarding the context of use when using an online shop. The user group might first state that they want to shop products easily and intuitively. Regarding the shipment delivery users could be asked "How do you feel about the packaging of your ordered shipment?". From this we could derive problems, constraints and needs about packaging from the answers.*
>
> *An experienced problem could be that users are annoyed by the cardboard coming with each order, especially if the order had been split into several parts due to faster shipment. Interviewees then might state that they are willing to wait one or two days longer for the shipment to have less cardboard waste at home. This would contribute to reducing waste.*

In summary, in this phase we identified the needs of the users in relation to the target 12.5 by e.g., involving questions about the users' sustainable behavior.

Phase 2

The second phase aims at concretizing the relevance of insights from the first phase by specifying user requirements and also identifying other stakeholders and their needs. While we might have understood the users' assumptions and behavior regarding the SDG 12.5 in the first phase, it is necessary to involve relevant stakeholders and understand their needs as well. Here, these could be sustainability experts, who have a particular view on sustainability matters within the organization, such as the relationship between production and resource consumption. In consequence, further requirements can be derived by looking at both, user and stakeholder needs, making sure to foster a holistic approach of interests. In a practical context this might lead

to conflicts between user and stakeholder requirements that have to be resolved trading them off against each other (ISO, 2019). We believe that a strong standing of involved stakeholders advocating sustainability and relevant SDGs is key to reach the most possible fulfillment of those goals.

For the development of the online shop this could mean that, by involving a sustainability expert as a relevant stakeholder, other requirements will be prioritized. For example, by interviewing the sustainability expert about corresponding sustainability goals of the company's strategy, insights could then be translated into requirements that contribute to fulfill SDG 12. The experts could state for example that reducing boxes when shipping products would help to first save costs on packaging and second help reducing resources. This could lead to a requirement "users must be able to choose to have all goods sent in one box for their order".

In summary, in this phase we are contributing to target 12.5 by generating requirements based on the insights on the user needs and the needs of the sustainability expert towards SDG 12.

Phase 3

After the second phase the defined requirements will be transferred into concrete design solutions. The third phase "Producing design solutions" has a significant influence on how the subsequent system or product will contribute to SDG 12.5. In concrete terms this means how many boxes, and thus packaging waste, can be saved in our product example. This influence is based on the design decisions made in this phase, which in turn influence the UX and thus the extent to which certain actions contributing to SDG 12.5 are attractive to the user. The principles for design (from ISO 9241-110 (2020)) assist in designing the interactive system to ensure satisfaction, effectiveness, and efficiency of the user in completing their tasks.

The development of the designs is based on the requirements developed in the second phase and within an iteration also on the evaluation findings in the fourth phase. If the defined requirements and the elaborated findings focus on the fulfilment of SDG 12.5, the developed designs will then also contribute to fulfilling it. E.g., a requirement is defined as "users must be able to choose to have all goods sent in one box for their order" - then a design solution could be to send goods in just one box by default rather than letting users decide actively to do so. In consequence, the automatic selection of the option increases the probability that several goods are ordered in only one box.

In addition to developing and refining the design solutions, communicating them is an important part of the phase. By involving both, those responsible for the implementation of the designs and the sustainability expert in the communication of the design solutions, the likelihood that the designs will be accepted and topics around the set sustainability goal will be discussed is increased. In summary, in this phase we are contributing to target 12.5 by creating design solutions that are based on the user requirements and evaluation findings connected to SDG 12.

Phase 4

The fourth phase is about the evaluation of the design. The goal is to provide feedback about

the strengths and weaknesses of the design solution from the users' perspective. The feedback is provided iteratively through userbased testing and inspection-based evaluation. With user tests, specific tasks and interview questions can be integrated into a usability test to support SDG 12.5.

> *The goal would be, for example, to understand the user's perception of sent goods in fewer boxes in contrast to the risk of waiting longer by asking e.g., "What do you think of this default option?".*

The overall aim is to find out what prevents the user from achieving their goals effectively, efficiently, and satisfactorily. The results are used for further development of the designs. One possibility of inspection-based evaluation is to validate whether specific requirements have been fulfilled. In this step, a usability expert checks, among others, all requirements related to the target 12.5. The design change based on these evaluations can lead to a better fulfilling of the goal. Also, in addition to the usability expert, the sustainability expert could carry out an inspection of the design solution. The aim here is to identify strengths and weaknesses of the design solution and potential risks for rebound effects. The findings are then used to improve the design.

In summary, we are contributing to the target 12.5 by generating findings in relation to SDG 12 based on including related tasks and questions in user tests. In addition, the findings based on inspections of whether the user requirements connected to target 12.5 have been met, contribute to the fulfilment of SDG 12. Moreover, findings based on inspections by the sustainability expert to exclude rebound effects and thus pay towards the target 12.5 in the long term.

Ⅴ. Discussion

As HCD is a well-known process for product development and the issue of sustainability is getting more present in all terms we aim at overcoming barriers to integrate sustainability in product development. SDGs are an accepted framework that is relevant on the one hand because of its strong influence on policy development, and on the other hand because it covers many issues that influence sustainable development. We developed an extended approach of HCD by integrating SDGs in corresponding HCD activities. We highlighted that certain SDGs are more likely to be integrated into projects than others, which are more distant from HCD use cases. We described that it is theoretically possible to contribute to fulfil a specific target of an SDG within every phase of the HCD process and emphasized the practical consequences with an example of a fictive online shop. This integration is also of great importance as both, the core elements of HCD and the issue of sustainability are receiving more and more attention in companies.

When it comes to the practicability of HCD, findings from a research report by MIT Sloan management review in collaboration with Deloitte Insights show that 47% of interviewed organizations are currently using crossfunctional teams (core-element of HCD: interdisciplinary teams). The report explains that teams across disciplines "are an integral part of the innovation efforts of digitally maturing organizations" (Kane et al., 2019, p. 16). Companies therefore must invest in structures that support and foster interdisciplinary work when aiming at being innovative and digitally mature.

This also is the case for working in iterations. The report from one year earlier states experiments

and iterations are essential emphasizing the importance of working in short but many cycles rather than in a traditional waterfall process. Organizations according to the report have to "(1) encourage new ideas to be shared and tested at all levels of the organization; (2) encourage feedback and iteration to learn how to work in new ways; and (3) share feedback of failed experiments to increase organizational learning" (Kane et al., 2018, p. 10) which makes the HCD process a suitable approach to meet those requirements. In addition to the attention companies are paying to human-centered approaches, the development of sustainable products has grown into a global trend. (Shuaib et al., 2014) The reasons for this growth include customer awareness of sustainability issues. Although the integration of SDGs in the HCD process is generally possible and helps exploiting potentials like described, some limitations must be considered.

First, the HCD process is standardized by the ISO 9241-210 (2019). which on the one hand helps the international community to have a common understanding of how to develop products and systems successfully in a humancentered way. On the other hand, organizations experience challenges when they integrate standardized processes in their daily business. Challenges are e.g., a lack of method competence; cultural change, which is necessary to be open to a human-centered mindset, and distributed teams due to e.g., IT departments working from other countries, which might not be involved that easily in development processes (Almughram & Alyahya, 2017). It is therefore necessary to have a closer look at implications in practice when integrating HCD and sustainability efforts. A company, for example, could already use established design methods which are not compatible with the approach described in this paper. Insights like this would have to be considered when reworking the approach for practical use, which could even include finding new methods or process steps.

The integration of the SDGs in the HCD process is only valid if it is done from the first stage of the process on. If companies only partially implement the phases of the HCD, or start with an advanced phase, the goals cannot be fully integrated. For example, the context of use related to the target must be taken into account. This allows the requirements to be defined accordingly and the designs to be developed based on them.

There is a risk of rebound effects since behavioral change of people cannot be predicted. A rebound effect is an unintended negative impact due to increased efficiency (Sorrell, 2010). Let's assume that in our scenario the user has rarely ordered new products because he shies away from having boxes lying around at home. As now several products are shipped in one box only, he might buy more products at once. This would then be a rebound effect leading to more consumption and therefore waste, which originally was intended to be reduced. This rises followup questions on how rebound effects could be considered in the design process and therefore HCD. Also, it is an interesting question whether the HCD process reduces the probability of rebound effects through the specific study of human behavior.

Further, it is not possible to do justice to the complexity of sustainability, or even a single target. To develop products in a sustainable manner, the entire product life cycle should be analyzed (Shuaib et al., 2014). Consider for example the target "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse" of our scenario. Even if we focus

on the online shop and leave out the production of the products sold, based on this target all the waste associated with the online shop still has to be considered. For example, in connection with the servers on which the data is stored, but also the waste generated in the product warehouses from which products are shipped. Further, a question is if and how the HCD process could be extended with e.g., evaluation methods from the sustainability debate, such as life cycle assessment (Shuaib et al., 2014) to ensure a holistic integration, also in practice.

Ⅵ. Conclusion and next steps

In this paper, we introduced an approach to combine sustainability efforts and human-centered product development by integrating SDGs in the HCD process. By that, we aim at offering a practical, sustainabilitysensitive framework for designers when developing human-centered products, systems, or services. We identified several research questions for the field of SHCI, e.g., concerning the connection between rebound effects and the HCD process. Further, cooperation with companies from different industries will show barriers that make it difficult to integrate the described process. For the examination of those barriers, it will be essential to look at both, the integration on a process level as well as in daily business. In consequence, insights will help us to further develop the process and the methodology. Eventually, we will examine if our proposed process helps designers to design in both a human-centered and sustainability-sensitive way, in this case, by reaching a SDG target.

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Challenges and concepts for the design and evaluation of usable and satisfying Voice Interfaces according to DIN EN ISO 9241-11 and -110

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Ⅰ. Abstract

From an economic perspective, Artificial Intelligence Systems are built to increase efficiency, productivity and reliability. Assistance systems like voice assistants (VAs) are one example of this kind of interactive technology; yet based on the Intelligence Augmentation approach, they ought to primarily support the users' capabilities and allow them to act with self-determination. Nevertheless, those systems are usually perceived as a black box. Thus, on the one hand, VAs can be seen simply as a tool for fulfilling a task, although on the other hand, the conversational interaction raises expectations and needs for humanlike interactions. According to the international norm ISO 9241-11, a usable system is one that can be used to achieve specified goals with effectiveness, efficiency and satisfaction. We use this definition of usability to delineate a framework for the design and evaluation of VAs. We posit that certain human values like trust and well-being are crucial for a satisfying user experience with VAs. Specifically, the system ought to prevent frustration of psychological human needs in order to ensure the users' self-determination – for practicing design and evaluation of VAs in a wholesome manner. Our aim is to provide guidelines that move the development of VAs towards enhanced usability and human centeredness. Considering each usability component, we discuss how to fulfill context-based user needs and requirements in order to ensure effectiveness of the VA interaction. To address the efficiency and satisfaction components, we develop evaluation guidelines for VAs based on the interaction principles according to ISO 9241-110 and current literature.

Ⅱ. Introduction

Voice interfaces like Alexa, Siri or Google Assistant are constant companions in the daily lives of many people. In 2019, 146.9 million smart-speaker devices were already sold worldwide (Watkins, 2020). Alexa, Siri and Google Assistant support their users in various tasks, like controlling smart-home devices, entertainment, creating lists or sharing reminders. Users appreciate the many benefits, such as easy setup and use as well as roomtranscending voice control (Pins et al., 2020). Nevertheless, users also mention concerns, as the interaction is often prone to error, leading to a limited use for simple tasks and disappointed high initial expectations at humanlike and intelligent interaction (Cho et al., 2019; Luger & Sellen, 2016; Pins et al., 2020). Furthermore, media reports about data use by companies and possible eavesdropping raise concerns and worries among users (Carr et al., 2019; Gray, 2016; Tabassum et al., 2019) and reduce acceptance among potential new users (Oberhofer et al., 2019). Further concerns refer to the loss of autonomy when using Artificial

Intelligence (AI) systems, as users fear to be negatively influenced or even manipulated by AI and automated decisions (Sankaran & Markopoulos, 2021). The lack of explainability and the accompanying skepticism and limited or even negative user experience (UX) give the impression of a black box (Hind, 2019). For example, due to so-called "always-listening" devices, user feel unsure about when recording is taking place by a VA (Lau et al., 2018).

Thus, users need to put a considerable amount of trust into the interaction and use of VAs. In line with Fischer (2020) who describes the field of tension between *Artificial Intelligence* (AI) and *Intelligence Augmentation* (IA), we aim to support the users' capabilities to allow them to continue to act with self-determination instead of the system replacing the user. Another aspect of our concept is *usability* as it is laid out in ISO 9241-11 (ISO, 2018) by the International Organization for Standardization (ISO). Accordingly, usability is defined as "the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO, 2018, p. 6). With all the above, we put the user – or rather the *human* – into the center of designing interactive products and systems. In this way, we are developing a conceptual model as a framework for the design and evaluation of VAs with a focus on the third usability component satisfaction and with the aim to ensure trust and well-being for the users. At the center of our approach is the notion that basic deficiencies and well-being detriments ought to be prevented first (or at least, likewise) – before designing for fun, excitement or personal growth (i.e., positive UX).

Ⅲ. State of the Art

a. Standards for Human-Centred Design

Our concept is, in a wider sense, based on human-centred design (HCD), which is defined in the standard, ISO 9241-210, as an " . . . approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques" (ISO, 2019, p. 3). The concept of *human-centred quality* captures the intended *outcomes* of use/interaction, which are, besides usability, *accessibility* (not directly considered in this paper), *UX* and *avoidance of harm from use*. In line with the fact that all four aspects are interrelated, and that usability reduces harm and risk, we focus on the concept of usability and especially the definition and implications of satisfaction. Usability includes three components *effectiveness, efficiency* and *satisfaction*, the complete consideration of which results in a usable system, product or service. The three components as intended outcomes of use are conceptually built upon each other (although a system can possibly achieve a higher outcome sufficiently but lack a lower one), with the typical procedure of inspection starting with the effectiveness component. Effectiveness can be verified by checking for completeness and accuracy in task completion when using the system. Second, to validate efficiency, the focus is on the effort and resources used in relation to the results achieved. Finally, and closely related to the UX of a system, usability includes satisfaction as a third component to ensure user satisfaction during use.

There has been a lack of agreement on what satisfaction as the third pillar of usability or the experience of user satisfaction really constitutes (Hornbæk, 2006): There is the attempt with the latest version of the norm, ISO 9241-11, to make the concept of satisfaction both less ambiguous and broader by stating that satisfaction is the "extent to which the user's physical, cognitive, and emotional responses that result from the use of a system, product or service meet the user's needs and expectations" (ISO, 2018, p. 9). Thus, whereas efficiency is rather objective, satisfaction takes a subjective perspective, which is why the third usability component is typically measured with self-assessment questionnaires. Satisfaction is obviously closely linked to the concept of UX as the "user's perceptions and responses that result from the use and/or anticipated use of a system, product or service" (ISO, 2019, p. 8).

ISO 9241-110 (ISO, 2020), another norm of relevance, comprises the interaction principles. Those seven principles can be described as requirements or design recommendations and further, can guide the development and evaluation of user interfaces, leading to improved usability (ISO, 2020). Whereas the majority of the interaction principles arguably addresses the first two usability components, the principle of *user engagement*, added in the latest version, mainly contributes to satisfaction – by means of motivating the user, enhancing trust and establishing user involvement (ISO, 2020). As personalized and automated decision-making of AI systems as well as the impression of a human-like interaction make VAs appear intelligent, the interaction principle, *user engagement*, is of particular importance in our approach. Having outlined the basic concepts of human-centered design and usability, we now turn towards recent work about the usability evaluation of VAs and conversational user interfaces (CUIs) in general and, in a further step, towards the conceptualization of trust and selfdetermination, which are integral to our approach to usability and satisfaction.

b. Recent work about the evaluation of Usability and UX of conversational user interfaces

There are already different approaches to investigate the use and appropriation of CUIs that focus on the usability and UX (Langevin et al., 2021; Pyae & Joelsson, 2017). Pyae and Joelsson (2017) conducted an online survey with people who already used a VA and concluded that in general VAs are convenient and easy to use. Nevertheless, there also occur difficulties regarding understanding (on the side of the VA). This is supported by other studies that also point out that expectations regarding capabilities often remain unmet (Beschnitt, 2017; Luger & Sellen, 2016; Pins et al., 2020; Sciuto et al., 2018). Pyae and Joelsson (2017) used quantitative questionnaires (SUS and UEQ) to rate usability, UX and usefulness of the devices. By adding open questions, participants were also allowed to comment on their usability issues. The other highlighted studies used qualitative methods like semi-structured interviews (Luger & Sellen, 2016; Pins et al., 2020; Sciuto et al., 2018) or observation (Beschnitt, 2017).

Other research focused more on the development of evaluation and design methods for VAs. Langevin et al. (2021), for example, propose a set of heuristics for conversational agents

(CAs), adapted from *Nielsen's usability heuristics* (Nielsen, 1994), and validated them on two kinds of CA (chatbot and VA). In comparison to the Nielsen heuristics, the adapted heuristics *context preservation* and *trustworthiness* can be used to identify more usability issues because they specifically address dialogue content, interaction design, help and guidance, human-like characteristics and data privacy. In a similar way, Sugisaki & Bleiker (2020) adapted the Nielsen heuristics using a linguistic approach in order to make the interaction more natural and usable. For this, they developed for each heuristic several checkpoints that should be considered in order to support design, development and evaluation of CUIs. Murad et al. (2018) synthesized established guidelines for graphical interfaces into 10 guidelines and examined how speech human-computer interaction (HCI) literature reflects on them. By doing so, they agree with previous findings that most issues refer to the cognitive load required, the need to have control and dealing with errors. In line with Langevin et al.'s (2021) adapted heuristics (*trustworthiness* and *context preservation*), the authors proposed two more guidelines: *ensure transparency/privacy* and considering how *context affects speech interaction* (Murad et al., 2018).

c. From trust to trustworthy AI

Trust represents an important component when it comes to interaction, both among humans and between human and technology, and plays a role in the adapted/added guidelines mentioned above. From a sociological and systems-theoretical perspective, trust is defined as a function, condition or tactic that allows higher risks to be taken by reducing the complexity of a (social) system (Luhmann, 2018). By doing so, ambiguity and unpredictability can be reduced and transformed into expectable behavior and reliance, suitable for everyday use. Trust can further be understood as a fundamental need to maintain and continue collaboration between the involved parties or actors (Endreß, 2002).

Transferred to HCI, trust is needed to ensure acceptance and use of technologies (Constantine, 2006). When thinking of the *Internet of the Things* (IoT) and AI in this context, concerns about privacy, data collection and use can limit the formation of trust (Chung et al., 2017; Worthy et al., 2016). Especially in private contexts like the home, trust is important, as people want or need to know and understand what the devices and sensors are collecting, sharing and processing (Castelli et al., 2017; Pins et al., 2021; Tolmie et al., 2016). Therefore, the field of *usable privacy* (Adams & Sasse, 1999) aims to enable consumers to be more aware of their personal data disclosure and to provide usable controls for privacy management (Adams & Sasse, 1999; Cranor, 2008; Whitten & Tygar, 1999). This includes both usable tools for accessing and managing personal data as well as support in understanding how and for what purposes the data are processed (Garfinkel & Lipford, 2014; Van Kleek et al., 2017).

However, building or ensuring trust is not only about transparency. For that reason, the EU put forward the implementation of a framework on how to achieve *trustworthy AI* by offering ethical guidance to AI (Smuha, 2019). Accordingly, in addition to transparency, which is reflected in the *explicability* principle, the guidelines prescribe three further principles: *respect for human*

autonomy, prevention of harm and *fairness* as so-called *ethical imperatives in the context of AI*. Following from this, seven more concrete requirements that should be considered with regard to AI systems were derived (Smuha, 2019). Other research in HCI also moves towards trustworthy AI and proposes guidelines for design and implementation by investigating user needs, (Constantine, 2006; Cowan et al., 2017; Felzmann et al., 2019; Fischer, 2020; Shneiderman, 2020). Constantine (2006), for example, concluded that "[p]eople can find it disconcerting to have their every need or intention anticipated through behind-the-scenes manipulation" (p. 28). Cowan et al. (2017) conducted a study with infrequent users of Apple's Siri and concluded that trust can be decreased by consistency and reliability issues that occur when executing a task, especially when it is about sensitive or interpersonal data. Further, concerns of infrequent users are higher regarding the collection and use of data or how companies might exploit them (Cowan et al., 2017). From another perspective, Elkins and Derrick (2013) investigated the extent to which trust can be measured based on the user's voice by looking at pitch and duration of response (Elkins & Derrick, 2013). The considerations regarding the adaption of the Nielsen heuristics highlight the importance of trust in design. Besides, the evaluation of VAs and current research towards a trustworthy AI underpin the relevance of autonomy, transparency and privacy/security for ensuring satisfaction from a perspective of trust that can be mapped very well on the interaction principles (see Chapter IV).

d. Self-determination Theory in the Context of HCI

A basis for thinking about well-being in the context of socio-technical systems provides *Self-Determination Theory* (SDT, Ryan & Deci, 2017). As a macro theory of human motivation, it includes a number of mini theories, one of which is Basic Psychological Needs Theory (BPNT, Ryan & Deci, 2017). It posits that there are three such needs that are considered nutrients for long-term psychological flourishing and personal growth. *Autonomy* refers to volitional and self-endorsed behavior, *competence* to effectively interacting with and influencing one's environment and *relatedness* to the closeness to and the care by others. According to SDT, (social) environments can either be need-supportive, need-depriving (i.e., neutral), or need-thwarting (Vansteenkiste & Ryan, 2013). On the experiential level, psychological need satisfaction and psychological need frustration are to be considered as two separate, opposite constructs (Bartholomew et al., 2011).Whereas need satisfaction provides personal wellbeing, meaning and growth, need-thwarting environments and the associated experience of need frustration have been linked to various negative outcomes, such as stress, anxiety, depression, reduced self-control as well as defiant and immoral behavior (Campbell et al., 2017; Ng et al., 2012; Vansteenkiste & Ryan, 2013; Weinstein & Ryan, 2011).

There are several established UX approaches that focus on the satisfaction of psychological needs through design (e.g., Hassenzahl et al., 2010). The *Positive Computing* approach with its *Motivation, Engagement and Thriving in User Experience* (METUX, Peters et al., 2018). There are several established UX approaches that focus on the satisfaction of psychological needs through design (e.g., Hassenzahl et al., 2010). The *Positive Computing* approach with its *Motivation, Engagement and*

Thriving in User Experience (METUX, Peters et al., 2018) model, however, is specifically centered on the three needs from SDT (Ryan & Deci, 2017), as they constitute universally valid and basal links between an individual's (technical) environment and their (user) experience – without devaluing other possible human needs like stimulation or identification (Hassenzahl et al., 2010). The METUX model describes how to induce satisfaction of autonomy, competence, and relatedness via the design of interactive technology in various aspects of the UX, including the interface or the task that is supported (Peters et al., 2018).

The direct application of BPNT to voice assistants is a rather recent development. For example, de Vreede et al. (2021), investigated in an experimental study how support of the three basic psychological needs by a chatbot is linked to various outcomes of using the chatbot. They found that all three needs contribute to user satisfaction, which was in turn related to user engagement. Yang and Aurisicchio (2021) investigated SDT's basic psychological needs in relation to CAs in an interview study. Their results show that autonomy depends on conversation flexibility and control, personalized experiences and users' control over their personal data. Competence is related to utilizing the full functionality of the CA and being effective in the communication with it. Relatedness satisfaction was shown to be enhanced by the CA's enabling communication between individuals and with social groups as well as by facilitating social activities. Based on those results, the authors derived ten design guidelines for CAs, four of which pertain to autonomy support (e.g., *Provide users with options to customize the commands and responses*) and six pertaining to competence support (e.g., *Present responses in a concise and informative way. Make it easy for the user to retrieve information*) . In this way, adherence to those guidelines is likely to provide autonomy support and structure to the conversation. Relatedness was excluded, as it arguably depends on particular features of the system and such features are often not expected. However, the authors do include the guideline, *Talk politely. Encourage polite and socially appropriate conversation style* (Yang & Aurisicchio, 2021), which, to our understanding, could potentially induce warmth during the VA conversation. Many aspects of autonomy and competence support are also reflected in classical usability guidelines like Nielsen's ten usability heuristics (Nielsen, 1994) or, in fact, in the interaction principles from ISO 9241-110 (ISO, 2020) as we discuss further below.

Ⅳ. Towards a usability framework for trust and well-being for VAs

a. Taking user satisfaction into focus in the design of usable VAs

As stated in ISO 9241-11, satisfaction as the third component of usability is the user's particular response that happens when the user's expectations and needs are met. According to our conceptualization, the resulting UX is neither very positive nor negative. As laid out by Hassenzahl (2003), *hedonic* (as a form of positive) UX is mainly the result of the *un*expected and the fulfillment of psychological needs. On the contrary, when expectations and needs fail to be fulfilled, the UX is likely to be negative, entailing negative emotions and negative subjective evaluations. This dichotomy is depicted in Figure 1, where on the left side of the spectrum, there

are negative personal experiences and consequences, which can be called "harm" or "risk" to the user, in line with the definition of *human-centred quality* (ISO, 2019). Although one could argue about the appropriateness of basing satisfaction partially on expectations – what if a distrustful user in fact expects negative consequences? –, we hypothesize that in general users who *trust* the system expect not to be harmed or put under risk through their interaction with the system – the avoidance of such ensuring satisfaction. Whereas usability has traditionally mainly been concerned with the fulfillment of *user* needs, a new baseline for satisfaction ought to include, according to our concept, also *human* psychological needs and the prevention of their imparted thwarting and experienced frustration. Assumedly, if everything works to their benefit, users are likely to be satisfied, that is, the system is likely to be perceived as satisfactory.

For that reason, satisfaction constitutes the midpoint of the graph in Figure 1, as an outcome that is dependent on the avoidance or prevention of harm and risk to the user. Notably, ISO 9241-210 (ISO, 2019) situates satisfaction and (avoidance of) harm as two distinct but interrelated kinds of intended outcomes of use. Personal harm and risk can take on a variety of forms like emotional, privacy-related, financial or physical, all of which arguably often entail psychological consequences and detriments to the user's (psychological) well-being. Typical negative outcomes as stated in ISO 9241-11 include "risks to health and safety or risks of stress, fatigue, frustration or lack of empowerment" (ISO, 2018, p. 28).

On the right side of Figure 1 is depicted the positive UX spectrum, which goes beyond user expectation and user satisfaction. Through the active fulfillment of psychological needs (e.g., autonomy, competence and relatedness), *hedonic* (positive emotions and evaluations) or *eudaimonic* (meaning and vitality) well-being (Mekler & Hornbæk, 2016) is ensured. In this way, the users gain benefits (experiences) that exceed their basic user needs and expectations, which is in line with common UX research and practice. However, from an understanding of a holistic usability practice, it must be ensured that the UX is *in every aspect* at least at that crucial threshold where any harm or risk to the user is prevented, and not in just a few aspects while leaving others harmful. Our argumentation is that only viewed via the "deficit lense" of our usability approach, basic deficiencies and detriments to the users' well-being can be avoided.

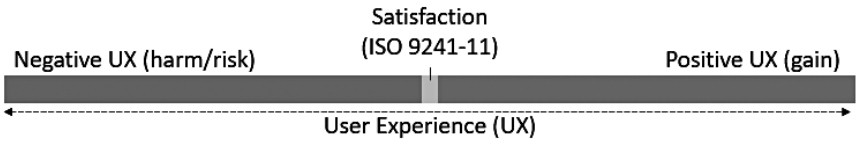

Figure 1 Satisfaction (ISO 9241-11) as the threshold between negative and positive UX and consequences.

We now turn towards the application of our satisfaction concept for VAs as a form of AI (or, more appropriately, IA) system. Thereby, we hope to contribute to a lifting of a veil that metaphorically often seems to shroud those systems in mystery or creates the well-known image of a black box,

whereby the users cannot be too sure that their interests are respected. Based on the concept of value-sensitive design (Friedman, 1997), we focus on the values, trust and human well-being, and associated factors as intended outcomes of use that contribute to ensuring satisfaction with VAs. Our concept does not claim to be exhaustive but comprises several factors for VAs that, if not considered, will likely result in negative UX and satisfaction not achieved. Figure 2 shows those intended outcomes: *Autonomy* constitutes the center of the figure. This reflects the basic premise to design intelligent systems for the support and thus preservation of the human's capabilities rather than the complete replacement of the human. This is also closely linked to the notion of user involvement and user engagement. Autonomy is one factor that is equally linked to the two principal outcomes, trust and *well-being*, which are mutually intertwined. All factors within the model contribute to both these outcomes, albeit each outcome has their respective main factors.

On the one hand, the value of trust means that optimally, users put their trust in the system that things in and beyond their UX are going in their favor (e.g., upholding their privacy) (Garfinkel & Lipford, 2014). Assumedly, without trust, neither will users willingly use the system (including sharing their data) nor be satisfied. Trust is mainly ensured by supporting the users' privacy and security and by establishing transparency. This is covered by various methods and designs of usable privacy (Adams & Sasse, 1999). On the other hand, the value of wellbeing in the context of satisfaction refers to the avoidance of harm or risk including overall stress, specific negative emotions like frustration, anger and anxiety, or feelings of need frustration (ISO, 2019; Ryan & Deci, 2017). From a pragmatic perspective, the way to eliminate a number of stressors is by increasing the VA's usability, which can be ensured by adhering to the interaction principles and includes the consideration of user needs for the system's tasks (ISO, 2020). Another way is to take into account basic psychological needs as a baseline for well-being. There are a number of such needs that a positive UX designer may support in order to make a VA interaction more exciting and fun and create meaningful experiences (Hassenzahl et al., 2010; Peters et al., 2018). However, SDT (Ryan & Deci, 2017) has established that certain psychological needs cannot just be not *satisfied* in a nonpositive sense, they can in fact be *thwarted* in an explicitly negative sense. Contrasting the experience of the satisfaction of needs, this dark side of human experience has been referred to as the frustration of human needs that results from need-thwarting environments. Therefore, in order to guarantee satisfaction with a VA, in the first place, the thwarting of the three needs, autonomy, competence and relatedness ought to be prevented through the design of the VA interaction, in line with the conceptual spectrum from negative to positive UX (see Figure 1). This distinction can also be included in evaluation questionnaires (Chen et al., 2015). For the most part, transparency and privacy/security in the course of VA use are likely to enhance trust as competence and relatedness are likely to enhance well-being. Moreover, trust is a factor for well-being and stress reduction itself, as it constitutes a letting-go of suspicion or worry (Luhmann, 2018). Trust in the system that oneself stays free from harm and the freedom of harm itself assumedly lead to satisfaction and the acceptance of technology.

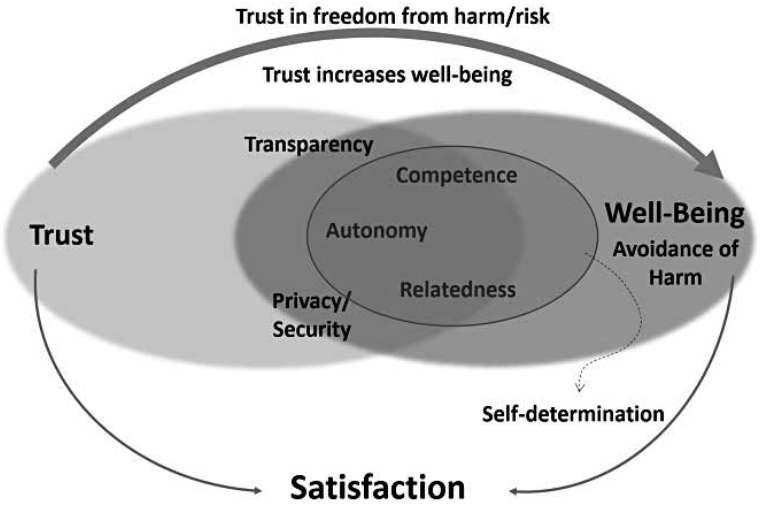

Figure 2 Intended outcomes of VA interaction as values to ensure satisfaction (ISO 9241-11).

b. Interaction principles for ensuring effectiveness, efficiency and satisfaction of VAs

To define guidelines for the design and evaluation of VAs in accordance with the usability framework laid out in this paper, we focus on the interaction principles (ISO, 2020). Thereby, we integrate them with the presented state of the art that forms the basis for our conceptual framework and with further concepts of communication like *Grice's Maxims* (Grice, 1975), which describe how a successful and purposeful interaction should be structured. Moreover, we draw parallels to the *Shannon-Weaver-Model* (Shannon & Weaver, 1998), which describes the basic process of communication. Thus, we argue to consider in the application of the seven interaction principles not only pragmatic (efficiency and effectiveness) but also experiential, human-value-related aspects (i.e., satisfaction).

Starting with the interaction principle, *suitability for the user's task*, and referring to Grice's maxims, it is necessary to design conversations to be informative in a purposeful manner, true and relevant in its content and, finally, perspicuous in its meaning. This principle is reflected in all components of usability through ensuring task fulfillment (effectiveness) and avoiding overly efforts on a pragmatic level (efficiency) . The requirements for the user's task ought to be based on the users' characteristics as well as their needs regarding task, equipment and social or organizational environment. Furthermore, regarding satisfaction, users whose tasks are supported are prevented from competence frustration (i.e., feeling incompetent and ineffective) when interacting with the VA. Taking into account the requirements regarding privacy and security ensures a usable privacy (Adams & Sasse, 1999), which leads to an increase in trust.

According to *self-descriptiveness*, a conversation can be accompanied by many risks and misunderstandings. That is why a VA should always show or offer the possibility to let the users know what they need or can do or alternatively, what the VA is doing or will do. By doing so, transparency generates clarity about hidden processes, which in turn benefits trust, as users become aware of the ongoing processes and, in conclusion, reduces complexity and unpredictability.

Thus, self-descriptive VA dialogs ensure that the users' competence is not frustrated during interaction by minimizing perceived chaos.

Controllability is important for an interaction in accordance with the users' preferences including the ability to talk in the users' own language or the flexibility of the interaction flow (e.g., asking queries, or talking about a certain previous step). When controllability is given, the thwarting of the users' autonomy is avoided so that they can continue to act in a self-determined manner and have sufficient control and power over their personal data, which coincides with trust in the VA.

Conformity with user expectations represents the way the interaction ought to be orientated to the context of use and its commonly accepted conventions, specifically when thinking about the user as a customer. In this way, adhering to this principle prevents competence frustration by eliminating inconsistencies. Respecting this principle makes the overall interaction more predictable and thus, trustworthy, as users feel more in control about the situation, which arguably also reduces complexity.

Taking up once the Shannon-Weaver-Model and according to the *use error robustness* principle, a VA should further support the users in avoiding mistakes (e.g., misunderstandings) and in recovering from such (e.g., providing suggestions about alternatives). This also implies imparting users with sufficient control (autonomy and competence) to be able to protect themselves from harms or risks. One hypothesis to explore in further research is that the help offered by the VA prevents relatedness frustration (seeing the VA as a cold, inconsiderate automaton) in the face of slips or mistakes during interaction.

The users' ability to ask questions further relates to the principle of *learnability* and is achieved, for example, when users can ask in every step what they can do. If users can ask for an explanation to better understand and use the VA, it enhances transparency and clarity about the VA's capabilities, and consequently, trust in the system. This option to learn again prevents feeling of incompetence and confusion in the users.

Finally, *user engagement*, is about motivating users to use a VA in the long-term. The way of talking and articulating by the VA can negatively influence the continuous interaction, for example, when its responses do not follow Grice's Maxims and instead, are confusing and ambiguous. This would imply a thwarting of the users' competence. In another way, VAs, like any other AI systems, record and generate data to enable automated and personalized decisions, which finally results in a data storage that – as the related work has shown – leads to mistrust. That is why, to empower users in their privacy, consideration of the concepts for usable privacy (Adams & Sasse, 1999) can enhance the trustworthiness of a system, e.g., by explaining the use and processing of data. Finally, consideration of the need for relatedness is dependent on the VA's functionality. In this way, the VA interaction ought to always consider the social environment of

the user, ensuring that no utterance of the VA or user action results in the user's social contacts distancing themselves from the user, which would lead to distrust and amotivation in the user.

Ⅴ. Conclusion

Our proposed framework is an attempt to consolidate the common understanding of usability (ISO, 2018) with more humane aspects related to human values and the avoidance of harm, which, in turn, is expected to enhance the acceptance and use of VAs. For that, we applied the interaction principles (ISO, 2020) to encompass privacy and transparency aspects as well as the prevention of basic psychological need frustration. Compared with the other recent guidelines for VA design that we presented in this paper, the interaction principles arguably allow for addressing both pragmatic task-achievement and avoidance of harm as major intended outcomes. Understanding and analyzing the user's task and context of use considering our proposed framework helps to develop those harm-free VAs. With the assistance of the interaction principles, VAs can be evaluated in terms of effectiveness, efficiency and satisfaction. Since a common approach is to note usability problems based on those usability guidelines, we attempt to provide with our considerations a new lens through which to notice and frame problems that can possibly endanger users' privacy and psychological well-being. Furthermore, quantitative UX assessments should include, in addition to measures of need satisfaction, also need frustration scales (Chen et al., 2015). Future research must bring the extended interpretation of the interaction principles into practice and empirically validate the relevance and applicability thereof for common usability engineering and UX design and evaluation.

In any case, there is no question that the adherence of the values, trust and human well-being, is desirable and humane. According to our concept, designing for usable privacy and for self-determination are two ways to support that. With this, we emphasize that usability means more than effective and efficient systems development and that satisfaction might have a different focus than the common understanding of positive UX.

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Sustainable Mobility Scenario Modeling - Evaluating Future Resilience of Modular Concepts for Electrified Trucks

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Ⅰ. Abstract

Facing a myriad of megatrends such as sustainability, digitalization, electrification, and automation, one of the greatest concerns for companies is ensuring their fitness for future markets. Predicting how the future will unfold is impossible yet failing to timely prepare organizations and products for the future may cause substantial losses for businesses, societies, and the environment. Consequently, many companies have drawn their interest to flexible product development strategies to cope with rising complexity, risks and changing requirements. Modularization is highlighted as one such strategy. But how does one modularize against the uncertain future? Guided by this question, our research aims to apply futures studies and scenario techniques along the innovation and modularization process from product planning to modular system and product platform development. The system-of-interest and case for this paper is electrified trucks including their power infrastructure. Regular conversations with key industry expert-, research- and management stakeholders guided the iterative creation of a logical and analytical model to evaluate high level modular truck configurations against multiple scenarios and design pathways. Aiming to close the futures studies to modularization method gap, we replaced a more typical needs-based market segmentation input to modularization with both qualitative and quantitative data from mobility scenarios and studies. Our research is still ongoing but our main conclusions to date are two-fold. One: such model may provide insight to improve future resilience of modular concepts and product platforms in the early stages of platform development. Two: such model can provide a structure for recurring assessment of modules and system architecture, to evaluate resilience and guide optimization of specific module variants and product configurations for multiple and evolving future scenarios.

Key words: scenario modeling, modularization, product planning, platform development, electric vehicles, sustainability, digitalization, conceptual design evaluation

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Ⅱ. Introduction

Our research approach loosely followed the Modular Function Deployment (MFD) modularization method based its the original publication (Ericsson and Erixon 1999; Erixon 1998) yet in its

evolved form (Modular Management n.d.) (See figure 1). A supporting logical and analytical model was created to evaluate both high level modular truck configurations as well as the module system's modules and module variants against multiple scenarios.

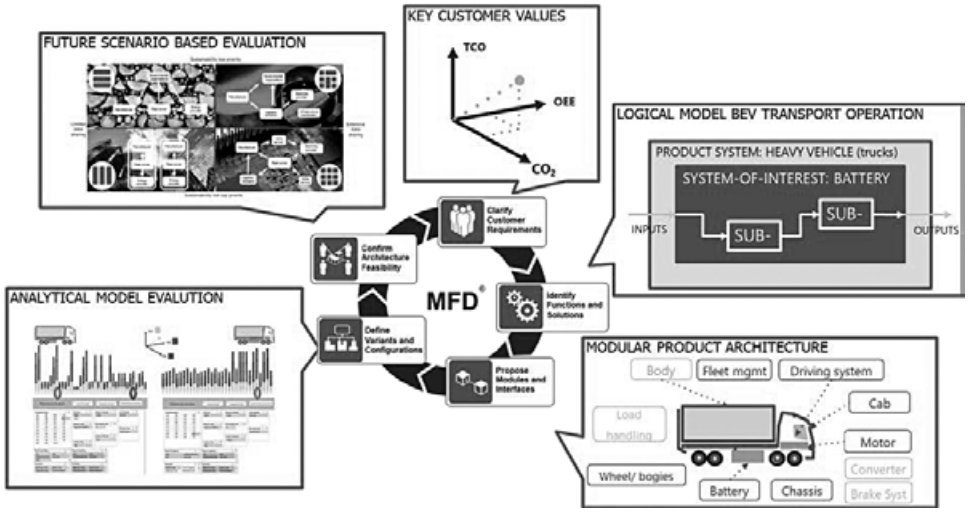


Figure 1: Research approach illustrated around the evolved MFD method loop

The customer values in this study were defined as Total Cost of Ownership (TCO), Overall Equipment Effectiveness (OEE), and Sustainability (CO2-emissions). Ongoing work has evolved the evaluations to assess sustainable development not only as CO_2-emissions but also as circular economic impact.

Goods flow infrastructure and transport operational conditions, requirement variables are clarified by exploring existing scenarios, literature, and conversations with industry experts.

Variables are connected with the chosen a system of interest, represented as a high level, battery electric truck architecture concept.

Goods flows physical properties such as distance, hilliness based on inter-urban and regional transport use cases have been introduced stepwise as needed or requested in iterations of developing the logical model and later evaluations using the analytical mathematical model.

Structure of this paper is as follows:

Chapter 3 provides the challenge facing transportation and commercial vehicles as background to clarify why this research is needed.

Chapter 4 describes the research gap and aim.

Chapter 5 introduces the method, starting by introducing our application of future studies as a discipline and then how it has been applied in this research by presenting the used scenario framework and Modular Function Deployment based iterative workflow.

Chapter 6 details the scenario evaluation logical model created to enable evaluating the performance of truck configurations to gain insights on design choices for the enabling module system and modules.

Chapter 7 presents a view on analytical model and insights gained from its iterative development.

This included evolution of the logical model and reflection for qualitative analysis and evolving the scenarios narratives towards a redefining sustainability to also a possible circular economy of battery modules.
Chapter 8 concludes on the findings and discusses the way forward for this research project. Two possible pathways are presented based on these conclusions.

Ⅲ. Facing future crossroads in transportation and commercial vehicles

Predicting future market directions is challenging, particularly for industries subject to significant disruptive change and unpredictable dynamics of megatrends. Failing to timely prepare organizations and products for future change, as well as failing to achieve sustainable development goals will cause substantial losses for businesses, societies, and the environment. One such industry facing substantial transformative pressure to meet sustainable development goals, rising demand for goods transport, urbanization, environmental standards and technology change is the market for road transportation and commercial vehicles (trucks) industry (Kluschke et al. 2019). As road transport is a key source of CO_2-emissions (Dominković et al. 2018; Kluschke et al. 2019; Pernestål et al. 2020), political pressure for transformation on truck manufacturers has increased with a first-ever EU wide regulatory framework to reduce CO_2-emissions (EU regulation 2019, EC Climate Action 2022). Industry's response meanwhile indicate the approaching tipping point towards electrification of, as manufacturers jointly commit to enable a zero-carbon road freight economy (acea.auto 2020; sciencebasedtargets.org). The transformation to electric mobility is undeniable both to enable and introduce electric or other non-fossil-fuel mobility alternatives (Kreitmair, 2021; caranddriver.com). Manufacturers and related research often link sustainability and electrification with other megatrends such as digitalization and autonomy of vehicles and fleets for transport. This myriad of trends and their interactions are complex and while undeniably transformative for the industries and society, global progress of sustainable development (SD) and outlook on achieving of the United Nations' Sustainable Development Goals (SDGs) (sdgs.un.org) or Paris Agreement (unfccc.int) climate commitments remain uncertain if not bleak. Combined such myriad of trends, challenges and deep uncertainty can be called a "wicked problem" or "social mess" in the field of futures studies, scenario and strategic planning (Ritchey 2011). Techniques in futures studies and scenario-based planning best suited to deal with the deep uncertainty of mentioned "wicked problems" belong to the exploratory and normative or backcasting type scenarios (Börjeson et al. 2006).

Aside from the uncertain future, the increasingly global competitive environment has required many companies to increase variation and differentiation in their product offering and pressure manufacturers to deliver masscustomization at mass-manufacturing costs (Shamsuzzoha et al., 2019; Seiler and Krause, 2020). Another central challenge for manufacturers is to provide configurable or even customized solutions from a wide range of products in a cost-efficient way. On this topic, modularization can be viewed as a strategy enabling to optimize the tradeoff between product differentiation by increased fit to customer needs and economies of scale from product

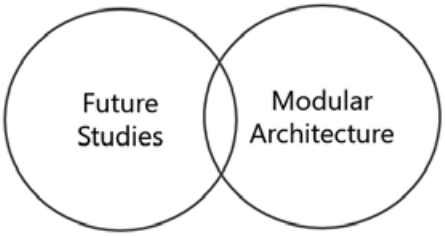
standardization (Schuh, Rudolf, and Vogels 2014). A modular product architecture is frequently described as a design or platform with standard interfaces that enables interchangeable modules and a wide variety of product configurations (Y. Liu, Zhang, and Z. Liu, 2011; Williamsson, Sellgren, and Söderberg, 2018; Shamsuzzoha et al., 2019). To define such systems of interchangeable modules, evaluate and optimize the balance between variety of products serving the customer needs, technology strategy and operational excellence, Erixon (1998) proposed a method: Modular Function Deployment (MFD), which has been applied and referenced in a growing body of research and cases in on modularization since then.

Modularization and modular product platforms have evolved strongly in the automotive industry, including commercial and heavy-duty trucks (Williamsson 2021), as many manufacturers attribute both their configurable product offering, technology, and industrialization performance to their modular systems (Scania.com; Volvogroup.com) (Stenqvist 2018). Yet the pace and rise of electric and digital technology and its transformative impact on vehicles adds additional challenge. Re-design of heavy-duty vehicles is remarkably challenging since both the trucks produced and the modular systems or product platforms they rely on are designed to be used for decades (Dominković et al. 2018; Eriksson and Simme 2020), and their development takes many years (Greene, Ogden, and Lin 2020). This implies manufacturers need to make long-term decisions and future predictions to ensure that their modular systems are able if not optimal to deliver products that fit the market by the time they are launched and the many years that follow. Despite electrification having gained increasing attention from policymakers, their geographic limits and elected timeframe of governance leave manufacturers and fleet owners without any perspicuous plan for development, scale and density of sustainable battery charging and service infrastructure. Meanwhile, road transport in general is growing, driven by megatrends such as urbanization and e-commerce, digitalization and evolving customer behavior causing changes in goods flows (Chalkia et al. 2018; Keseru, Coosemans, and Macharis 2021; Kostiainen and Tuominen 2019). Consequent changes in the business landscape may reinforce other megatrends such as servitization and accommodate new players with a different perspective on goods flow performance, vehicle manufacturing or transport operations. Such trends force incumbent manufacturers not only to rethink their product, but the larger product service system, the business models and value capturing mechanisms as margins and profits are shifting throughout the value chain (Jentzsch et al. 2019).

Ⅳ. How does one modularize against the uncertain future?

Against the background provided above it is both important and urgent to explore multiple possible future scenarios and use scenario techniques to prepare products and companies for the future as suggested in futures studies research (Börjeson et al. 2006; Heijden 1996). Scenario studies specific for inter-urban transportation also underpin several scenarios can unfold in the future (Chalkia et al. 2018; Keseru, Coosemans, and Macharis 2021; Pernestål et al. 2020). Consequently, to develop resilient modular systems, able to deliver products facing a perhaps

unprecedented “wicked” myriad of megatrends, climate change and “social messes”, modularization methods and innovation processes need to include and evolve with such futures scenarios. And evaluate how multiple scenarios, different customers, goods flow use cases and geographies can provide insight for or challenge product planning, design and architecture choices. Despite this paramount challenge, research on how futures studies and scenarios can be integrated into the modularization process appear limited. Apart from Bonvoisin et al. (2016), who partly touched upon unknown constraints when proposing ”modularization for X”, little research appears to have joined modular product architecture and future scenarios. Examples for evaluating the efficiency of modular configurations against evolving future scenarios were found such as Diba and Esmailzadeh (2020), F. M, Lehmeyer M, and Lienkamp M (2017), and Sim et al. (2019), who demonstrated component-optimization in vehicles partly based on futuristic assumptions about fuels and costs. Yet, no research was found to assess modular architectures’ overall efficiency based on key variables for multiple future scenarios. This research is therefore aimed to reduce the gap between futures studies and modularization methods.



Ⅴ. A method to bridge futures studies to modularization gap

Given methodological objective to bridge futures studies to modularization gap, a key question was uncovering what, if any, methods connection exists or may exist between the two fields of research? Studying the fields separately, futures studies are essentially methods enabling to gain insights about the future. These may be of a predictive (what will happen?), explorative (what can happen?) or normative type (how can a certain future be reached?) each suited for specific horizon of timing and range of uncertainties (Börjeson et al. 2006), as illustrated in figure 2. When applied in a business strategy evaluation context, companies often seek insights about their future markets and other externalities. In comparison, outside-in modularization methods like Modular Function Deployment usually start with a needs-based customer segmentation (Jiran n.d.) to uncover value potential of product differentiation by increased fit to customer needs to balance mentioned trade-off between market shares and price premium gains with design efficiency and economies of scale gains from design or process standardization. However, such outside-in needs-based segmentation oftentimes only focused on the known, analyzed markets and foreseeable future. But what if we develop insights about the longer-term future by using foresight and scenario techniques, could such input enable us to design modular architectures and product platforms that are more future-proof? To answer this question, we replaced the needs-based market segmentation input to a Modular Function Deployment-like (Ericsson and Erixon 1999) flow with a market context based on future scenarios. Due to the timeframe constraints of this

study, scenarios were not generated specifically, instead, already existing scenario framework from earlier research (Pernestål et al. 2020) was used.

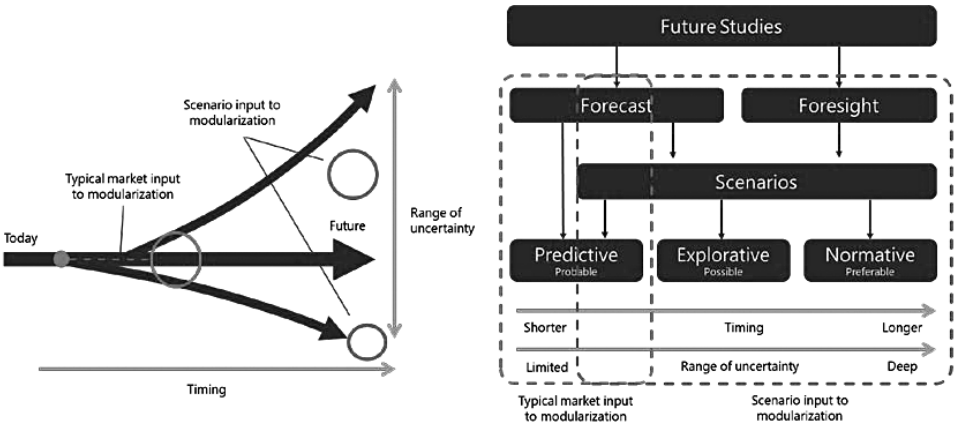


Figure 2 Future studies, scenario types, and typical input considered in modularization

The used scenario framework, presented in figure 3, represents the outcome of a workshop series that involved more than 50 experts from more than 30 different organizations within the freight transport landscape. These scenarios were selected as the foundation for this study since they reflect also other found literature and our industry stakeholders' perception on trends, certain development, and uncertain development. In addition, the scenarios are of exploratory nature, pointed out as particularly suitable when researching interconnected systems that are affected by multiple driving forces, and when time-horizon is ranges far into the future (Börjeson et al. 2006). The authors underline that the four scenarios should not be seen as the most probable futures but rather as plausible futures with distinctive characteristics, which is the desired scenario feature for in this study to augment the assessment of modular architecture concepts and subsequent discussion on modularization.

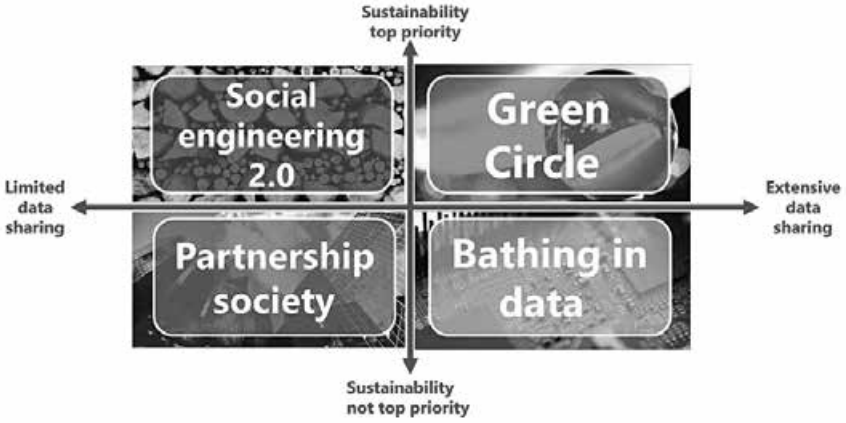


Figure 3 Scenario framework centered around sustainability- and digitalization-crossed futures adopted from Pernestål et al.(2020)

The scenario framework and narratives serve as a foundation from which high-level customer values can be extracted and weighted to amplify the value potential of a solution for each scenario-specific characteristic. The customer values in this study were defined as Total Cost of Ownership

(TCO), Overall Equipment Effectiveness (OEE), and Sustainability (CO2-emissions). These three high-level customer values are apparent across all four scenarios, although their relative importance will be considered differently. In addition, the customer values were thought to be relatively easy to quantify and connect to product properties when proceeding in the modular design process. The modular product configurations analyzed in this study were limited to consider a few high-level modules with distinctive yet limited line up of conceptual module variants. This way the complexity that arises for each module and its variants added to the evaluation can be kept minimal for the initial development and early tests of the simulation model. The modules used were considered significant, and at the same time, largely independent of other modules. The selected modules, and module variants enabled us to simulate and assess multiple unique product configurations of heavy-duty trucks: 42 configurations in a first iteration and 576 in the latest. Each product configuration was evaluated based on its individual performance in relation to the high-level customer values across the four scenarios. Consequently, the evaluation can be considered bi-directional: "Outside-in" scenario directed and "inside-out" architecture directed. "Inside-out", the performance of each product configuration results fromits module variants with respect to their impact on the three high-level customer values. "Outside-in", the overall performance is affected by the weights given to customer values (level of importance consistent with the scenario narrative), which is scenario-specific. An overview of the method is provided in figure 4 below.

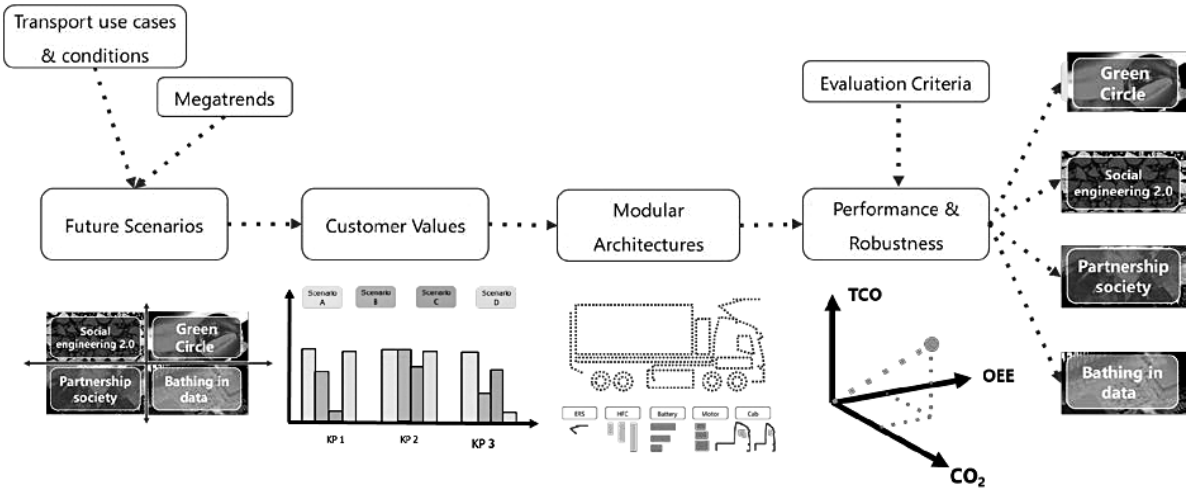


Figure 4 Overview of the method and flow incorporating future scenarios in modular architectures and product configurations evaluation

Ⅵ. A scenario evaluation model for modular systems

The evaluation model developed during the study has essentially three different layers as illustrated in figure 5. The system level, in which scenarios characterize goods flows and transportation infrastructure system, product level including the vehicle architecture and product configurations, and the module level. Firstly, "outside-in" properties, like the customer values importance have been extracted from the scenario narratives. An example being the density of roadside charging capacity and CO_2 impact of electricity sources. The original scenario framework served as context ensuring consistency in collecting such transportation infrastructure system

properties. Values are derived from research literature, published forecasts and foresight, or otherwise assumed and qualified as “plausible” in conversations with industry experts. Secondly, transportation and vehicle use case specific application properties are used as input to simulate the performance with respect to transportation operations. Transport operations or application properties include factors such as driving distance, cargo weight, and road slope profile to mention a few. Thirdly, a module variant specification matrix is used to specify each of modules’ variants on their corresponding properties. Hence, taking a “inside-out” perspective on the model, this setup enabled to simulate many different modular product configurations to serve in many different applications and in many different futures. Dividing the model into separate levels also enabled to change input to one level at the time and yet simulate the levels altogether. This proved advantageous for several reasons such as making it easier to stepwise increase complexity and scope of use cases or more data becomes necessary on a certain level to improve insights or consistency.

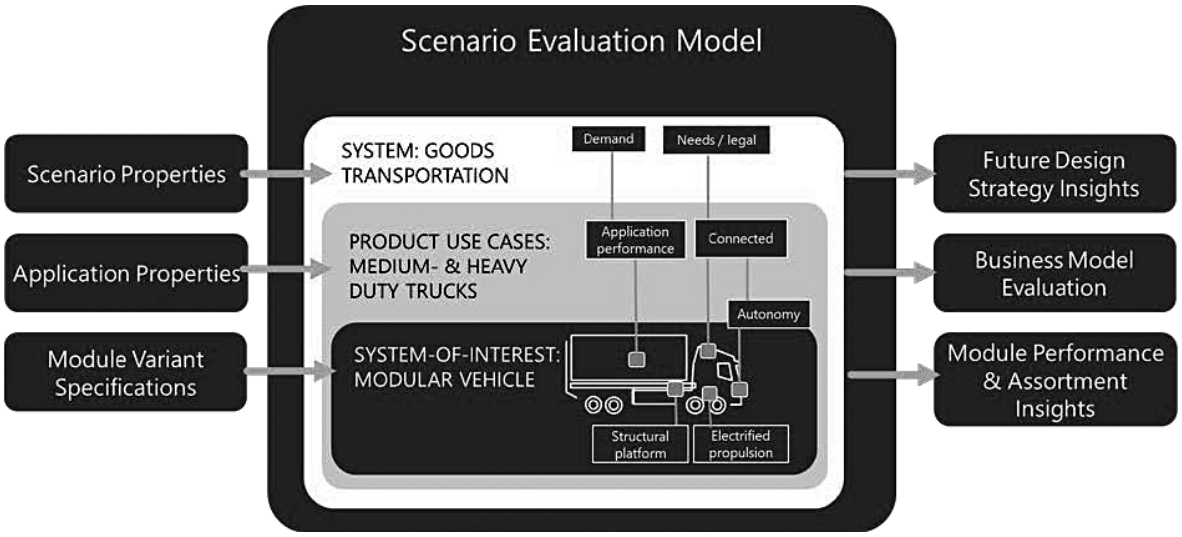


Figure 5 Schematic overview of the scenario evaluation model

Scenario Properties:

The scenario properties used in the model mainly refer to events described in the scenario framework that could impact the business landscape of the goods transportation system. Such properties are typically related to macrotrends and policies, affecting services, vehicle solutions, infrastructure, and goods flow.

Application Properties:

The evaluation model currently enables randomized and normal-distributed topographic simulations for four given road conditions: flat, predominantly flat, hilly, and very hilly for a given transport distance. Further, the topographic simulations can easily be simulated for any given distance, which enable simulations to reflect a particular or mix of transport use case(s). Three typical transport use cases are considered so far. One short, that reflects typical urban distribution, and then one longer regional transportation mission ~300km, and finally the longest distance that

aim to reflect a typical long-haul mission, ~500km.

Modular Architectures:

In the first version of the model, a simplified modular architecture, referred to as Modular Architecture 1 in figure 6, was used to develop the initial proof-of-concept. After the model proved it could deliver sought insights, a second version was developed with refined input and increased the detail of the evaluations. At this time conversations with our industry experts requested increased focus on batteries and architecture. Hence, in the second version modules such as the hydrogen tanks, fuel cells, and ERS-module were excluded in the second modular architecture (figure 7, Modular Architecture 2). Yet, increased detail in the second version on both architectures and transport wider range of transport use cases resulted in an increase of modular truck configurations to evaluate from 42 to 576 unique product configurations.

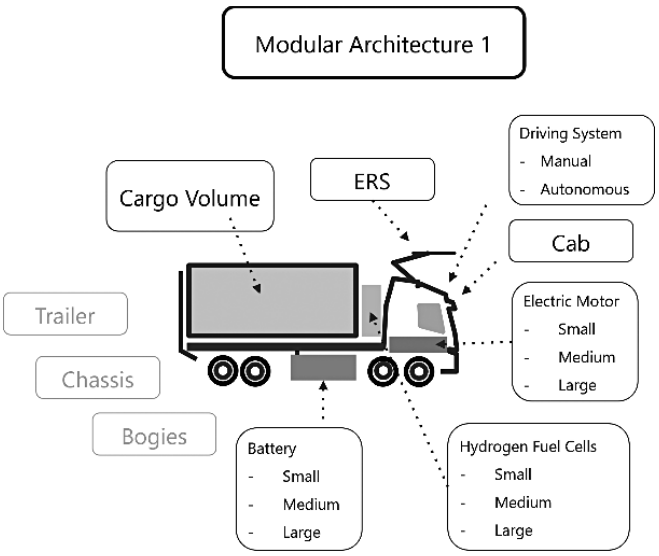


Figure 6 High level modular architecture - 1st version

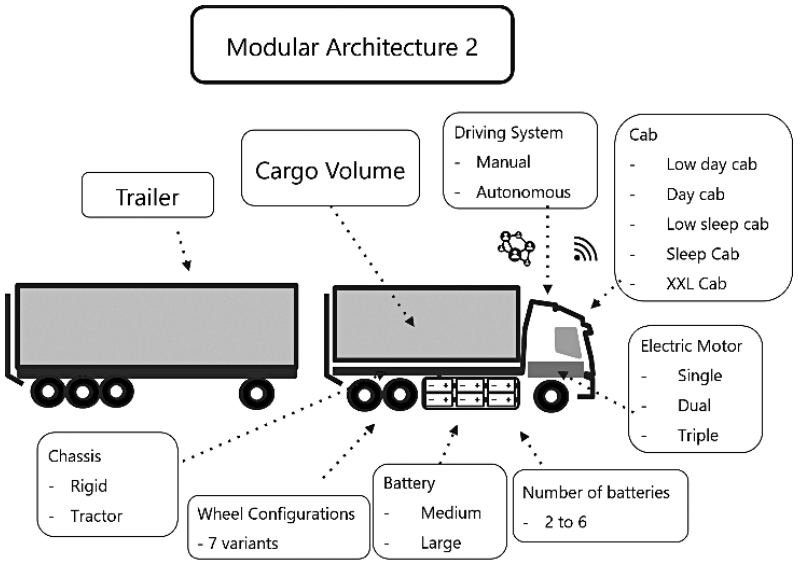


Figure 7 High level modular architecture - 2nd version

Ⅶ. Insights gained from the scenario evaluation model

Insights from the combined evaluations are many, but most noteworthy is perhaps that configurations that tend to be most robust when looking at all scenarios at the same time, not necessarily are the among the top performing configurations when simulated against one specific future scenario. The subsequent analysis then revolved around the difference between such product configurations. One finding is that the number of battery modules tends to be crucial attribute for top performance. For example, when simulating long-haul transportation use case, the significant difference between the most robust configuration, meaning a top performer across all scenarios (figure 7, left) and the best product configuration in one scenario (figure 8, right, scenario: Green Circle) is the number of battery modules. In addition, when evaluating regional transportation use cases and long-haul transportation separately, the difference between the product configuration found most robust is again, only the number of battery modules.

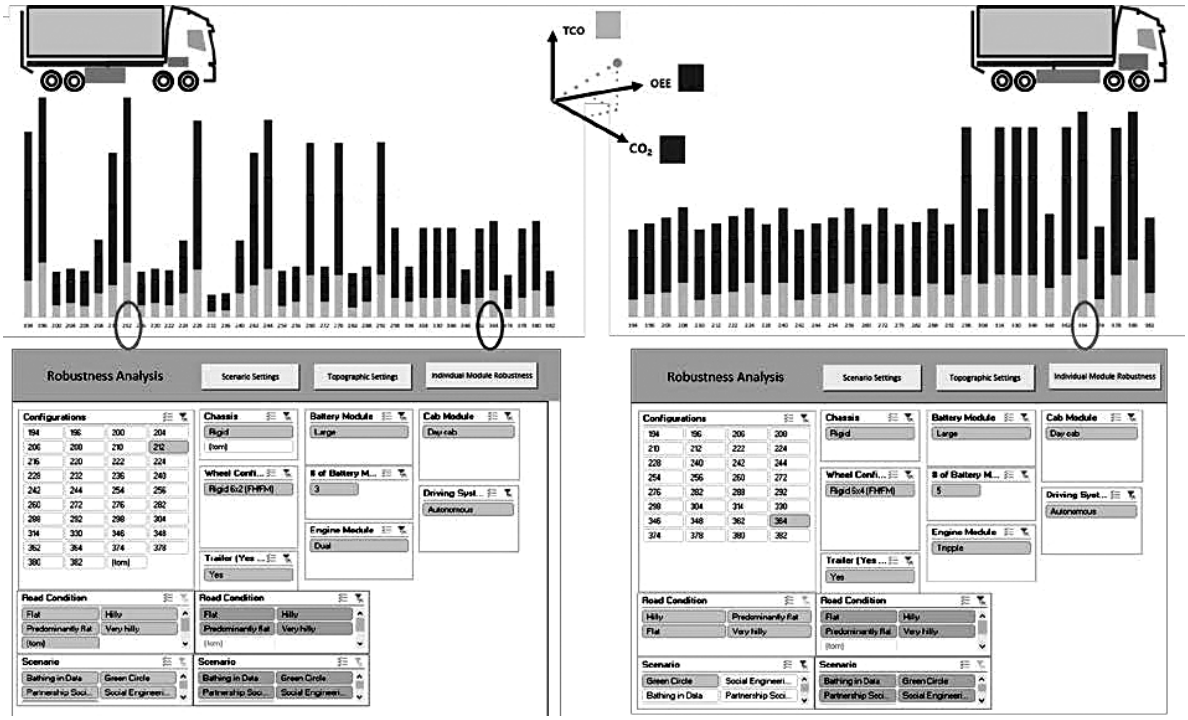


Figure 8 Snapshot of the scenario evaluation model highlighting top performing vehicle configurations across all scenarios(left) versus only one (Green Circle) scenario (right)

From a modularization perspective, these insights raise new questions on how the battery modules may be designed to enable upgradability so that the modular architectures not only become robust against multiple futures, but product configurations may also be re-configurable to become top performers in specific futures or changed mix of transport use cases. Taking a business perspective, different business models may be plausible to support and optimize value captured as well as sustainability impact from such battery upgrading offerings as suggested in figure 9 below.

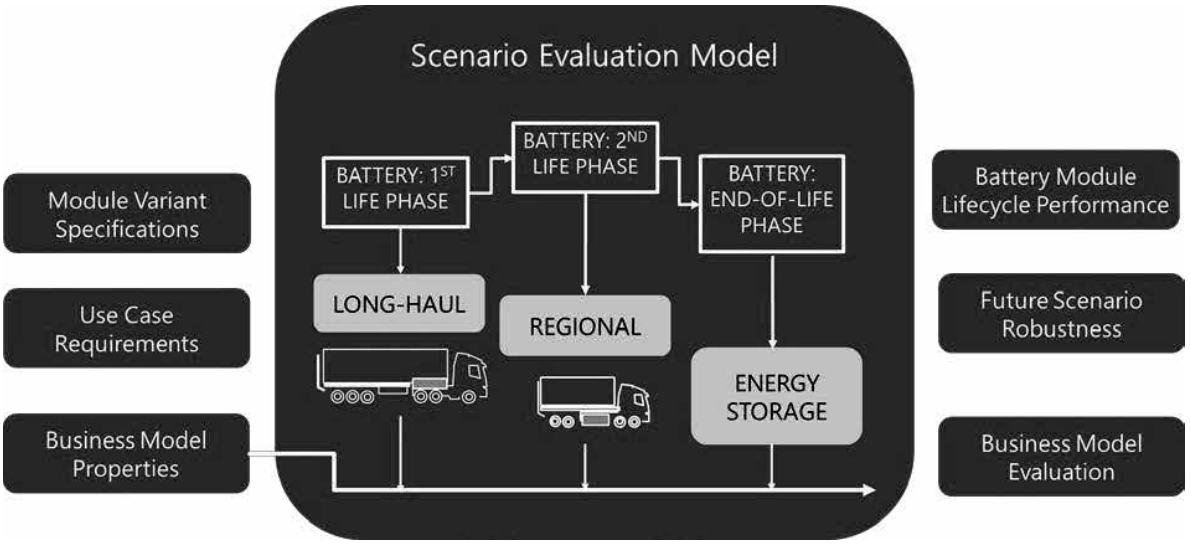


Figure 9 Suggested new insights towards modularization strategy and battery module business value potential

Here, co-creation of value between vehicle manufacturer and vehicle customers may been seen as contradicting, as the vehicle costs for the customer are the manufacturer's revenue. However, breaking down the factors that affect transporter Total Cost of Ownership (TCO) value and reducing losses in transport operations (captured as OEE value) might be value shared between manufacturer and its customers. Non-value-adding downtime is one of the most significant factors to transporters operational costs and one such example is downtime for charging during the transport operation. Customer operations could become more profitable by minimizing waste (i.e., unnecessary downtime, wear, or end-of-life replacement costs) across are larger scope of battery (electric vehicle) operations and lifecycles. This could be enabled by operations and lifecycle data used by manufacturers to ensure provided vehicles and battery configurations are better optimized for their specific operation lifecycles, such that all parties co-create growth of their individual profitability, from the elimination of waste and improved battery raw material and production sustainability (see figure 10 below).

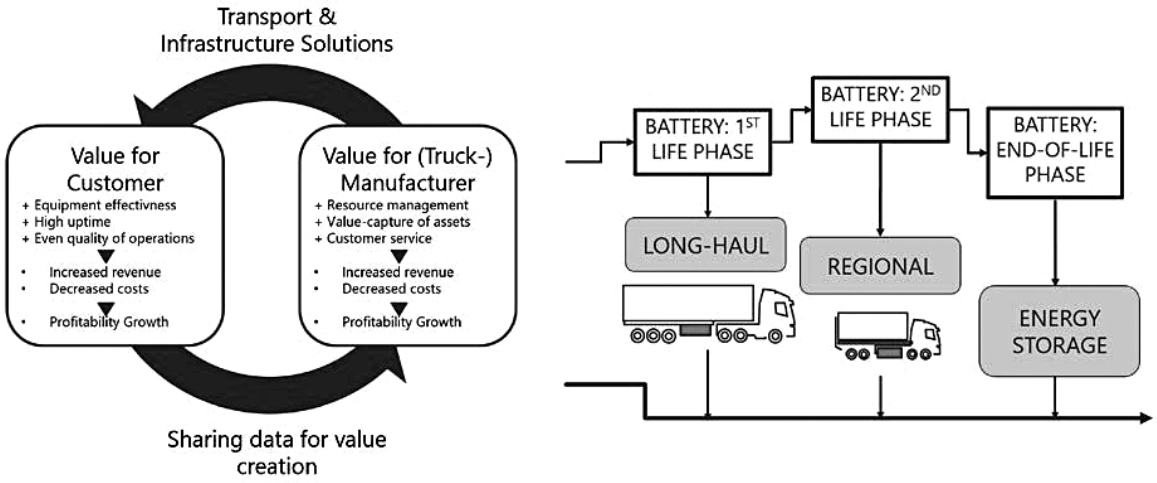


Figure 10 Strategic value co-creation scenario enabled by digitalization and more sustainable, circular battery module lifecycling

Ⅷ. Conclusions

The results and mentioned potential insights on battery modules upgradability enabled by the scenario evaluation model will be continued in a next phase of the study in which we aim to build upon preceding work but narrow the scope to the battery modules even further. Conversations with industry on this aspect have highlighted battery electric mobility as a very useful case for futures studies in modular product platform development as well as model refinement. Narrowing the scope in order to refine the model inherently means other, additional capabilities and future critical requirements may exist outside our battery-focused view. The dynamics that may ultimately decide which vehicle (and battery) solution as well as business model will be the best fit from a (circular) business perspective will always be challenging any system boundary. Therefore, we will select two different perspectives, to be explored individually but also with the possibility to create synergies and additional insights if combined. This offers more possible insights and realistic evaluation but also challenges the model to be modular itself. A modular scenario model may also, similarly to a modular product, provide ease in upgrading and focused development on specific new areas of modeling, while reusing data and algorithms in other areas and evolve the configurations and simulations enabled. Perspectives for the next stage of the project, we will firstly aim to evaluate a set of future (circular) goods flow scenarios within the mentioned framework of scenario narratives. The scenario framework used contains a comprehensive outlook on possible future goods flow which have not yet been studied in detail nor included in the model. Ideally the more typical needs-based market segmentation input to modularization can be augmented with such data from mobility scenarios and studies, as each serves their own insights. Secondly, we will aim to evaluate vehicle battery-oriented business model scenarios from a modular vehicle design and circular battery product lifecycle perspective. The combination of the two perspectives is aimed to provide insights on battery module design and lifecycle strategies with respect to future more circular business models serving the needs and characteristics of circular and digitalization scenarios for goods transportation.

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The SDGs in the Anthropocene: A Gandhian Critique

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Ⅰ. Abstract

Today, many people worldwide wear a 17-color badge to support the Sustainable Development Goals (SDGs). Their goodwill can certainly not be denied, as the badge expresses their compassion for others on the planet. Governments, NGOs, and corporations are so eager to promote the SDGs that these appear to have become the entire humanity's agenda. To that end, however, are we not transgressing the planetary boundary and causing the Anthropocene, a geological era in which humans have completely transformed the earth into an unlivable place for all species?

Mahatma Gandhi considered a village-based India as ideal and asserted that we need to willingly reduce our material wants instead of increasing them. From that viewpoint, in the argument of the SDGs, it may be insufficient for us to only invite people, both in the present and future, to participate in global development; we would also have to question the material abundance monopolized by a handful of people in today's society. It is indeed the rich who need to fundamentally reduce their material wants if we are to enhance the living standards of the poor. Thus, in this article, I would like to present a brief critique of the SDGs from a Gandhian viewpoint.

Ⅱ. History of Sustainable Development

To trace the history of "sustainable development," this expression first appeared in the World Conservation Strategy proposed by the International Union for Conservation of Nature and Natural Resources and the United Nations Environmental Programme (UNEP) in 1980. It was, however, the World Commission on Environment and Development (WCED), chaired by Gro Harlem Brundtlant, that defined the concept clearly in its final report, "Our Common Future," in 1987. According to the WCED, "sustainable development" is to meet "the needs of the present without compromising the ability of future generations to meet their own needs" (WCED1987: 16). Through this definition, it expressed its concern regarding the earth's limited resources and environment and compassion toward people in intergenerational relations. This attitude should be highly valued as it presents a possibility for humans to coexist.

Sustainable development was also considered in the Rio Declaration on Environment and Development and Agenda 21 at the 1992 United Nations Earth Summit. The UN's concern for development and the environment was taken further at the World Summit on Sustainable Development in 2002.

While it was impossible to achieve the Millennium Development Goals (MDGs) to their fullest, the UN General Assembly adopted the 2030 Agenda for Sustainable Development in 2015 to further and promote the ideals of the MDGs in the form of the SDGs.

Ⅲ. Critique of SDGs

However, the concept of the SDGs seems to assume that it is possible for everyone in the world to attain the same living standard as that enjoyed by the average people in the richest societies. Currently, the nominal per capita income of the United States, $63,380, is 243 times that of the Republic of Burundi, $261 (IMF 2021). In terms of ecological footprint, the average American already utilizes four to five hectares of land, even though there is only 1.5 hectares available for each person in the world (Wackernagel and Rees 1996: 13). Only a small portion of the world's population—mainly those living in the richest societies—is rapidly depleting resources, destroying the environment, and pushing species toward extinction. Therefore, before we discuss sustainable development, we must question whether development itself is sustainable.

Kohei Saito regards the SDGs as "opium for the masses," which, according to him, would allow people to "misunderstand that they are tackling the global warming without taking any bold actions" (Saito 2020: 3). Observing capitalism as the chief cause of the climate crisis, he criticizes all growth and de-growth arguments not based on Marxism, as they do not consider labor-capital relations in that system of economy (ibid.: 126–29). He describes the Anthropocene as the era when peripheral labor, environment, resources, and foods—objects for humans to exploit—have been exhausted at the frontier [of capitalist expansion] (ibid.: 31). Although I doubt Saito's assertion that ideas of what he calls "de-growth communism" are found in the late works of Karl Marx, I agree with his argument that global capitalist development is now bringing us to the fringes of the "planetary boundary."

From a non-Marxist viewpoint, Serge Latouche observed US business groups' lobbying activities behind the UNEP's proliferation of the notion of the SDGs. He found that the UNEP's purpose was to rescue the religion called "economic growth" that confronts the ecological crisis (Latouche 2019: 5). According to him, by parting from "developmentalism" based on productivism and fusing anti-developmentalism with ecologism, we would reveal the deception of sustainable development, so as to provide a foundation of the project alternative to the dominant model [of society] (ibid.: 6–7).

According to Latouche, it is modernity that should be questioned. It has liberated humans from the world of religion that governed medieval society and replaced divine rules with those based on human reasons. However, the "beloved freedom" that the people won encompasses freedom to "deprive nature and ruin the planet without any sense of shame and exploit others in a shameless manner" (Latouche 2019: 36). As a result of their pursuit of that "freedom," Latouche states, "regenerational capacity of the earth has become unable to catch up with the demand [of people]" (ibid.: 38). This is causing the Anthropocene, "in which the biosphere would coevolve with human

activity and be altered by it" (ibid.: 119).

Ⅳ. Gandhism in the Anthropocene

Latouche was deeply influenced by Gandhi, who had severely criticized modern civilization. Looking at the capitalism developed in the Western world since the Industrial Revolution, Gandhi found materialism to be the main characteristic of that civilization. He opposed the idea that India be industrialized like Europe or the United States as, for that, it would have to find other places for exploitation. Instead, he advocated hand spinning and hand weaving as ways for India to become independent both politically and economically; this was based on his conviction that the country should remain frugal and, thus, at peace with the rest of the world.

Gandhi's movement to revive spinning wheels might appear absurd to people living in modern society. Even in his time, machine-made cotton cloth dominated textile markets in India, which was 63 times more productive than hand spinning and hand weaving. Why then did he continue with this project? In short, 1/63 productivity by hands would mean that if we used them instead of machines, we could provide the poor with 63 times more work opportunities (Ishii 2010: 104). To borrow Ivan Illich's concept, Gandhi wanted to establish a "convivial" society in which economic fruits would be shared by as many people as possible.

Ⅴ. Conclusion

In order for us to escape the Anthropocene, it may not be enough to invite everyone to the stage of economic development; we must also question the legitimacy of the richest societies. It is in fact such societies that should first reduce their needs so that every one of us can coexist on this earth. The idea of sustainable development should be remolded to this line of thought. At this point, the following words by Gandhi that Ernst F. Schumacher quoted would give us a fundamental insight when we consider development in both intra-and intergenerational contexts: "The earth would provide enough to satisfy every man's need, but not for every man's greed" (Schumacher 1973: 29).

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A method to convert learning history into data for learning path study in sub-Saharan Africa

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Ⅰ. Introduction

The global focus on the United Nations' Sustainable Development Goals (SDGs) has prompted African countries to try to improve their societies. Special attention has been paid to the topic of education related to SDG 4. As of 2019, many countries in sub-Sahara Africa (hereafter abbreviated to SSA) were unlikely to meet their goals, despite their best efforts.

E-Learning has great potential to help SSA states succeed in reaching their goals of SDG4, particularly if learning paths or pathway generation is adapted to the learners and their environment. Jih stated, "Learning pathways also reveal learning traits while learners traverse any interactive environment" (Jih, 1996). In other words, while learning is a lifelong journey, a learning path is the specific route a person takes to reach a desired outcome, knowledge, or achievement.

A properly constructed learning path can provide effective knowledge and skill acquisition and reduce the skill mismatch. The European Union Commission defines skill mismatch as, "a situation of imbalance in which the level or type of skills available does not correspond to labor market needs" (EU Commission, 2020). Skill mismatch is also a serious problem for young professionals including recent graduates in SSA, particularly those in the Information and Communication Technologies (ICT) sector. With considering skill mismatch, the learning path must be customized for each young professional based on her/his learning history. Usually, a lot of data as learning history are needed to generate a proper learning path. However, such a big data approach for data collection is not suitable for SSA due to cultural, educational, and even linguistic diversities and computer resources. We propose an alternative data collection method to use a limited set of learning history which consists of First-Hand Knowledge, Official Transcript and Record, and Log Data in this paper.

Ⅱ. Educational situation and the use of e-Learning in African countries

With Africa containing 44 of the 79 most underdeveloped nations in the world, it also holds 57% of the world's poor. SDG 4, which seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (The Sustainable Development Goals Center for Africa, 2019), has been particularly difficult for many SSA countries to achieve.

Although "education for all" might be obtainable for many developed nations, SSA countries have found it to be consistently out of reach. The outbreak of COVID-19 and its subsequent extended school closures only proved to perpetuate turbulent preexisting conditions such as frequent teacher strikes, civil unrest, and long-term power outages (Balogun & Ahlan, 2015; Kituyi & Tusubira, 2013; Adelakun & Omolola, 2020). Trained teachers in primary education were estimated

to be at 67.9% in 2019. The effect of these chaotic conditions was evident in September 2021, when the UNESCO Institute of Statistics placed literacy in SSA countries at under 66%. To compensate for such unstable learning conditions, many students seeking to attend university have turned to e-Learning for technical skill acquisition instead of traditionally formatted education.

Some e-Learning services can provide their users with customized learning paths, but the system requires a lot of data to generate them. Collecting the data is often far easier for Western users than for those in SSA. In addition, such data and their subsequently obtained learning paths generally do not have much relevance with current educational and economical situations in SSA countries. Thus, SSA students need learning paths that fit their unique situation and environment (Balogun & Ahlan, 2015; Kituyi & Tusubira, 2013). If their projected learning paths were made more accessible and relevant, it is possible that the impact of learning interruptions could decrease.

It is worth stating that while some might argue that e-Learning is not practical in an area that struggles with infrastructure challenges, it is encouraging to note the progress of the mobile economy in SSA. Mobile device internet penetration reached 46% of the region's population by the end of 2020, a 4% increase (or 20 million users) from the year before (GSMA, 2021). Therefore, SSA students would indeed be able to access their customized learning path platforms.

Ⅲ. Data collection for learning path generation

The purpose of our research is to find a method to collect proper learning history to create learning paths for young professionals in SSA. A lot of information about learning history can be obtained from log data in e-Learning platforms such as Moodle (Moodle documentation, 2020).

The typical data collection method for generating learning paths often done in developed nations is based on the big data approach with the concept that learning history equals log data. However, this method is not appropriate for SSA, because the log data are often scarce and hard to access. Therefore, other information must be used to formulate proper individual learning history. The target users of this research are young professionals in SSA, so we can focus on the period from their graduation at an educational institution to becoming young professionals. We think individual learning history can be formulated by collecting information about learning related to the period.

Ⅳ. Data collection method

To best understand how learning paths relate to real-world skills, we limited our participant selection to recent graduates and young professionals working in the ICT sector. Seeking as comprehensive an understanding as possible regarding one's current learning status, we selected three main sources of data:

1. First-Hand Knowledge
2. Official Transcripts and Records
3. Log Data

These data sources, while diverse, are processed to produce usable training data for learning path generation.

1 - First-Hand Knowledge; Written questionnaires and verbal interviews are used to inquire about

the subject's experience and skills. The questions are intentionally short and left open-ended to allow the respondent freedom in answering. The questions asked are:

- Tell us your occupation name and characteristics.
- What skills did you have when getting your job?
- What skills did you have to acquire during in-house training?

Their current occupation is asked to see if there is a direct correlation between what they studied in school and their vocation. Often interviewees would describe the same course using different names. A learning data collection tool must be able to understand the association between relatively interchangeable subjects' terms. Revealing correlations between these subjects with different names but similar contents helps to expand the default learning path with skills that could be otherwise overlooked.

2 - Official Transcripts and Records; We collect the student's academic background, that is, the subjects studied. These include both the subjects in their field as well as any other general courses they may have taken before graduation. These are obtained directly from the students rather than asking the respective educational institutions. This helps to add to our understanding of what learning choices have been made to that point in time; Students may individually have enrolled in courses that are not required for their major. Those courses would be part of their learning path. In the case of e-Learning to progress to the next course, the current course must be passed. However, several courses are taken concurrently in the case of the transcript. This is why in the current case; grade or performance evaluations didn't have to be used.

3 - Log Data; According to (Rotelli et al., 2021) several cases must be considered while processing log data. In addition, there is a different level of detail that can be acquired. Therefore, restricting the scale of data collected becomes necessary; Here we collect two types of data - the student ID, and subject titles.

E-Learning is becoming an important factor of SSA education. Commonly, producing a Learning path would require having a large sample of e-Learning users' data. If that large sample is unavailable, the workforce is. In an environment of high cultural diversity, identifying the local needs is critical to making adaptable learning tools.

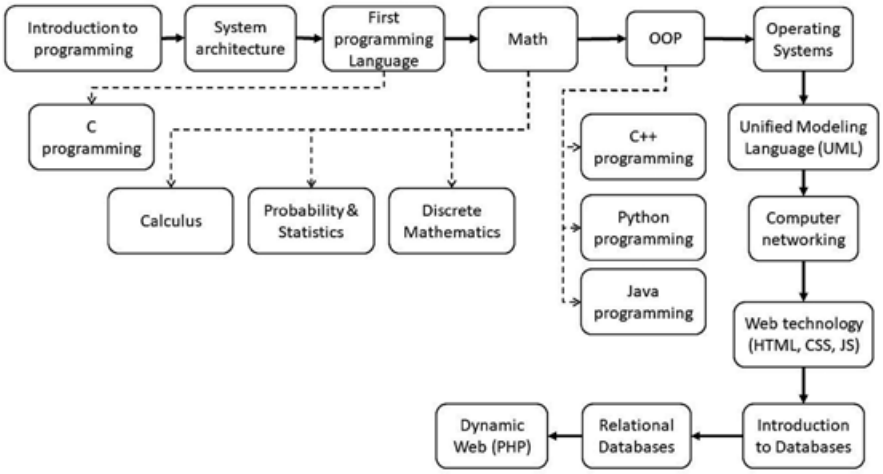

Figure 1: Default learning path

Fig. 1 shows an example of a default learning path containing the most commonly studied subjects in computer science. Dashed arrows show relations between a subject and the more concrete subjects. From the scientific viewpoint, system architecture, introduction to programming, and operating systems are fundamental and necessary knowledge to understand the workings of computers. In the learning on software development, the goal becomes to understand the practical application. Such learning starts the first programming language (FPL) by providing the introduction of programming by C language in the case of Fig.1. In addition, this learning path order is not absolute but it may be changed by the curriculum policies of universities and e-Learning service providers. For example, if the operating system is regarded as a more important subject than FPL on the curriculum policy, it may be moved before FPL.

V. Results and discussion

Our first step was to collect the learning history from four technology graduates in SSA by a survey. We gathered data on what professionals learned during school and between graduation and the end of their first year of employment. The interviewees were an AI engineer from Guinea, a database administrator from Cameroon, a data coordinator from Senegal, and a software engineer from Senegal. Every individual has a different learning path in regard to IT. Table 1 shows examples of data collected from former students in computer science in Senegal. These students have different specializations in IT after graduation.

Table 1: Example of collected data

Status	Skills	Category	Source
Data coordinator	Video editing	Unknown	In house
Software engineer	Computer architecture	Introductory	Transcript
Software engineer	C Programming	Programming class	In school
Database administrator	MERISE modeling	Unknown	In school
Data coordinator	Web cartography	Unknown	In-house

With this information including data shown in Table 1, we could identify a case of skill mismatch as video editing is not part of the main computer science learning path. MERISE is a modeling methodology for software engineering (Avison, 1991). As a subject, it is less common than the Unified Modeling Language. Many young professionals had to undergo training and acquire extra skills during their school-to-work transition, to better adapt to their new environment. This highlights the fact that what is currently being taught in a subject at school is not adequate for real-world survival, in other words, skill mismatch. By relying on professionals' experience and skills, future skill mismatch can be minimized and the need for retraining reduced.

Categorizing the courses allows identifying the course that is missing from the default learning path. They can be reviewed for identification of the ones that are related to IT such as MERISE. Such a method can be used to expand the default learning path. The others would not be part of

an IT learning path.

It is important to note that skills and subjects are not mutually exclusive. In other words, the outcome of studying a subject is often a skill. However not all skills will be taught as a subject, some will form after being repeatedly solicited through the studies of various subjects. From the viewpoint of e-Learning, subjects will be considered. Which subject must be studied to acquire a specific set of skills? While from the viewpoint of skill mismatch skills are being considered. What skills are required to meet specific market demands or needs?

Our goal is to simplify, as much as possible, one's learning path by personalizing it through the addition or deletion of selective content. This might include potentially adding skills that appear unrelated to subjects, like debugging shown in Table 1. Debugging is not often what comes to mind when someone mentions being good at critical thinking. While debugging is certainly an important skill, and one that can be used as a foundation for other skills later, the knowledge of that ability would not have been discovered exclusively through log data generally obtained. That is that such log data would not show that debugging is a skill possibly needed for critical thinking. Using the survey, professionals can express their learning history in terms of skills learned. Based on this history, undiscovered or unexpressed learning data can be obtained.

While having a comprehensive history will help in learning path generation. However, it might be impossible to generate a learning path, unless one can provide a full picture of her/his learning history to that point. This data can be complemented by using the information in resumes and curriculum vitae to give an overall picture of individual learning history. In another viewpoint, the data generated by these sources may prove to be valuable to the content providers to see if the learning path generated through this data can affect the conception of the curriculum (Stabback, 2016).

Our proposed method has some disadvantages. The first one is missing memory in the acquisition process of First-Hand Knowledge. We do not always remember all the details of our learning history. In general, only the best courses are remembered. To reduce the influence of this disadvantage we can use cross-referencing information from people that have studied in the same institution and time. Such cross-referencing information can fill the missing memory. The second disadvantage is hidden information on Official Transcripts and Records. For example, if a student audits a class, it will not be reflected on her/his transcript. Asking for such hidden information explicitly is a simple and effective way to avoid this disadvantage. The third disadvantage is Log Data recorded on plural e-Learning platforms. Generally, Log Data for a user is recorded on a specific e-Learning platform. However, some people may use more than one e-Learning platform. Several tools to visualize or analyze Log Data are being developed as not all content providers can use such data directly (Jugo et al., 2014; Rotelli et al., 2021). Integrating such Log Data remains in future work.

Ⅵ. Conclusion

This paper described a data collection method for generating useful learning paths for young people in SSA. To improve the quality of education in SSA and assist in reaching SDG 4,

generating a personalized learning path from locally provided data is vitally important. Using multiple and diverse local sources further helps to ensure the paths' relevancy. Consulting recent graduates and young professionals proves to be a viable source of information and provides unique insight into skill acquisition, something that is missed through official transcripts and Log Data alone. This First-Hand Knowledge data collection has the potential to not only create highly culturally specific learning paths but also reduce skill mismatch drastically, leading to a more educated and productive workforce in sub-Saharan Africa.

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Online Japanese Language Education for Elementary Level Learners

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Ⅰ. Background

Foreign language education is important in the sense that it is a prerequisite for students to communicate with one another. However, due to COVID-19, it is not easy for educators to provide in-person opportunities to learn a language.

There are several possibilities to overcome this situation: 1) students use self-study materials and learn by themselves, 2) students use on-demand materials and learn by themselves, and 3) students take online real-time courses. The materials in 1) are typically books, while those in the others are typically online. This presentation will focus on 3) because the other two are generally difficult and less effective for most students and 3) is a practical alternative to an in-person language class because it is able to be interactive.

1) and 2) are the same in that these are basically self-study, even if there are differences between them: through traditional means or online, or, with or without supervision by a teacher. Self-study is difficult or less effective for many learners. Self-study materials are improving and becoming more available especially online. However, the lack of interaction is an unsurpassable obstacle. In contrast to these two, online real-time courses are much closer to "normal" classes. Although there are still several challenges in order to provide effective real-time courses, by introducing the suggested means below, the learning experience will be much better.

Ⅱ. How to Overcome the Challenges

In this manuscript, what was/could be difficult and how to overcome these challenges in Japanese language online education will be discussed in detail, especially for elementary level learners. Just replacing all elements with online alternatives results in an inferior version due to these difficulties. For language education, interaction is not only a way or mode of teaching. It is one of the purposes of language education and a key to an effective online class.

Another thing we would like to take into account is the level of a course: Elementary courses are more difficult than the other levels because there is a big gap between the very first step and the second step and thereafter. If the students have too little knowledge of pronunciation, alphabets, grammar, or vocabulary, it is very difficult to teach them online at the same pace as in-person classes because they do not have basement.

	Difficulties	Suggested means
Basics of writing	It is not easy to recognize "what is wrong" and interactive instant feedback is impossible	By using a portable visualizer, interactive feedback is possible
Reading practice	Reading together does not work because of latency	Following means are able to solve the problem ・reading short sentence(s) one by one ・giving up or reduce "reading together" practice in class: instead, use more time for role playing ・alternatively, giving students "reading (and recording) assignments"
Feedback on submitted reading assignments	It is not easy to understand points that an instructor is discussing	Combining written feedback with real-time model reading helps students understand and improve easily

In this regard, the very basics of writing is difficult to introduce online. The most basic alphabet, Hiragana, is not easy for learners to write correctly due to its shape. Even if there are many online and printed materials available, to recognize "what is wrong" is difficult. In an in-person class, Japanese language teacher usually walk around in a classroom and check the students' writings. They can correct the students' mistakes immediately and interactively.

Under online environment, using a portable visualizer or a tablet will help instructors show how to write and "what is wrong" interactively by which the students will recognize their own wrong points.

The second example is "reading together" practice: In in-person classes, it is common and effective especially for elementary level students. By listening and speaking at the same time, students can adjust their own pronunciation. However, in online classes, due to latency, if speaker A tries to follow the timing of speaker B, it will be a problem for speaker B because speaker B will hear delayed sound from speaker A.

Instructors can avoid this by doing alternatives: When there is a paragraph with seven sentences, let speaker A read sentence 1, followed by speaker B who reads sentence 2, and so on, instead of reading together. Latency is not a big problem in this practice. Another way is putting more emphasis on role playing, which will work naturally online. Also, instructors can give reading and recording assignments to students. This way is now easy for both instructors and students because it is reasonable to assume that students have smart devices recently.

The last example raises another matter to discuss, how to give feedback on submitted reading assignments. In an online class, non-verbal clues are less available, such as facial expressions, gestures, timing, and indicating by a finger. Especially when students have little knowledge, in in-person classes they can utilize much information from non-verbal communication. Under these limitations, the students cannot easily understand the points that the instructor is discussing. When

in-person classes are impossible, utilizing visual or written information is recommended. Combining written feedback with real-time model reading and explanation helps students understand and improve easily. Also, when online real-time sessions are not possible either, instructors can use recorded audio files with written comments.

Another possibility is that the problems described above will be solved by developing related technologies. While zero latency is theoretically impossible, better "input devices" including high quality touch pen is highly possible. In addition, when both students and instructors get more accustomed to various tools, the situation will be easier to overcome.

By introducing these suggested means, online courses worked in a proper way. The learners could experience effective alternatives made possible by technologies and techniques.

Ⅲ. Conclusion

Because the Japanese language has its own unique properties, it is not easy to teach online, especially to elementary level learners. However, by some adjustments, providing desirable opportunities for learners is possible, and students could master the elementary level and proceed to the next level.

It is easier for intermediate and advanced learners to learn online compared to elementary learners when in-person courses are not available. However, the technologies and techniques discussed above could alleviate the situation and these means can be partially applicable to wide range of language education. These means are not too difficult to purchase or introduce. Lutes, Takamizu and Chambers (2019) stated that "it is important not to replicate the classroom experience, considering the abovementioned disadvantages", where the disadvantages include ease of use and familiarity. Now, due to COVID-19, many language courses were forced to switch to online and at least the world got familiar with video conferencing. As a result, the disadvantages were alleviated. In addition, the courses can be switched to in-person ones and vice versa depending on the situation because experiences that these means provide do not change fundamental elements of a class.

More opportunities of in-person courses will be available in the future even if nobody can predict when the impact of COVID-19 will be gone. Educators are required to provide alternatives and improve them.

Ⅳ. Acknowledgements

The author thanks Dr. Lrong Lim for correcting grammatical mistakes of the first draft, and the reviewers for comments that greatly improved the presentation and manuscript.

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Study on Dug Well Distribution and Water Balance in Teshima Island: Environmental Humanities and Hydrological Perspectives

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Ⅰ. Introduction

The islands of the Seto Inland Sea are climatically characterized by low rainfall and topographically characterized by low altitude, low-lying mountains; geologically, the region is characterized by impermeable granite that does not retain water in some regions that only have a few surface-water systems. Therefore, freshwater resources on the islands are scarce, and the islands are prone to water shortages and droughts[1)]. Notably, Teshima Island in Tonosho town (area: 14.4 km^2, Figure 1), which is our study area, has a unique water environment with abundant water resources, compared to other islands in the Seto Inland Sea; this region hosts the "Karato no Shimizu" spring that flowed even during the severe droughts in 1994 and 1995 [2)3)] (Figure 2) and large scale rice terraces that use substantial amounts of agricultural water.

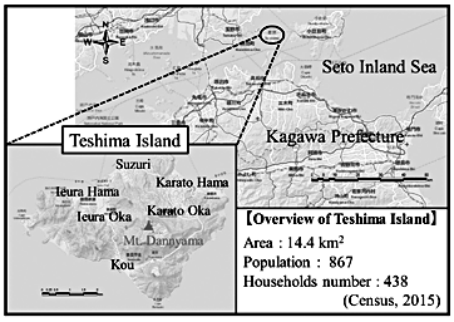

Figure 1. Map portraying of Teshima Island

Figure 2. Spring water "Karato no Shimizu"

Figure 3. Communal dug well "Maegawa"

(December 13, 2020)

On Teshima Island, dug wells were used as a source of water for daily life before the construction of a piped water supply system, owing to the abundant water resources (Figure 3). Therefore, dug well water plays an important role as a water source for life in this region. However, detailed investigations that focus on dug wells have not been conducted in this area to date. Furthermore, there are only some fragmentary descriptions of dug wells on Teshima Island, most of them in local historical literature[4)]. The distribution and number of dug wells, as well as their usage, have not been determined since the construction of the piped water supply system to the present.

Through this study, we determined the distribution of dug wells on Teshima Island, described their characteristics, and analyzed the changes in their usage. As the distribution of dug wells and their use are strongly related to the natural hydrological cycle, such as rainfall and infiltration into the ground, we estimated the water balance at one of the river basins in Teshima Island using a hydrological approach and analyzed its relationship with the island's water use.

Ⅱ. Method

In general, there are two types of water cycles: 1) natural hydrological cycle, which includes rainfall, evaporation, and infiltration into the ground, and 2) artificial hydrological cycle, which includes the use of dug wells, piped water supply systems, and sewage treatment plants (Figure 4). The artificial hydrological cycle is synonymous with human water use, and the distribution and use of dug wells is the prime factory that drives this cycle. However, because the natural water cycle is strongly related to anthropological use, it is necessary to also consider natural water recharge. Therefore, to determine the supply from dug wells and the water balance in Teshima Island, we adopted an approach that combines two different fields, namely, environmental humanities and hydrology.

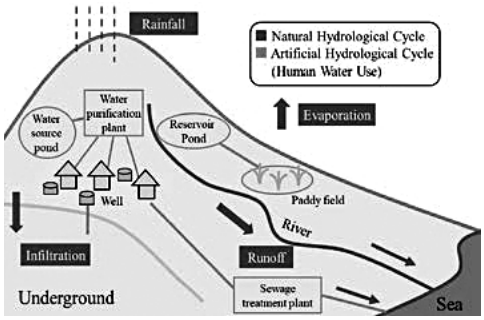

Figure 4. Interpretation of natural and artificial hydrological cycle

1. Environmental Humanities Approach

In the environmental humanities approach, we mainly focused on the distribution and use of dug wells and the related anthropological water use, including the usage of dug wells as a source for the piped water supply system. The methods applied in this approach included field surveys, interviews with residents, and the analysis of local historical literature and administrative statistics. In the hydrological approach, we focused on the natural hydrological cycle and estimated the water balance on Teshima Island using a hydrological runoff model simulation.

2. Hydrological Approach

In the hydrological approach, we focused on the natural hydrological cycle and estimated the water balance on Teshima Island using a hydrological runoff model simulation.

2.1. Hydrological runoff model

In this study, we used the Rainfall-Runoff-Inundation (RRI) model, which is a distributed runoff analysis model[5]. The RRI model simulates river runoff depending on the rainfall and flood inundation in the entire river basin in an integrated manner; notably, it even considers the inundation caused by inland rainwater in low flat basins and river branches[6]. Owing to its wide applicability, the RRI model has been applied to mountainous river basins, low flat areas in Japan, overseas river basins, and small and medium-sized rivers in Kagawa Prefecture[7].

2.2. Datasets

The RRI model uses elevation (digital elevation model, DEM), land cover classification (land cover), soil classification (soil), and rainfall data (Table 1). In our study, the Japan flow direction map (JFDM) was used as the elevation data[8]. The JFDM is a surface flow direction map of Japan with a grid size of approximately 1 s (approximately 30 m). Land cover classification data (land

cover), collected by the MODerate resolution Imaging Spectroradiometer (MODIS) in 2008, were obtained from the International Steering Committee for Global Mapping (ISCGM) (Terra and Aqua)[9] and soil texture classification data (Soil) were acquired from the Food and Agriculture Organization (FAO)[10] to include as defaults in the RRI model, with spatial resolutions of 15 s (approximately 380 m) and 5 min (about 7.6 km), respectively. For the rainfall data, we used the observations from a rain gauge installed at the top of Mt. Danyama (34.48168 ° N, 134.07820 ° E; elevation: 339 m; Figure 1), which is the highest peak on Teshima Island, by the river and sediment control division of the civil engineering department in Kagawa Prefecture.

Table 1: Input data set used in RRI model in our study

	Name	Data Source	Spatial Resolution
Elevation data (DEM)	Japan Flow Direction Map (JFDM) ver.1.31	Yamazaki, 2018 [8]	1 sec. (30 m)
Land cover classification data (Land cover)	The Global Land Cover by National Mapping Organizations (GLCNMO) ver.2	ICGCM [9]	15 sec. (380 m)
Soil classification data (Soil)	Digital Soil Map of the World (DSMW) ver.3.6	FAO [10]	5 min. (7.6 km)

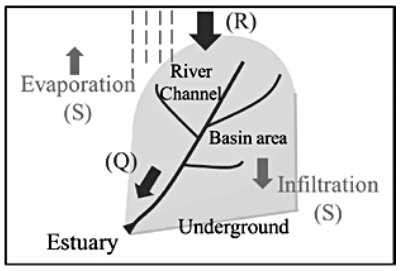

Figure 5. Concept of water balance

2.3. Concept of water balance

As a case study, the water balance, $R-Q=S$, was estimated to evaluate the natural hydrological cycle on Teshima Island, especially with respect to groundwater storage (Figure 5). In the equation, R is the total amount of rainwater, which is equal to precipitation × basin area, Q is the total amount of runoff from rivers, and S is the difference between R and Q (Table 2). In our study, S included the amounts of evaporation and storage (groundwater). For the calculation of Q, the discharge at the downstream end of the river was obtained using the RRI model.

Table 2: Parameters of water balance equation "*R-Q=S*"

"R"	*"Q"*	*"S"*
Precipitation × Basin area (m^3)	Total Discharge (m^3)	R-Q (m^3)

2.4. Target river basin

In our study, we selected Kasuga River, which has the largest basin area (1.96km^2) on Teshima Island, for our case study to estimate the water balance (Figure 6). The Kasuga River flows through the northern part of Teshima Island and traverses Ieura, which is the most populated area on the island, from south to north. The river channel and basin area were simulated using ArcGIS Pro ver.2.8.3 (Esri Inc.) using the elevation data acquired from JFDM.

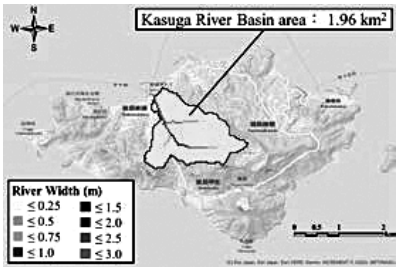

Figure 6. River channel and basin area in Kasuga River

2.5. Calculation period

The simulation was conducted for one year from 00:00h on January 1, 2015, to 00:00 h on January 1, 2016. The reason for selecting this period was because the average annual precipitation (1150mm) in the past 30 years (from 1990 to 2020) observed at Takamatsu of the Japan Meteorological Agency, Automated Meteorological Data Acquisition System (AMeDAS), is similar to the annual precipitation in 2015[11]. Notably, the annual precipitation at the top of Mt. Dannyama

on Teshima Island in 2015 was 1257 mm.

2.6. Topographical conditions of target basin

The land cover classification data acquired from the Global Land Cover by National Mapping Organizations (GLCNMO) used in the RRI model had a total of 20 classification patterns. In the case of Teshima Island, most grids could be classified as mountainous land areas, such as forests (mainly, green or orange color), except for flat cultivated land (pink) in the lower Kasuga River basin (Figure 7).

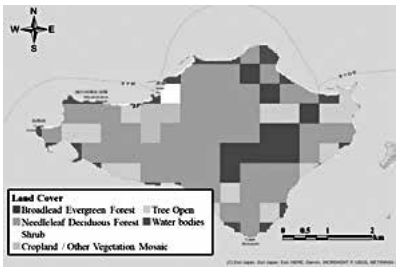

Figure 7. Map of land cover of Teshima Island using data acquired from GLCNMO

The soil classification data used in the RRI model, acquired from the digital soil map of the world (DSMW), indicated that clay was distributed over the entire area of Teshima Island; notably, clay has small inter-particle pore spaces and low permeability.

2.7. Calculation conditions for RRI model

In the RRI model, the land cover classification data were used to determine the infiltration models through the application of Darcy's law in mountainous areas and the Green-Ampt model in flatland areas. The soil classification data could delineate the parameter values for the infiltration model.

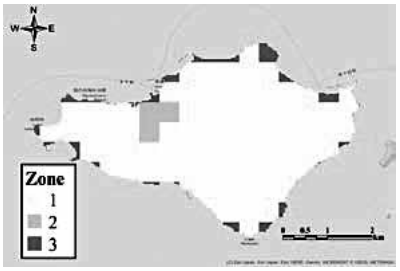

Figure 8. Set Parameter (Zone)

Table 3: Calculation parameters of RRI model (default)

Zone	1	2	3
Infiltration Model	Darcy's law	Green-Ampt Model	Green-Ampt Model
Soil	Clay	Clay	Clay
Diff or Kinem (Diffusion Wave or Kinematic Wave)	Diff	Diff	Diff
ns slope ($m^{-1/3}s$) (Manning's roughness on slope cells)	3.000d-1	3.000d-1	3.000d-1
soil depth (m) (soil layer depth)	1.000d0	1.000d0	1.000d0
gammma (effective porosity)	3.850d-1	3.850d-1	3.850d-1
ksv (m/s) (vertical saturated hydraulic conductivity)	0.000d0	1.670d-7	0.000d0
sf (m) (the suction at the wetting front)	3.163d-1	3.163d-1	3.163d-1
ka (m/s) (lateral saturated hydraulic conductivity)	1.670d-3	0.000d0	0.000d0

The application of Darcy's law for mountains areas does not allow the use of vertical saturated hydraulic conductivity (ksv) in the calculation, and the application of the Green-Ampt model for flatlands does not allow the use of lateral saturated hydraulic conductivity (ka). Therefore, according to Darcy's law, water only infiltrates in the lateral direction and not in the vertical direction, whereas the Green-Ampt model assumes that water infiltrates only in the vertical direction and not in the lateral direction.

In the case of Teshima Island, the entire area was classified into three parameter sets or zones (Zone 1, Zone 2, and Zone 3) (Figure 8). The infiltration model and calculation parameters for each zone are presented in Table 3.

Ⅲ. Result of Environmental Humanities Approach

1. Distribution of Dug Wells and Their Characteristics

A total of 57 dug wells were confirmed throughout Teshima Island by conducting field surveys twice in September and December, 2020 (Figure 9). To portray the characteristics of the dug well location clearly, the layers of dug well location, land use, elevation (JFDM), and landslides were visualized and overlaid. For the land use layer, we used the land use subdivision mesh

provided by the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) (grid size: 100 m)[12]. It was clear that most of the dug wells were located in residential areas. This means that dug well water was used as a source of water for daily life (Figure 10).

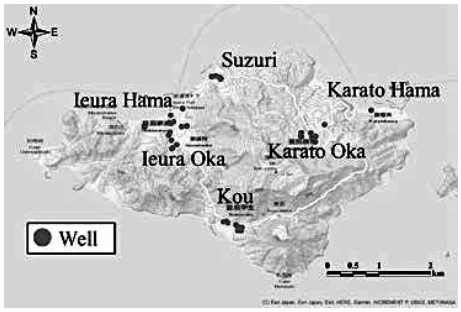

Figure 9. Distribution of dug wells on Teshima Island

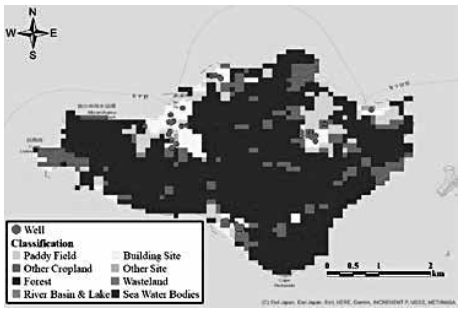

Figure 10. Distribution of dug wells with land use

In most areas, the altitude at which the dug wells were located was less than 10 m above the mean sea level (MSL), except in the Karato Oka area. The dug wells in the Karato Oka area were located at much higher elevations, between 101 and 150 m above the MSL (Figure 11). Furthermore, the location of these high-altitude dug wells overlapped with the topography of landslides (Figure 12)[13]. Notably, most of the dug wells, along with the spring "Karato no Shimizu" and rice terraces, are located near the landslide topography around Karato Oka. It was assumed that the landslide topography strongly contributes to the rich storage of groundwater in the region.

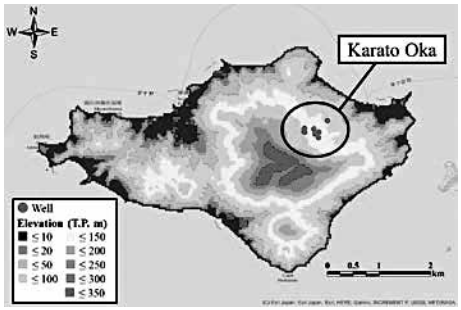

Figure 11. Distribution of dug wells and elevation

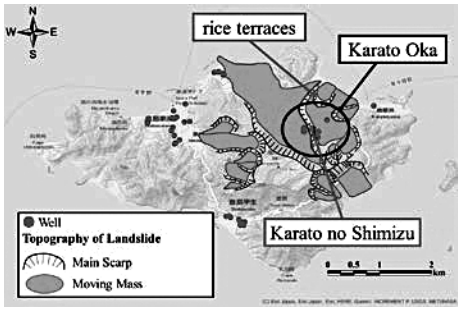

Figure 12. Distribution of dug wells and topography of landslide

2. Changes in Dug Well Use and Purpose of Usage

The introduction of piped water supply on remote islands in Japan progressed as part of the "Light and water on remote islands" project which was a part of the Remote Islands Development Act implemented in 1953[1]. The construction of the piped water supply system started in 1955 on Teshima Island, the year that the island's jurisdiction was merged with Tonosho (Table 4)[14]. During this time, piped water supply was introduced in the Ieura area, which is the most populated region on Teshima Island.

Table 4: History of piped water supply system on Teshima Island

	History of piped water supply system in Teshima Island
1953	Enactment of remote Islands development act with the keyword "Water and Light for the Islands"
1955	Completion of the Teshima Ieura piped water supply system, triggered by the merger with Tonosho town
1965	Completion of the Teshima Karato piped water supply system
1976	Completion of the Teshima Kou piped water supply system
2001	Integration of piped water supply system in Ieura and Karato area

However, in 1970, 15 years after the introduction of the first piped water supply system, the water supply coverage rate remained at 44.6%, and more than half of the population still used dug well water (Figure 13)[15]. In 1980, the water supply coverage rate rapidly increased to 95%. Corresponding to the increase in the piped water supply coverage rate, opportunities for using dug wells decreased, and ever since, their use as a source of water for daily life has been declining.

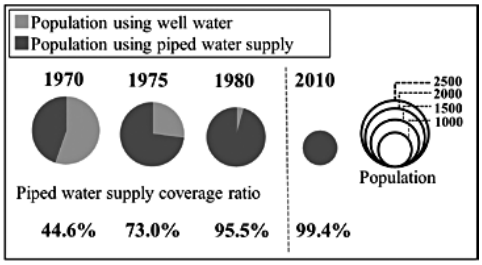

Figure 13. Changes in population using dug wells water and piped water from 1970 to 2010

Based on our interviews with local residents about the current use of the dug wells, we obtained testimonies that they no longer used the dug wells as a source of drinking water because of the easy access to safe water via the piped water supply system. However, some households still use dug wells, albeit only for outdoor water use, e.g., for watering plants and vegetables and cleaning purposes. Thus, residents use different water sources according to their needs.

Ⅳ. Result of Hydrological Approach

1. Default Topographic Conditions (Darcy's Law)

Using the RRI model under the default conditions (Table. 3), we considered the runoff at the downstream end of the Kasuga River in 2015 as the output and calculated the water balance (Table 5). For the given amount of rainfall (R), 90% was observed as the runoff (Q) from the river; 10% was the residual difference (S). The Q estimated in our study exceeded the estimates calculated in previous studies that estimated the water balance of Ishima Island, which is located to the west of Teshima Island; notably, our estimate did not reflect the actual situation.

Table 5: Water balance in Kasuga River basin (default condition)

	"R" Rainfall × Basin area (m^3)	"Q" Total Discharge (m^3)	"S" R-Q (m^3)
Clay	2469883 (100%)	2242970 (90.8%)	226913 (9.2%)
Sand	2469883 (100%)	229058 (90.3%)	240825 (9.7%)

To address this issue, the soil cover classification of the region was changed to sand, which has a higher hydraulic conductivity than clay and is known to have a higher permeability (Table 6). The water balance was calculated again using the calculation conditions listed in Table 6. The results were the same as those obtained for clay, where Q accounted for 90%, and S for 10% of total R (Table 5).

The reason why Q accounted for 90% was because of the similar infiltration conditions in each zone. The default infiltration model uses Darcy's law over a wide area of Teshima Island (Tables 3, 6, and Figure 8). In Darcy's law, rainwater does not infiltrate vertically and only laterally, regardless of soil conditions. Therefore, it was considered that most of the given rainwater did not infiltrate into the ground and flowed into the river.

Table 6: Caluculation parameters of RRI model (sand)

Zone	1	2	3
Infiltration Model	Darcy's law	Green-Ampt Model	Green-Ampt Model
Soil	Sand	Sand	Sand
Diff or Kinem (Diffusion Wave or Kinematic Wave)	Diff	Diff	Diff
ns slope ($m^{-1/3}s$) (Manning's roughness on slope cells)	3.000d-1	3.000d-1	3.000d-1
soil depth (m) (soil layer depth)	1.000d0	1.000d0	1.000d0
gammma (effective porosity)	4.170d-1	4.170d-1	4.170d-1
ksv (m/s) (vertical saturated hydraulic conductivity)	0.000d0	6.540d-5	0.000d0
sf (m) (the suction at the wetting front)	4.950d-2	4.950d-2	4.950d-2
ka (m/s) (lateral saturated hydraulic conductivity)	6.540d-1	0.000d0	0.000d0

2. Changes in Infiltration Conditions (Green-Ampt Model)

To reduce Q, the Green-Ampt model was used as the infiltration model for all zones in the Kasuga River basin (Table 7). Notably, in the Green-Ampt model, water infiltrates in the lateral direction and not in the vertical direction. Generally, when the soil layer is saturated with water and infiltration exceeds the limit, excess infiltration is discharged as surface flow.

Table 7: Calculation parameter of RRI model (Green-Ampt model)

Zone	1, 2, and 3	
Infiltration Model	Green-Ampt Model	
Soil	Clay	Sand
Diff or Kinem (Diffusion Wave or Kinematic Wave)	Diff	Diff
ns slope ($m^{-1/3}s$) (Manning's roughness on slope cells)	3.000d-1	3.000d-1
soil depth (m) (soil layer depth)	1.000d0	1.000d0
gammma (effective porosity)	3.850d-1	4.170d-1
ksv (m/s) (vertical saturated hydraulic conductivity)	1.670d-7	6.540d-5
sf (m) (the suction at the wetting front)	3.163d-1	4.950d-2
ka (m/s) (lateral saturated hydraulic conductivity)	0.000d0	0.000d0

The water balance using the Green-Ampt model for the Kasuga River basin indicated that when the soil type was clay, approximately 60% of the water was discharged from the river as Q, and the remaining 40% was S (Table 8). However, when the soil type was changed to sand, although the R/Q ratio was slightly (2.5%) different from that when the soil type was clay, approximately 60% of the water was discharged from the river as Q and 40% was S, similar to that observation for the model that considered the soil cover to be clay.

Next, the temporal variations in river discharge under clay and sand cover were compared. Although there was no significant difference in Q over one year, the maximum discharge and temporal variations in the discharge differed depending on the soil type. For example, in April, the maximum discharge for clay soil was 1.75 m^3/s, while that for sandy soil was 0.21 m^3/s, more than 8 times greater than that for clay soil (Figure 14a). Notably, clay has a low infiltration capacity, and with time, water can infiltrate the subsurface; however, when it rains continuously, it is difficult for water to infiltrate into the subsurface in a short time. Therefore, in the case of clay, most rainfall does not infiltrate the ground and flows out as surface flow. As a result, river discharge can be expected to increase. In contrast, in the case of sand, the soil pore sizes are large and the permeability is high; thus, rainwater can easily infiltrate the ground.

Table 8: Water balance in Kasuga River basin (Green-Ampt model)

	"R" Rainfall × Basin area (m^3)	"Q" Total Discharge (m^3)	"S" R-Q (m^3)
Clay	2469883 (100%)	1448561 (58.6%)	1021322 (41.4%)
Sand	2469883 (100%)	1386171 (56.1%)	1083712 (43.9%)

In April, there was no excess water infiltration, and the amount of water flowing into the river as surface flow was less because rainwater infiltrated into the ground. Moreover, with respect to the data for June, there was almost no difference in the maximum discharge and temporal variation of the flow rate between clay and sand (Figure 14b). The reason for this was that both clay and sand were saturated with water in June, and the precipitation that exceeded the saturation level did not infiltrate into the ground and flowed out to the river as surface flow.

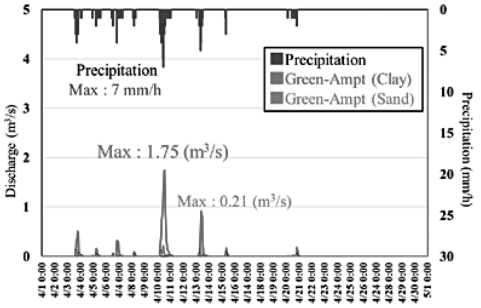

Figure 14a. Hyetograph and hydrograph (April, 2015)

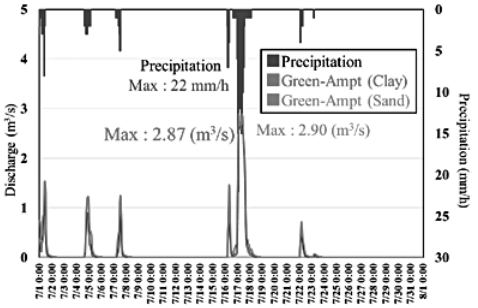

Figure 14b. Hyetograph and hydrograph (June, 2015)

Ⅴ. Conclusion and Future Scope

In this study, the distribution and locations of dug wells on Teshima Island were clarified using environmental humanities and hydrological approaches. It was found that dug wells are still used as a source of water for outdoor use other than drinking, 60 years after the construction of the piped water supply system, even though the piped water supply coverage ratio was almost 100% during our study period.

The hydrological runoff model was used to calculate the water balance in the Kasuga River basin. The water balance equation revealed that Q significantly changed because of the different infiltration conditions considered by Darcy's law and the Green-Ampt model; furthermore, we deduced that the soil conditions largely contributed to the temporal variations in river discharge.

Notably, the residents informed us that there may be dug wells inside old houses, and it is highly possible that a greater number of dug wells may exist than the 57 dug wells determined in this study. In addition to the usage of dug wells, we obtained information on the characteristics and quality of the dug well water, such as changes in the water level of the dug wells and the water salt content. In the future, we would like to identify the number of existing dug wells throughout Teshima Island, study the changes in their water level, and analyze the water quality. The provisional water balance was estimated using the RRI model, but the accuracy of the simulation results was not determined because of the lack of observational data. A3L (low cost, long life, and localized) water level gauge was recently installed in the middle part of the Kasuga River by the Kagawa prefectural government[17], and this could be used to calibrate the output of the river discharge.

In this study, we only calculated the water balance and did not estimate the specific groundwater flow and storage in Teshima Island. Notably, groundwater flow and storage are considered to be closely related to the distribution and use of dug wells. In a future study, we would like to clarify the relationship between the groundwater flow/storage and the distribution and use of dug wells in the region using higher-resolution land cover and soil data, along with a hydrological cycle simulation model specialized for groundwater flow.

Ⅵ. Acknowledgement

This work was supported by the Japan Society for the Promotion of Science (JSPS) KAKENHI, Grant-in-Aid for Scientific Research (B) (Grant. No. JP20H01523).

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Verification of human resources development methods for continuous disaster prevention and crisis management unique to local governments

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Ⅰ. Introduction

In Japan, large-scale disasters such as the Great East Japan Earthquake[1)] and the Kumamoto Earthquake [2)]and heavy rain disasters occur almost every year. Local governments will be at the forefront of disaster response. However, in disaster response, there are some disasters where past experience is not always utilized in local governments that have little experience of disasters. In recent years, there are systems developed by AI that can analyze and advise on past disaster data, but only humans can make the best use of that data, and humans must make the final decision. In addition, humans need to respond in the field. Therefore, human resource development is one of the important issues because it is necessary to outsource data aggregation and analysis to AI, make human decisions, and respond, cooperate, and coordinate in the field.

Therefore, in this study, a training system for staff of local government was established. In the training system, the local government first trained disaster prevention and crisis management specialists for one year as the leader of the organization. In the next step, the specialist trained other members of the organization through a 10-hour training program prepared by the specialist. In this study, the effectiveness of the training program was verified at Sakaide City Hall.

Ⅱ. Outline of the training system

1. System features

In this study, local governments independently train specialists within their own organizations, and the specialists provide disaster prevention and crisis management specialized training to all staff. It is a circular training system[3)]. There are two points in this training system.

1) A cyclical training system

Local governments train specialists in disaster prevention and crisis management education by themselves, and the specialists continuously train all staff. By doing so, it can be expected that the disaster prevention and crisis management capabilities of the entire organization will be enhanced. Expert training will be held in the first year, disaster prevention / crisis management training for all other staff in the second, third, and fourth years, and expert training again in the fifth year. By using the system, we will continue the system on a regular basis and enhance the training content. In short, it is a cyclical training system (Fig1).

2) We divide the 16 specialists into 4 groups, A to D, and one of those groups mainly provides professional training. The main group rotates for each training session. G1 to G4 members are in

charge of training for the same program, and each group reviews the materials and slides used in the training (Fig2)

Fig1. New training system image

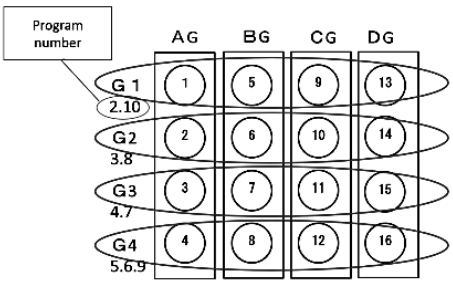

Fig2. Grouping of specialists

2. Participants in specialist training

The target audience for experts is the staff of the crisis management office, the staff of the former crisis management office who have been transferred to other departments, firefighters, and trained applicants will be designated under the guidance of experts in future. The reason is that the staff of the Crisis Management Office play a central role in disaster response in the city, such as the operation of the disaster response headquarters, and firefighters participate in disaster sites on a daily basis. In addition, participants in designated training sessions are also eligible. This system can increase the number of specialists year by year. In the first phase, a total of 16 professionals were trained, including 5 staff from the Crisis Management Office, 5 staff from the former Crisis Management Office, and 6 firefighters.

3. Training content

To that end, we have formulated a 40-hour specialized training curriculum by expert (Fig. 3) and a 10-hour designated training curriculum by specialists (Fig. 4).

The designated training content was conducted in the form of classroom lectures, workshops, and exercises. The training content is "disaster prevention knowledge", general disaster prevention, damage estimation / hazard map. The "plan" is the operation, support, and support system of the disaster prevention headquarters. "Training / Workshop" includes training, action card creation, and simulation training, which are systems for imagining disaster response on a map and experiencing disasters. As a "system," we conducted training on the handling of prefectural disaster prevention information systems and earthquake / tsunami observation / monitoring systems (DONET).

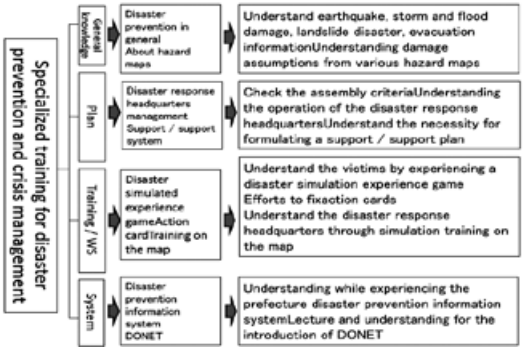

Fig3. Specialist training curriculum

Fig4. Training curriculum for all staff underexpert guidance

Ⅲ. Result

Regarding verification of the training system, we exchanged opinions and conducted a questionnaire survey with the specialists who provided guidance after the training. We also conducted a questionnaire survey of the training participants. From the specialists (16 people), there was no particular problem in teaching in the exchange of opinions, but there was an opinion that it is necessary to change several contents and order of some programs in progress. From the results of the questionnaire, 69% of the respondents answered that the system for rotating the group mainly in charge of training was generally good (Fig. 5). However, 12% of them gave a negative answer. Regarding the guidance system that divides the program in charge, almost all answered that it is good (Fig. 6). From 89% of the participants (a total of 88 people in the two training sessions) answered that the circular training system was generally good. No one took it negatively (Fig.7).

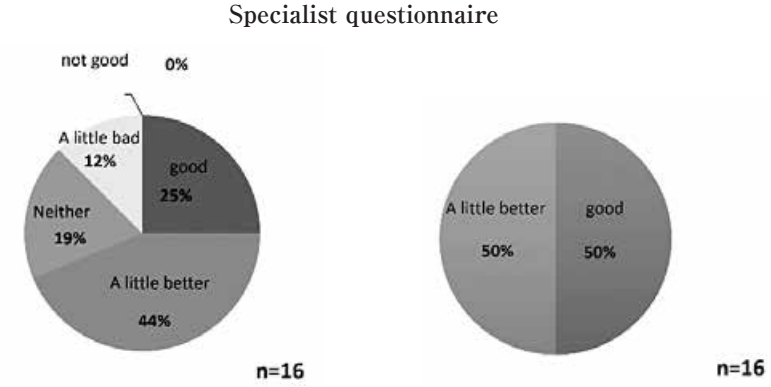

Fig5. Opinion about the method in which one group is mainly in charge of each training is good.

Fig6. Opinion about grouping your programs and standardizing materials is good.

Ⅳ. Discussion

After the initial training, after exchanging views with specialists, some progress issues were raised. As a result of urgently considering and modifying the second program, there was a reply that it was good to exchange opinions after the second training. In addition, from the results of the questionnaire, 12% of the respondents had a negative opinion about the group rotation system, which is mainly in charge of training. This may be due to lack of confidence in teaching. The solution is to divide the program into groups, take charge of teaching materials and teaching

methods, and standardize them. A system that enables mutual follow-up even with little educational experience is considered good. The group responsible for each program has the flexibility to work within the group until each specialist becomes accustomed to education.

From the results of the questionnaire to the participants, it can be said that the system that trains the experts of the organization and conducts disaster prevention / crisis management training for all staff is an effective training system within the organization.

Fig7. Opinion about the training system is good.

V. Conclusion

Based on the above results, we have established a regular training system to train specialists within the organization and instruct all staff. In addition, we utilize the rotation group system that is mainly in charge of training and the style of creating and standardizing teaching materials for the programs and support specialists who are unfamiliar with and uneasy about teaching. It is effective because the specialists can improve their skills through those programs. Furthermore, this training system is just a framework, so each organization can freely set the curriculum content, training time or number of participants, considering the characterictics of the regio.

Moreover, it the number of specialists or the number of people in a group is set freely, the system can be introduced regardless of the size of the organization.

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Development of human resource development methods for local disaster prevention and crisis management. JSNDS, Vol 40, No.1, pp67-79, 2021

Closing remarks

The EJEA Conference 2021 in Kagawa was conducted online from October 22 to 24, 2021. About 200 participants from 13 countries delivered 80 presentations in the conference.

After the conference, all presenters were offered the opportunity to submit their work to be published as journal articles in one of two journals, namely the 'Kagawa University International Office Journal' (ISSN 1884-8745) and the 'Frontiers in Artificial Intelligence / AI for Human Learning and Behavior Change'.

13 submissions were received by the Editorial Committee of Kagawa University International Office Journal. For each manuscript, 2 reviewers were appointed.

The Editorial Committee also decided to publish the abstracts of all the other papers from the conference. Furthermore, records related to the preparation, the actual event, and the follow-up activities of the conference were also included.

This special issue acts as an archive for the EJEA Conference 2021 in Kagawa. Hopefully it can be used as a reference material for the next EJEA Conference which is scheduled to be held in November 2022 in Berlin, Germany.

Finally, the Editorial Committee wishes everyone involved in the EJEA Conference 2021 in Kagawa good health and much happiness and hopes that everybody stays strong to overcome the COVID-19 pandemic.

March 11, 2022
Editorial Committee of Journal of Kagawa University International Office

結　語

2021年10月22日～24日にオンライン開催された、EJEA Conference 2021 in Kagawaでは、13カ国からの約200名の参加登録者に80演題の発表を届けることができた。

本カンファレンスでの発表者には、論文として発表できる機会を提供した。一つは、Frontiers in Artificial Intelligence / AI for Human Learning and Behavior Changeであり、もう一つは、香川大学インターナショナルオフィスジャーナル（ISSN 1884-8745）である。

後者には、Proceedingsとしての掲載を希望する13のmanuscriptの投稿があった。香川大学インターナショナルオフィスジャーナル編集委員会では、各manuscriptに２名の査読者を指名し査読を行った。また、その他のカンファレンスでの発表については、アブストラクトを掲載することとした。それに加えて、EJEAカンファレンス開催にあたっての準備から当日の運営と開催後の処理までに係る様々な記録も掲載し、今回のカンファレンス開催のアーカイブとなるように企画した。

次回のEJEAカンファレンスは、2022年11月にベルリン（ドイツ）での開催が予定されており、その参考になればいいと願っている。

最後に、日本で初めて開催したEJEAカンファレンスに関わった全ての方々が、新型コロナウィルス感染症に打ち克って健康で幸多かれと願い、結びの言葉とする。

2022年３月11日
香川大学インターナショナルオフィスジャーナル編集委員会

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