DIMECC

ANNUAL REPORT 2018

CONTENT

NTRODUCTION

This annual report summarizes 2018, the 11th operational year of DIMECC Ltd. The mission of DIMECC is to be the leading co-creation platform for digital transformations. In summary, 2018 was a real turnaround year of our company. The focus of DIMECC changed during 2018 from leading primarily large research program portfolio towards versatile facilitation of new innovation openings. In the future, both of these will be in the service toolbox of DIMECC.

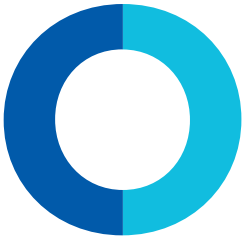
As a short summary of new openings: We started a new artificial intelligence project MIDAS. We created new concept DIMECC Machine Learning Academy for tailored coaching of companies. Finnish Industrial Internet Forum (FIIF) was renewed by us. DIMECC Ltd. acquired minority shareholdership of Demola Global Ltd. Autonomous maritime traffic (One Sea) took a serious step forward with the unique legislative opening by the Finnish government and an exceptionally long-term public funding by Business Finland. We planned a national cyber security growth roadmap for Finland, and we started the first ever Swedish government funded program (Smart Steel II) with Vinnova.

DIMECC – Digital, Internet, Materials and Engineering Co-Creation – Ltd. is a non-profit company, and the form of our annual report primarily supports the documentation of the most important impact, outcomes, and activities. Economic analysis is not in focus because the objectives of DIMECC Ltd. are in long-term change of company-university cooperation, knowledge creation, and innovation activities' impact rather than in financial perspective.

For more information about DIMECC, see www.dimecc.com.

DIMECC IN NUMBERS 2018

- 1M€ PoDoCo scholarships by private foundations
- 300+ Customers
- 2 000+ Persons involved in DIMECC activities
- DIMECC MLA launched: 34 participants, 10 organizations
- 3 FIIF Events and 2 sessions
- 11 Employees
- 3 DIMECC offices (Helsinki, Tampere, Turku)



UTCOMES AND IMPACT AS THE BASIS – THE POSITIVE WAY FORWARD IS OPEN

DIMECC Ltd. is the leading industry-led co-creation platform for boosting digital transformation and disruption in EU. In October 2018, we hosted the 10-year anniversary party of our company in Helsinki with about 180 invited guests. The work-oriented networking party gave a reminder that industrial leaders, entrepreneurial minds, and academic & practical research really belong together. The celebration day was used to publish *ÄlySuomi*, our fresh statement on what kind of a country and innovation atmosphere is needed in order to reach Finland's official targets of innovation leadership and 4% investment of GDP in RDI.

The best and the most fruitful part of Finnish innovation system during the last 40 years has been collaborative research and cooperation over the boundaries. All kinds and sizes of companies, all kinds and sizes of educational and research institutes, and all disciplines at universities have been integrated to same projects, programs, targets, and joint work when needed. DIMECC was built on this tradition, and we have changed the set-up from individual collaborative research projects to continuous co-creation within ecosystem that is not limited to any specific time, project, funding, partners, or topic. This has been able with the help of governmental public funding instruments, that have, at the same time, incentivized collaboration over the boundaries of any single organization and accepted systematic upscaling of the really important objectives. This is exactly what EU will call "Missions" in the next framework program Horizon Europe.

The way forward in Finland should be the re-establishment of Public Private Partnership as an official policy and funding instrument. PPP works now in Finland as a bottom-up model and for small projects, but the scalability in the era of ecosystem and platform economy is lacking, and the systemic use of all kinds of resources, competence, and knowledge for missions larger than any single consortium or project is missing.

Finland needs the Academy of Finland and Business Finland to fund joint projects, joint research, and joint targets. Finland needs the fundamental research and applied research to be connected to industry and business. We need neutral facilitators capable to work with private sector methods and incentives, and under public sector policy, mandate, and funding. The facilitators should be independent from any single executing or implementing organization (e.g. regions, companies, and universities). We need research, development, and innovation programs, where the total innovation funnel is present, and all the players are subjected to meet the unexpected partners, solutions, and disciplines.

While Finland has advantage and benefits for historical reasons in the global competition in this specific collaboration area, most of the European countries are investing significantly more today. Innovation system should produce impact for taxpayers, not only research results or single commercial outcomes. The fastest way to high impact in a small export-oriented economy like Finland is to build on collaborative and systemic PPP and innovation platforms that have proven track-record.

Since 2008, an investment of 830M€ has been made through DIMECC programs. Share of public and private funding in this has been about 50/50. In 2017, this ended up to 5.3B€ business potential measured and announced by DIMECC's shareholders and customers. This means that DIMECC creates 10 euros business, growth, and jobs for each invested public euro on average. If scaled only to five-year average program life-time, the ratio is as high as 20! All this is done with administrative costs of only 3,5%, which

is the lowest management fee in European RDI activities. This business potential as such is a record-high pay-back in Europe, but with such a lean and cost-efficient organization, it means transcendent productivity.

DIMECC has proven track-record since 2008 in following outcomes:

1) Shorter time-to-market. There is a clear evidence from companies' quantitative and qualitative feedback, that by participation in DIMECC activities has led to faster executions than trying to carry out tasks alone. With DIMECC Demobooster, the time for searching right partners to create POCs and MVPs was decreased from three weeks to two days.

2) Increased probability of innovation. Statistics Finland data 2016 shows that DIMECC's customers outperform the comparison group in all business success and performance measures.

3) Neutral, open platform for all. DIMECC does not sell any specific capacity, idea, or technology. We facilitate ideas to pop-up, we help organisations to co-create making sure that the best experts from selected fields are contacted independently from the name, size, or location of their employer. Public funding is used only to increase the risk that private money is willing to take. As an example, DIMECC is the professional facilitator of One Sea ecosystem, bringing competing marine industry companies and the whole industry together for joint efforts towards autonomous maritime logistics and business.

The great industrial turnarounds of Meyer Turku, Nokia, and Outokumpu have all been made during significant investments in DIMECC programs. Successful products and services like Ponsse Scorpion, Wapice IoT Ticket, SSAB Smart Steel, and KONE People Flow have been created, further developed, or finalized in DIMECC programs. The start-ups and spin-offs like Sapotech, Luxmet, SFTec, and DIMECC Prize 2018 winner Norsepower have used DIMECC as their platform for growth.

2018 was a real turnaround year of our company. The focus of DIMECC changed during 2018 from leading primarily large research program portfolio towards versatile facilitation of new innovation openings. DIMECC initiates and facilitates business ecosystems, that have ambitious targets of creating growth, jobs, and new business worth of billions of euros. DIMECC's wide shareholder and customer base prepares and implements roadmaps to make the shared visions reality. The roadmaps include all kinds of co-creation activities from large-scale systemic research, development, and innovation programs to specific and detailed facilitation services, which are typically trademarked.

I would like to thank DIMECC's customers, program participants, investors, shareholders, stakeholders, service suppliers, and our personnel for the successful turnaround year 2018!

Harri Kulmala, CEO

IMECC OPERATIONAL MODEL

DIMECC thematic areas

Digitalization is not just about embracing new technology. Instead, it is a comprehensive approach referring to the changes associated with the application of advanced technological solutions at all levels of organization and in all aspects of business. Technological innovations lead to technology disruptions. Companies need to adopt new technologies by utilizing new solutions in products and services and by integrating traditional assets to address new challenges and pursue new opportunities. The business process needs to build new capabilities and formulate new business models to exploit full potential of emerging technologies, to create intelligent and sophisticated customer understanding and to harness customer value. Digitalization also drives systemic changes throughout the industry affecting society overall. Thus, to unlock the potential of digitalization comprehensive systemic approach are needed. DIMECC's vision is to be the leading co-creation platform for digital transformations. The vision is achieved through mission driven co-creation activities in four main domains:

1. Manufacturing,
2. ICT,
3. Maritime, and
4. Materials.

Under these four domains DIMECC drives systemic change by addressing following thematic areas:

1 **Enabling Technologies:** World-class enabling technologies and utilization of these technologies in business creating competitive advantage and differentiation in the market.

2 **Technology Cross-utilization:** Global leadership in technology cross-utilization and technology integration by combining latest R&D&I results and by turning these to insightful market offerings.

3 **Business:** Capabilities to exploit the full potential of emerging technologies in business, to create intelligent and sophisticated customer understanding and to harness customer value.

Research programs and projects have been an important part of DIMECC's operation and continue to be. To achieve the targets other co-creation instruments are needed as well: co-creation services and network actions focusing on facilitated foresight activities, ideation, innovation commercialization, rapid prototyping and crowdsourcing are integrated as an essential part of our operations. The purpose of these activities is to accelerate the research work of the programs and support the research work execution even after the programs finish. These activities include, for example: Demobooster (rapid commercialization), PoDoCo (strategic renewal & technology transfer) and effective utilization of partnership networks.

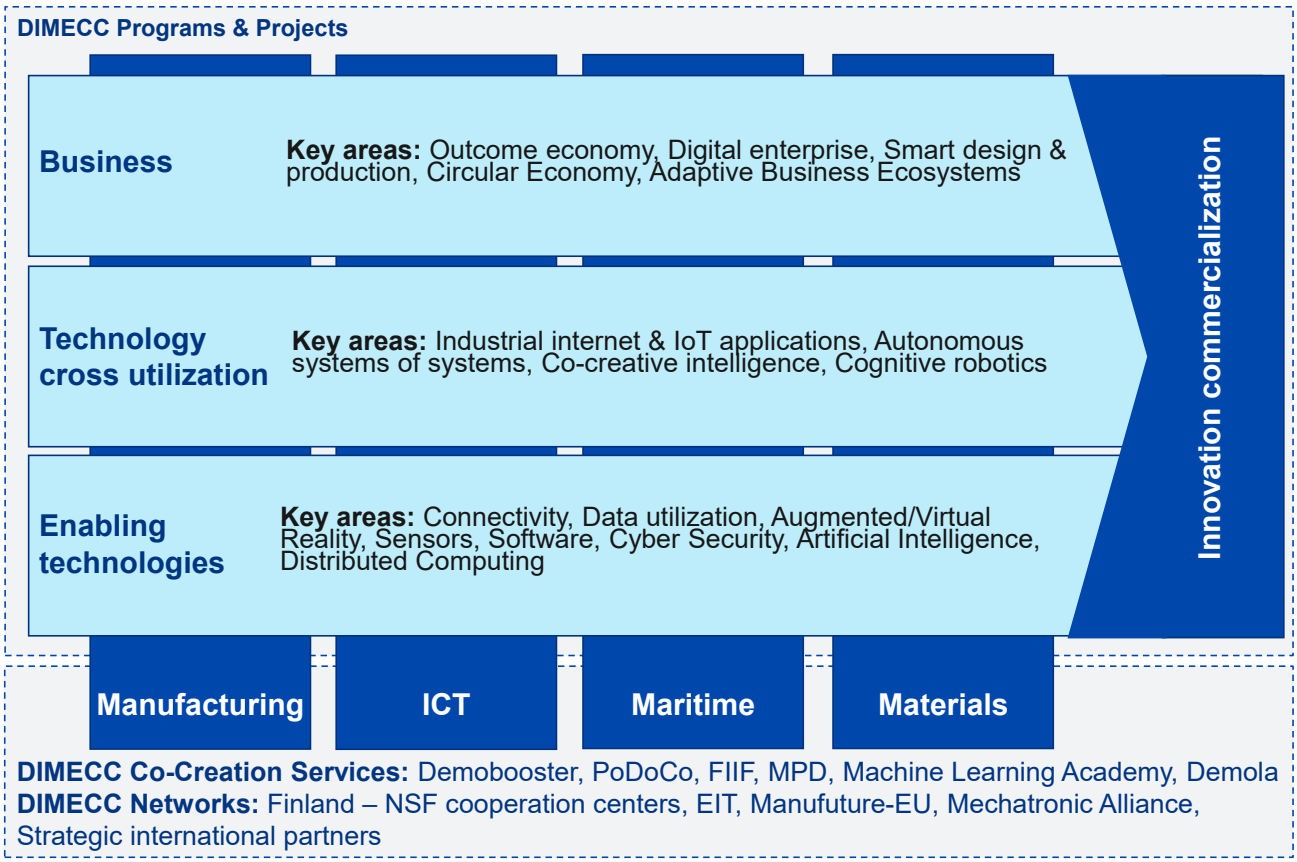


Figure 1: DIMECC main domains and thematic areas.

DIMECC innovation funnel

DIMECC's role in the innovation landscape is to effectively resolve the challenging high-risk research questions with significant business potential through mission driven co-creation. DIMECC accelerates R&D&I activities through three types of services:

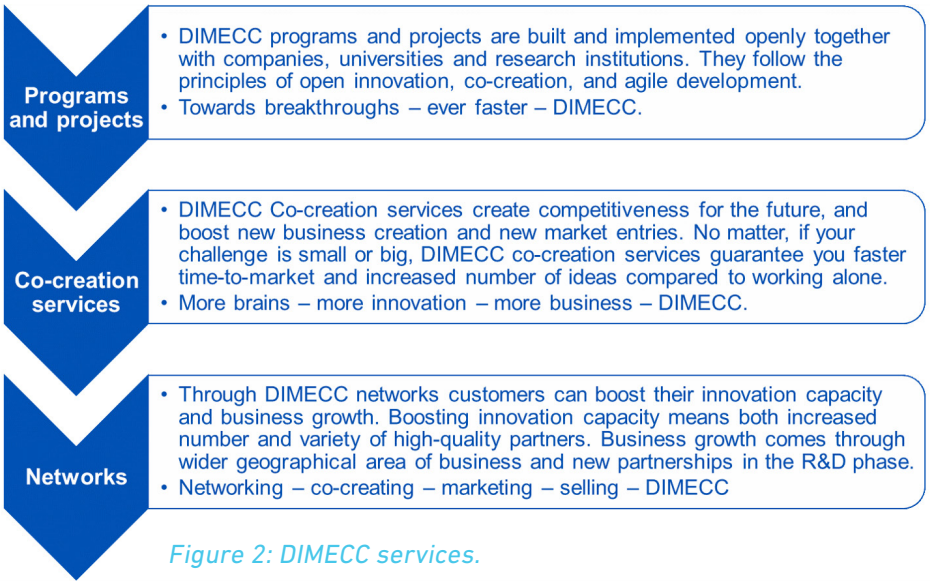


Figure 2: DIMECC services.

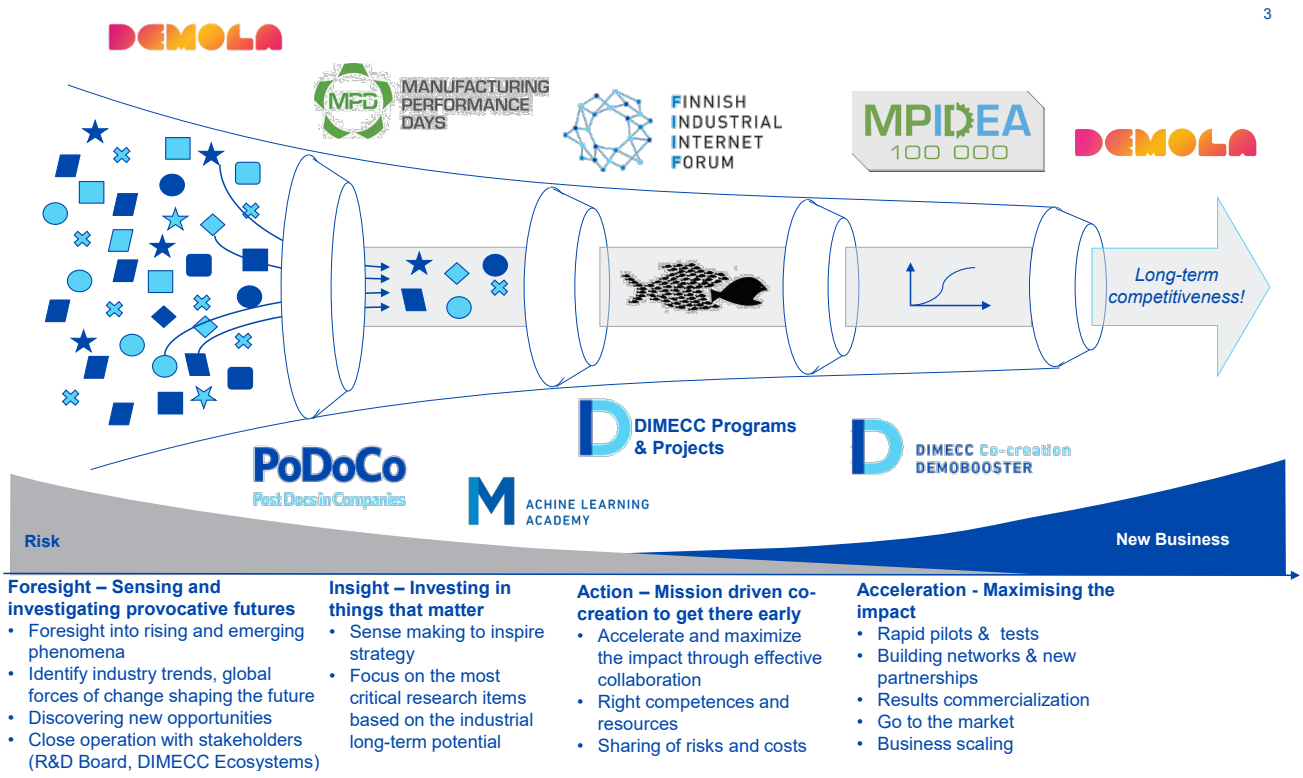


Figure 3: The relationship of DIMECC Innovation Funnel and DIMECC services.

1. **DIMECC Programs and projects** – Accelerate your R&D&I

2. **DIMECC Co-creation services** - Speed up your sales and R&D&I

3. **DIMECC Networks** - Open up new avenues for business

DIMECC's process can be described as an "innovation funnel". DIMECC innovation funnel is accelerated through DIMECC services (i.e. programs & projects, co-creation services and networks).

In the first phase industry trends and global forces of change that are the shaping the future of industry are identified and elaborated. The aim is to discover new opportunities of future. The shareholders define the focus of DIMECC activities and foresight activities are carried in close collaboration with DIMECC shareholders. This is organized through an R&D board that is used for foresight activities to produce and interpret the foresight data. Also, DIMECC ecosystems are in important role in producing foresight to selected industry domains.

In the second phase shared understanding of future business opportunities are formed and R&D&I needs required to realize future opportunities are identified. The aim of the second phase is to define the most relevant strategic research areas. Relevant strategic research areas need to fulfil the following criteria: 1) Significant long-term business potential; 2) High scientific ambition; 3) Enough joint industrial interest. Based on the defined strategic research areas future R&D&I programs and projects, and other joint development actions, such as training and competence development programs, and commercialization activities, are initiated.

The third phase focuses on company driven development activities that turn the new opportunities into business that ensure the competitive advantage of Finnish industry. DIMECC mission driven PPP-programs and projects are an effective way to accelerate strategic research in which risks and investments can be shared while the benefits of the results are maximized within the consortium partners. The programs enable large companies and SMEs to co-operate with the leading national and international universities and research teams. The work developed in DIMECC´s programs and projects are often transversal with respect to the different thematic areas. The development and growth of individual companies is a key motive for the companies to join DIMECC, but DIMECC's aim are systemic digital change which goes beyond the success of individual companies.

DIMECC maximizes the impact through DIMECC co-creation services and DIMECC networks, which focus on accelerating the development actions of individual organizations and in which the research results are developed in the direction of the commercial phase. All the activities drive towards result commercialization, enabling the long-term competitiveness of the industry.

Overall DIMECC emphasizes the development of the ecosystem through which individual companies can develop their business in collaborative manner. The systemic R&D&I programs and projects focus mainly on precompetitive research, while many co-creation services are close to market. Since all R&D&I programs and projects within DIMECC are industry-driven, the results are strategically important for the companies and interest to go to market with them is in-built into the DIMECC system.

DIMECC key operation responsibilities

DIMECC's organization and operating model are based on lean operations through which network-based co-creation activities can be effectively steered and managed. This operating model requires strong commitment from shareholders and other stakeholders, which is ensured on a strategic level through typical limited company processes – steering and governance by a Board of Directors. The core content is steered by shareholder experts in the R&D council, and committed customers in the Management Boards of DIMECC's ecosystems. Both the BoD and R&D council are used as communication channels.

The operating infrastructure of DIMECC (employees, offices, etc.) is paid through service fees.

DIMECC Activities

DIMECC Programs and Projects

This chapter introduces shortly the program and activity portfolio and research volumes of DIMECC in 2018. All on-going research programs, projects and other activities can be joined later, if the existing consortium accepts the new applicant and the new applicant accepts the existing consortium agreement.

The focus of on-going programs in 2018 was in initiating the creation of DIMECC's new Strategic Research Agenda based on strong vertical focus. The renewal effort took place through One Sea and Intelligent Industry ecosystems.

Following figures represent companies' (Figure 5) and research institutes' (Figure 6) DIMECC participation in all programs in 2018. The budget division of DIMECC program portfolio in 2018 is presented in Figure 7.

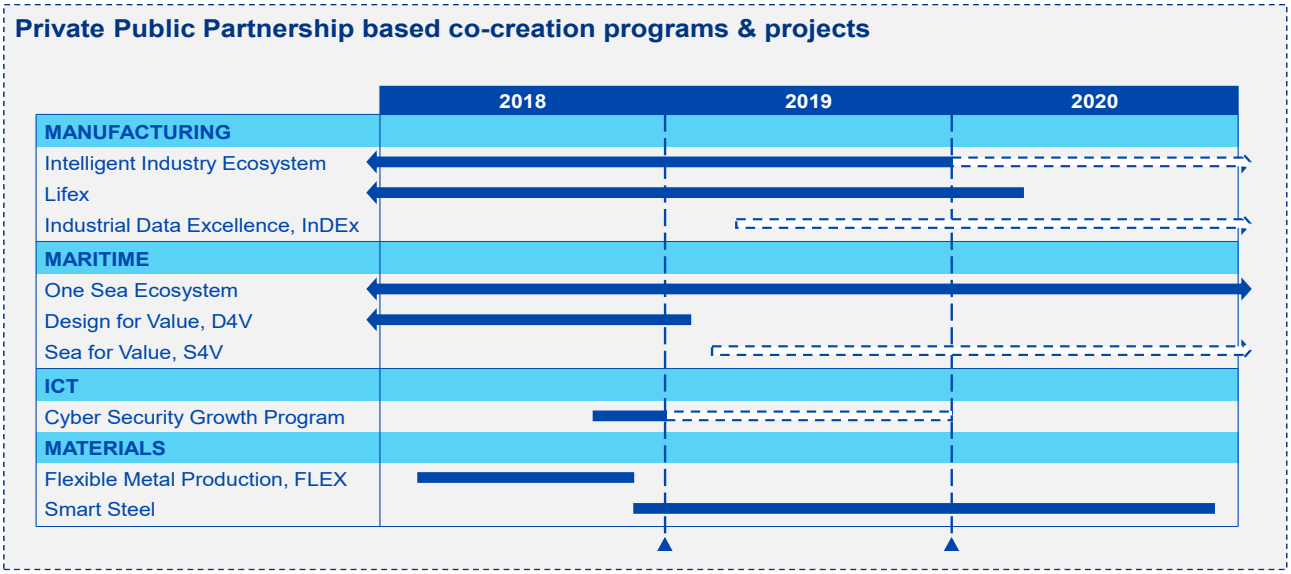


Figure 4: DIMECC program portfolio 2018

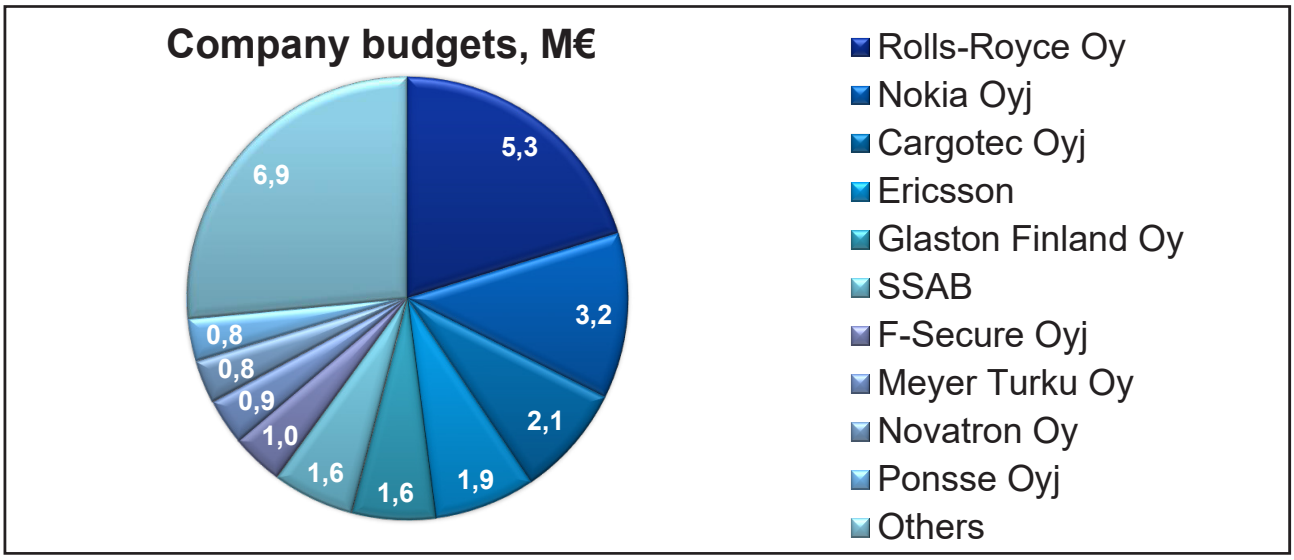


Figure 5: Companies' total investments in DIMECC portfolio (M€) in 2018.

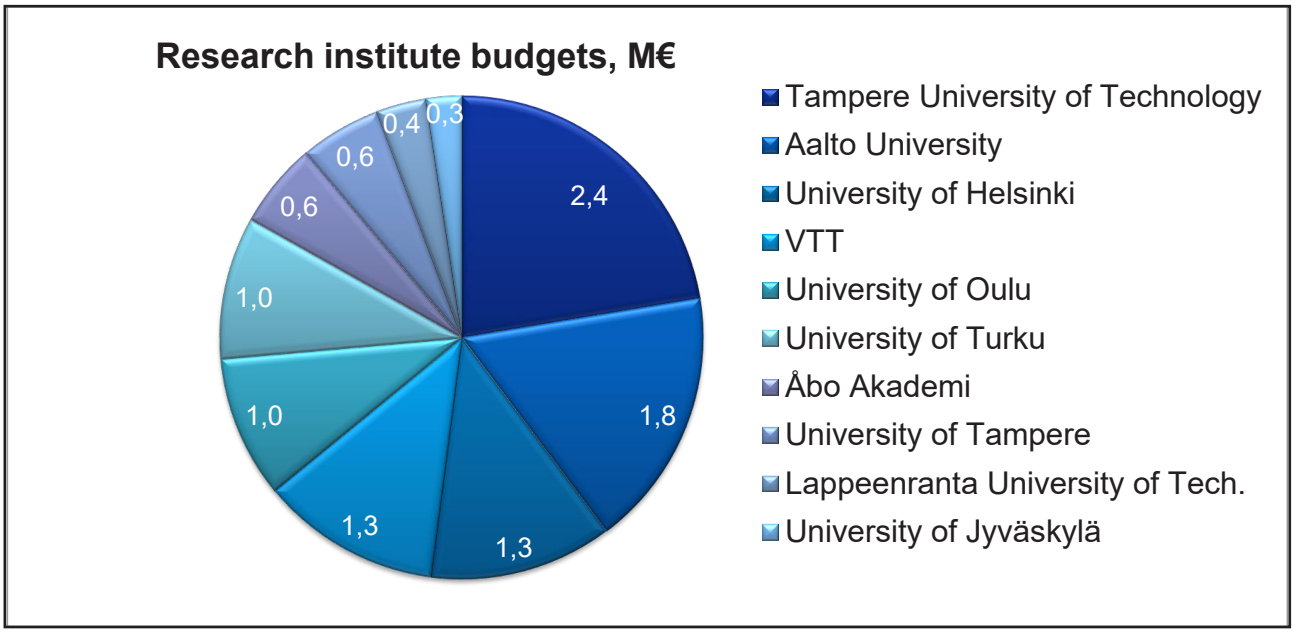


Figure 6: Research institutes' total program budgets in DIMECC portfolio (M€) in 2018.

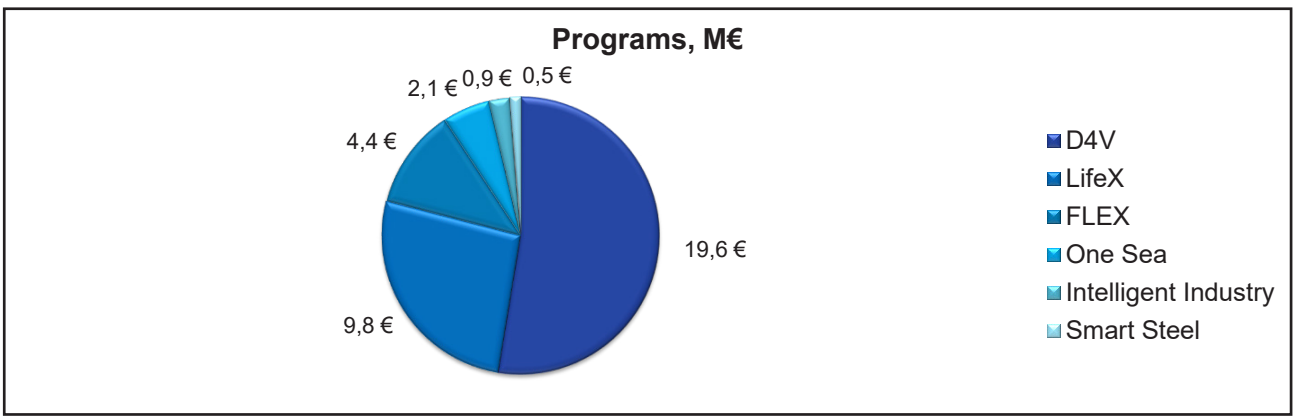


Figure 7: Total budget division of on-going DIMECC portfolio (M€) in 2018

Current DIMECC portfolio

DIMECC Program
D4VALUE

DIMECC D4Value program will enable the best possible use of digital disruption for business growth. The D4Value program has a strong industry demand which has been emphasized by the rapid development in different supply chain parts (factories, ports, ships, etc.). The program focuses on door-to-door supply chain which is under digital disruptions and is rapidly changing towards an ecosystem of fully autonomous system-of-systems. Although changes are ongoing in many fronts of the supply chain, the overall value network has not been disrupted yet.

The program focuses on two application areas: autonomous maritime and manufacturing use cases in digitalization. In autonomous shipping, D4Value program has a critical role as it is the first ecosystem level approach in the area.

In the program business concepts are driving the research in 3 areas: business models and ecosystem design; technology solutions and platforms; regulatory, societal and people aspects in creating new ecosystems. DIMECC D4Value program is collaborative research effort with consortia of 11 companies and 9 universities. Website http://d4value.dimecc.com/ provides additional information about the program.

Schedule: 2016-2019
Volume: 19M€

DIMECC Program
FLEX

Metals production is facing major economic and environmental challenges. The main requirements for competitiveness in the future are the capability for a flexible response to changing demands and the ability to produce metals at high cost efficiency. In addition, the planned reduction of CO2 emissions requires drastic changes to the current process practices. These demands cannot be met with the existing operation paradigms, but requires implementation of new flexible approaches.

The vision of the project is a paradigm shift from stiff and reactive production to flexible and proactive operating mode, while moving the Finnish metal industry towards circular economy with zero waste plant concept and CO2 lean metal production. The shift necessitates digitalized and interlinked information flows at various levels of the production chain.

The program is divided to three work packages; Proactive Metal Production, Adaptive Refining Metallurgy and Intelligent Rolling. One of the major goals of the **FLEX** program is to develop zero waste plants in accordance with circular economy and increasing the internal recycling rate of byproduct fines by 20%. Another major goal is to digitalize metals production processes in order to increase process efficiency by 5%.

Program company partners: SSAB Europe Oy, Outokumpu Stainless Oy, Outotec Finland Oy, Casim Consulting Oy, Luxmet Oy, SFTec Oy and Sapotech Oy. Research institutes in the program: University of Oulu and Aalto University

Schedule: 2017-2018
Volume: 3,5 M€

GROWTH FROM DIGITAL SECURITY

Growth from digital security – roadmap 2019-2030 was based on an order from three Finnish Ministries (Ministry of Economic Affairs and Employment, Ministry of Education and Culture, and Ministry of Transport and Communications), Business Finland, and Finland's National Emergency Supply Agency, DIMECC planned and facilitated creation of the roadmap for Finland's strategic competence development in digital security and trust. In the work DIMECC leveraged its co-creation methods and the expertise of more than 150 experts from companies, universities, research institutions, and public sector organisations. Six workshops were organised during October and November 2018. The work was grouped under four main themes: "digitalisation of business", "competences and continuous learning", "cyber resilience", and "growth and internationalisation".

Main results of the work included:

- Plan for strengthening and accelerating strategic competence and asset development on national level (i.e. the roadmap).
- Identifying key actors and stakeholders, and ensuring their commitment to the roadmap and its execution plan.
- Determining the most relevant execution ecosystem(s) for the roadmap.

Final report provides a comprehensive overview of the digital security and trust landscape in Finland. It also contains a list of key recommendations and the strategic roadmap for 2019-2030, focusing on how Finland can create, attract and accelerate growth in this sector. The report will be published by Ministry of Economic Affairs and Employment in its publication series in March 2019.

INTELLIGENT INDUSTRY

Turning digital into practical

Intelligent Industry is an innovative ecosystem connecting leading Finnish industrial companies and providers of digital solutions to drive and realise the immense opportunities of the emerging new era of intelligent industry. The ecosystem is leading the way towards a new era of networked, information driven and autonomous value systems that adapt flexibly to changing operating environments and user needs. The vision of the Intelligent Industry ecosystem is to make Finland a global leader in intelligent industrial systems and related business ecosystems by 2028.

The strategic core partners of the Intelligent Industry Ecosystem are Cargotec, Fastems, HT Laser, Konecranes, Nokia, Ponsse, Prima Power, Raute, SSAB, Elisa, Innofactor and Tieto, all leading companies in their own fields. The ecosystem is funded by the participating companies and Business Finland.

Intelligent Industry ecosystem is driving collaborative activities in four focus areas: Data and advanced analytics, Autonomous systems, Value co-creation in ecosystems and Human-Machine collaboration. Core activities include R&D&I programs and projects, pilots and PoCs, participating in standards and regulation discussions and competence development. The ecosystem builds for example holistic operating models and standards for data sharing in industrial value networks. Artificial Intelligence and Machine Learning competences are fostered by the DIMECC Machine Learning Academy, which provides tailored training for manufacturing company personnel.

The Intelligent Industry ecosystem is shaping the future of Finnish manufacturing industry.

DIMECC Program
LIFEX

LIFEX program focuses on advancing digitalization and Industrial Internet in Finnish industry. To develop and produce competitive new product related services, companies need deep knowledge throughout the whole product lifecycle. The knowledge is gathered and shared during design, operation and recycling phases with help of Industrial Internet.

LIFEX program currently consist of three joint projects of companies and research organizations.

MIDAS project focuses on artificial intelligence in industry. Participants include among others Epec, Glaston, Novatron, Nokia Technologies and Tampere University. The overall MIDAS ecosystem consists of over thirty partners and it forms an active network advancing usage artificial intelligence.

DYNAVIS project develops and tests next generation Product Lifecycle Data Management practices where virtual and augmented product information is efficiently created and used for different business needs. The key partners in DYNAVIS are Konecranes, Kone, VTT and Tampere University.

IVM project focuses on new innovative vibration management solutions. Based on earlier successful marine applications a novel damping and design concept is applied to several new industry applications. Participants include among others Meyer Turku, Wärtsilä, Sampo-Rosenlew, Vibrol and VTT.

Schedule: 2016 ->
Volume: 9,8 M€

ONE SEA
Autonomous maritime ecosystem

One Sea is a high-profile project with a primary aim to lead the way towards an operating autonomous maritime ecosystem by 2025. The Finnish collaboration gathers together leading marine experts and is a strategic combination of top research, state-of-the-art information technology and business. The project began in 2016, and the aim is to create an environment suitable for autonomous ships by 2025.

At the end of 2018, One Sea received commitments for further funding for three more years. One Sea is funded by Business Finland and the member companies. ABB, Cargotec, Ericsson, Finnpilot Pilotage, Rolls-Royce, Tieto and Wärtsilä are One Sea member companies. Finnish Marine industries, Finnish Port Association, Finnish Shipowners' Association and Shipbrokers Finland are One Sea partners.

Digitalization of the marine environment

Ship owners and operators should consider when to take advantage of the lower capital and operating expenditure – with the better efficiency, reliability, safety and sustainability – that digitalization has brought into other areas of business and industry.

Marine industry suppliers and shipyards are actively looking for opportunities to be the first to offer ship owners the latest competitive edge of digitalization. The companies and organizations collaborating in the project are forerunners in their respective fields and the knowledge they share sets them apart from other likeminded projects. The ecosystem ensures a well-researched, tested and highly capable autonomous shipping network.

The co-creation ecosystem will also set the course for new industrial standards and international regulations. With the leadership, participation and steering from the One Sea Autonomous Maritime

Ecosystem, the new standards will correspond with the targets of minimizing accidents, decreasing the environmental footprint of marine traffic, and advancing possibilities for new commercial ventures.

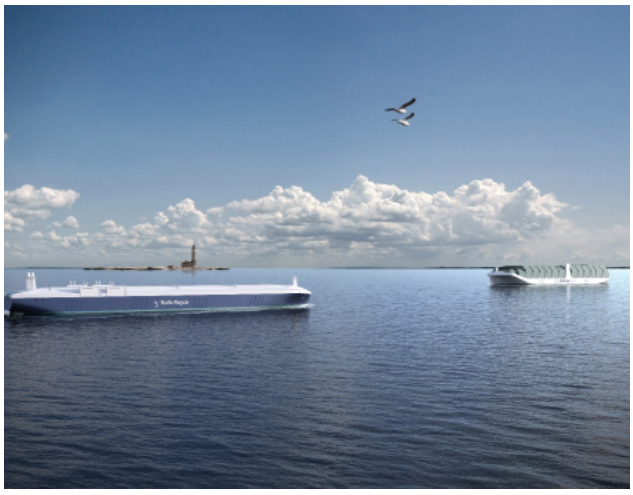


Figure 8: At the end of 2018, One Sea received commitments for further funding for three more years.

SMART Program STEEL

DIMECC with its customers and shareholders started the company's very first project in Sweden in November 2018. In **Smart Steel**, SSAB, Sandvik, and Siemens will create new digital marking, fingerprint and identity for steel and it's use cases. These will change the way how customers can analyse and use the information related to steel through data systems and mobile applications. The target is standardization of digitally identified steel. The idea of Smart Steel is brought to publicity by SSAB, the biggest investor of the project.

Swedish research institute RISE and Swerim will carry out technological research and pilot tests together with the companies. Swedish industry network FindIT will disseminate the results fast to a network of more than 200 manufacturing and IT companies in Dalarna region. DIMECC brings the most efficient and well-proven co-creation mechanisms to the leadership and management of the project, and to the ecosystem's new business creation. Vinnova, the Swedish governmental RDI funding institution, has granted the 50% public funding for the project.

Smart Steel is part of the Swedish strategic innovation program (Strategiska Innovationsprogram SIP) and it's center PIIA (Process Industry och Industrial Automation). SIPs were established in Sweden in the mid-2010s after benchmarking the high-impact experiences in the Finnish SHOK-programs. DIMECC now continues the Public Private Partnership once started in Finland also in Sweden.

Schedule: 2018-2021
Volume: 10 MSEK

DIMECC Co-creation services

The co-creation activities consist of reducing the time-to-market, accelerating companies R&D&I, supporting technology transfer and bringing together companies and research organizations into ecosystems facilitating the large-scale systemic transformation of industries.

DIMECC Demobooster

Demobooster is an innovation service for rapid commercialization. It provides a collaboration platform for companies hunting for killer applications through strategic partnerships: an innovation highway from ideas to products.

Demobooster in a nutshell

- The market place where demand and supply of software demos efficiently meet
- Provides immediate feedback on the functionality and applicability of the demo
- Speeds up product development process through "success or fail fast" principle

The mission of Demobooster is to demonstrate new ideas in practice. The outcome is not a "slide show presentation" but a concrete solution!

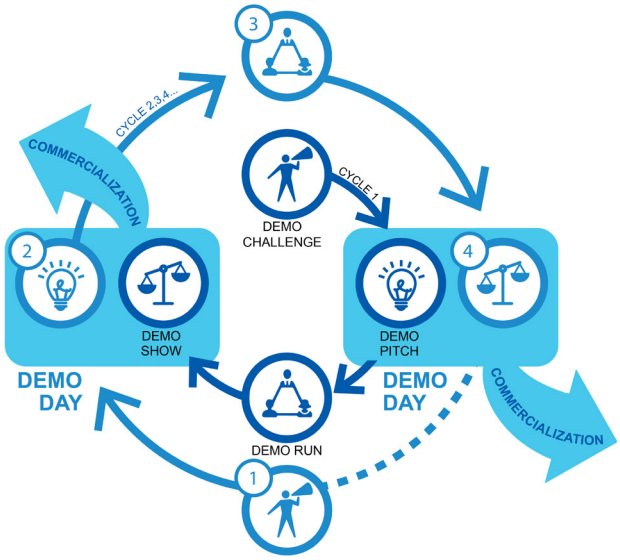


Figure 9: DIMECC Demobooster service cycle.

Demobooster in numbers 2018:

11 Demodays

56 Companies

43 Challenges

110 Solutions

24 Demos

Demobooster creates a specialists' network for the development and marketing new ideas between Appliers (engineering industry) and Producers (software enterprises and expert organizations). We've had alltogether 11 successful Demodays with 43 different challenges presented by the Applier companies. The Producers have pitched 110 innovative solutions to the problems, 24 of which (with a few additional ones currently under development) resulting in a concrete demo. In total, there have been participants from 56 different companies. Demobooster is a registered trademark of DIMECC.

www.demobooster.com

PoDoCo

PoDoCo is a matchmaking program supporting long term competitiveness and strategic renewal of Finnish companies and employment of young doctors in the private sector.

The duration of PoDoCo project is 1-2 years and it consist of two phases: research period and targeted research period. PoDoCo program is funded by PoDoCo foundation pool and companies participating in the program. PoDoCo foundation pool offers research grants of 6-12 months for the research period. Grants awarded by PoDoCo foundation pool are intended for academic research investigating new innovative ideas to boost the strategic renewal of Finnish industry. After the research period the company hires the Post doc to deepen the research results and to

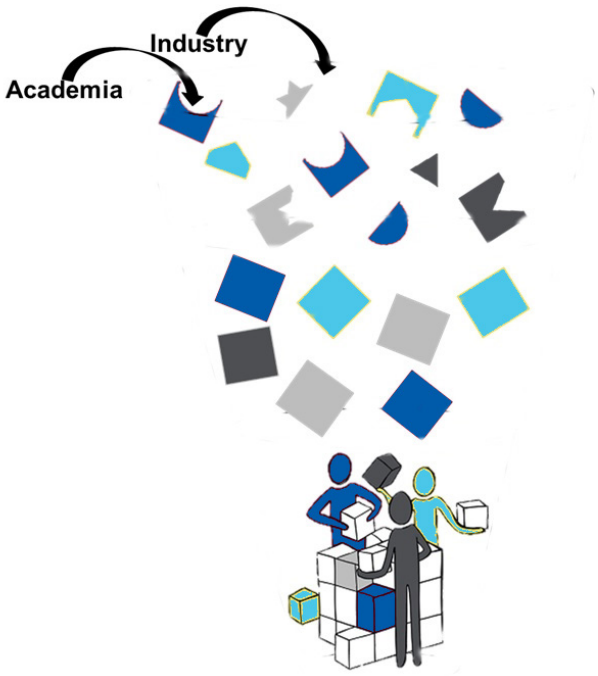


Figure 10: PoDoCo matchmaking.

create company specific insight. The result is a win-win situation where academic research is supporting the long term competitiveness and strategic renewal of Finnish companies and young doctors get industrial experience.

Post Docs in Companies, PoDoCo program, is a joint initiative of Finnish universities, industry and foundations. Nine foundations allocated altogether almost 1 000 000 euros to the program during year 2017. The program's foundations are Finnish Cultural Foundation, Jenny and Antti Wihuri Foundation, Maa- ja Vesitekniikantuki ry, Svenska Kulturfonden, Finnish Foundation for Technology Promotion, Maj and Tor Nessling Foundation, The Foundation for Economic Education, KAUTE Foundation and Technology Industries of Finland Centennial Foundation. DIMECC operates the PoDoCo program and facilitates the novel matches and meeting between companies and postdocs. PoDoCo is a registered trademark of DIMECC.

After 2018 PoDoCo program has funded 99 collaborative projects between companies and postdocs. Most of the participating doctors have been employed to private sector with the help of PoDoCo program. Based on the experiences PoDoCo program has opened new career opportuities for doctors and improved their career prospects. Additionally, doctors have gained valuable experience in working on R&D in private sector through PoDoCo program. For companies the program has offered new avenues for growth. in addition, companies see that PoDoCo program has increased the collaboration with the universities. In total over 500 postdocs and 200 companies have participated in the program activities.

www.podoco.fi

Machine Learning Academy

AI is poised to have a transformational impact on all industries, however the bottlenecks to AI and machine learning adoption are lack of human skills, business imagination, management and implementation. DIMECC Machine Learning Academy is a response to train manufacturing personnel with AI/ML skills. The course is aimed for professionals working in the industry, and the content of the course is tailored to the needs of the Finnish mechanical engineering and manufacturing industry.

DIMECC Machine Learning Academy consists of diverse learning modules from machine learning algorithms to ethics, and from designing and managing artificial intelligence (AI) projects to implementing AI in the company business. The goal of the training is to increase the participants' understanding of how to utilize AI and machine learning in their company.

After the course, participants will have understanding of the fundamentals of machine learning, as well as the ability to recognize and manage development tasks that aim to benefit from machine learning. The course uses a combination of theory, discussion, practical exercises and examples of existing applications and business cases to emphasize the application

Figure 11: The first DIMECC Machine Learning Academy was organized in fall 2018. The participants presented their projects in the course.

of the methods and concepts.

The first course was organized in fall 2018 in co-operation with Futurice Ltd. Interest in the training has been immense and the first course got over-booked immediately. The feedback has been very positive. With the help of Machine Learning Academy, the expertise in companies has increased, and participating companies have also implemented pilots' projects under the course. Encouraged by positive reception from the industry the second course started in February 2019.

AI Morning

DIMECC organizes in co-operation with Suomen Yliopistokiinteistöt and Nokia Technologies a series of events entitled AI-Morning http://www.aiaamu.fi . Since February 2017 over 400 representatives from industry and academia have participated in these half day events with top quality artificial intelligence and machine learning presentations. During year 2018 three events with varying topics like AI in Industry and AI in Healthcare were organized. The popularity of the events indicates that the interest in artificial intelligence opportunities and skills is growing steadily. An increased number of private and public sector actors consider artificial intelligence as a key enabler towards next generation intelligent products and services.

MPD as the visionary renewal platform

MPD is an international top level B2B summit, which is organized every second year in Tampere, Finland. MPD is an executive and visionary event for digital and manufacturing industries, researchers, and technology & service providers worldwide. This highly appreciated event brings together top management of manufacturing and digital business companies, internationally recognised experts in the field of digitalisation, and academia to discuss and represent best industrial practices and operational excellence, novel business concepts, as well as scientific and technological breakthroughs in the field. Company visits, side-events, meetings, and networking nourishes potential for R&D&I collaboration over the boarders, and grows opportunities for new business contacts.

In 2018, the 7th MPD was pre-designed and planned. MPD2019 will be titled "Harnessing the ecosystem economy". The innovation competition, MPIDEA, was opened in November 2018. MPD is a registered trademark of DIMECC.

MPD MANUFACTURING PERFORMANCE DAYS

www.mpdays.com

Demola – millennials as the source of renewal within DIMECC

Demola is a global innovation challenge platform that brings together students and leading brands. With Demola, global and local organizations challenge university students to create better Future. Today, Demola innovation challenges bring together over 50 universities, 750 000 students and leading companies from around the world.

The year 2018 was a significant one for Demola. DIMECC Ltd. bought a minority share of Demola Global Ltd. in order to stimulate industrial renewal. The radical and experimental innovation made possible by university students via Demola projects became part of DIMECC's co-creation service portfolio. Co-operation with DIMECC settles Demola as a successful innovation tool for Finnish industry and boosts Demola's international growth.

In June 2018, the Demola Summit in Helsinki gathered together Demola's employees, facilitators and stakeholders from alliance universities around the world to celebrate Demola's 10-year anniversary. This event brought together the many new Demola university alliance members, as Demola expanded both globally and in Finland, where the alliance covers now several additional universities from Helsinki to Lapland.

Crowning Demola's expansion, a new gateway to Asia for future-oriented companies was opened in 2018, when Demola's first round of innovation challenges were run in Hokkaido, Japan. Demola will continue providing Finnish companies with a unique opportunity to set innovation challenges in Asia, as Demola in Shanghai will be launched in spring 2019.

DEMOLA

www.demola.net

Figure 12: Ville Kairamo CEO of Demola Global Ltd, Ilari kallio Chairman of DIMECC Ltd and Chief Digital Officer at Konecranes, Petri Räsänen, the Chairman of Demola Global Ltd and Director, Innovation and Foresight at Council of Tampere Region and Harri Kulmala, CEO of DIMECC were happy to join the leading innovating forces.

DIMECC Networks

DIMECC supports its shareholders and program participants in increasing their international research collaboration through international networks and strategic cooperation partners. DIMECC is closely embedded in a larger ecosystem. It is part of the EIT Raw Materials KIC, and the Industry–University Cooperative Research Centers Programme of the US National Science Foundation (NSF). DIMECC is also part of EFFRA (European Factories of the Future Research Association), and ensures that there will be topics of interest for digitalizing manufacturing industries in the EFFRA roadmap. The network also participates in the public private partnership SPIRE (Sustainable Process Industry through Resource and Energy Efficiency). In 2017, DIMECC´s CEO was a member of Commissionaire Moedas' the high level group on maximizing the impact of European research and innovation programs.

DIGINNO

Digital Innovation Network's (DIGINNO's) objective is to advance the digital economy and to speed up the process of moving towards the single digital market in the Baltic Sea Region (BSR). The project aims to increase the capacity of policymakers, industry associations and industrial SMEs to enable faster and more efficient uptake of digital solutions both in public and private sector. The focus specifically is on promoting uptake of ICT in the business sector, developing innovative and interoperable digital public services and facilitating Digital Single Market related policy discussions on the Baltic Sea Region level.

DIMECC, together with the Finnish and Estonian project partners, has raised Real Time Economy (RTE) on the project's agenda. Real Time Economy is key part of the on-going shift towards an economy model in which business processes and value chains are entirely digitized and connected. RTE offers an environment where financial and administrative transactions connecting citizens, business and public sector entities are in structured standardized digital form and are increasingly generated automatically and completed in real time.

DIGINNO partners: 14 full partners and 11 associated partners from nine BSR countries (incl. Norway) Finnish partners: DIMECC as full partner and Ministry of Finance and Technology Industries of Finland as associated partners

Schedule: 01 October 2017 – 30 September 2020
Volume: 3,5 MEUR

www.diginnobsr.eu

DIGINNO Digital Innovation Network
Interreg Baltic Sea Region
EUROPEAN UNION EUROPEAN REGIONAL DEVELOPMENT FUND

EIT Raw Materials KIC

EIT Raw Materials was designated as an EIT Knowledge and Innovation Community (KIC) by the EIT Governing Board on 09 December 2014. The KIC will address challenges in the field of raw materials, such as sustainable exploration, extraction, processing, recycling and substitution. KIC includes over 120 companies, universities, and research institutes all over Europe. DIMECC was an associated partner of EIT Raw Materials 2018. From Finland other KIC participants are Outotec, Metso, Spinverse, Aalto University, Oulu University, Lappeenranta University of Technology, VTT, and GTK. EIT Raw Materials' has co-locations in Espoo, Luleå Sweden, Leuven Belgium, Wroclaw Poland, Metz France, and Rome Italy, and the headquarters in Berlin Germany.

eit RawMaterials

FIIF

FIIF (Finnish Industrial Internet Forum) was founded by Technology Industries of Finland (TT) in 2014 to speed up new businesses enabled by digitalization. It is a company-driven activity that brings together appliers and providers of digital solutions with research organizations. It also offers an open platform for sharing experiences, identifying new business opportunities and future trends, exploring testing and piloting activities, and formulating collaborative development actions. Ownership of the FIIF concept and responsibility of its operations were transferred to DIMECC from Technology Industries of Finland as of April 1, 2018.

DIMECC conducted a survey for FIIF members in February-March 2018. New FIIF web pages were opened in April (www.fiif.fi). Later partner web pages were opened for sharing event presentation materials with FIIF members.

During the fall of 2018, three open FIIF events were organized: "Connectivity" (September 20, 2018 in Helsinki – 66 registered participants), "IoT software platforms" (October 19, 2018 in Tampere – 32 registered participants), and "Artificial Intelligence/Machine Learning" (November 22, 2018 in Helsinki – 41 registered participants). Other FIIF sessions were organized at Advanced Engineering exhibition (May 2018 in Helsinki) and at Alihankintamessut (September 2018 in Tampere). Also, four issues of FIIF Newsletter were published.

As of December 31, 2018 FIIF had 242 member organizations and 666 names on its mailing list.

FINNISH INDUSTRIAL INTERNET FORUM

High Level Forum

High Level Forum is an international forum devoted to leading innovation ecosystems and managed by the Grenoble Innovation Campus GIANT (Grenoble Innovation for Advanced New Technologies).

The High Level Forum was initiated in 2012. DIMECC is the industry representative among the over 30 internationally recognized leading cities in innovation. Tampere is the only Finnish city that was invited to attend the High Level Forum.

The goal of the High Level Forum is to share policies, strategies and experiences about innovation management and promotion between leading campuses, encourage and strengthen collaboration between the world's most powerful innovation ecosystems and to develop common initiatives for maximizing the social and economic benefits of the innovation programs from the participating campuses.

In 2018, the High Level forum was attended by DIMECC and Demola, which together opened the new public private partnership set-up of Tampere.

GIANT | HIGH LEVEL FORUM
Leading Innovation Ecosystems

NGI

The Next Generation Internet initiative (https://www.ngi.eu/about/) was launched by EU in 2016 to re-imagine and re-engineer the Internet for the third millennium and beyond. NGI aims to shape the future internet as an interoperable platform ecosystem that embodies the values that Europe holds dear: openness, inclusivity, transparency, privacy, cooperation, and protection of personal data.

In the spring of 2017 the Future Internet Forum (FIF) members were asked to nominate NGI Contact Points in their member states and associated countries. From Finland, DIMECC is

the nominated contact point.

NGI Contact Points help in reaching out to the right group of stakeholders, getting actors on board and exchanging information with the FIF members and the European Commission regarding ongoing trends and topics. NGI Contact Points also act as links to the future key actors, i.e. high-tech start-ups and SMEs, young researchers and civil society, and raise awareness about the NGI initiative and the related H2020 funding possibilities. In addition, NGI Contact points promote, build and broaden the NGI ecosystem in their member states and feed back information and viewpoints to shape the evolution of the NGI initiative. There are several on-going NGI projects that help to identify specific research topics and to create an ecosystem of relevant stakeholders.

NSF

DIMECC together with partners have created new opportunities of international cooperation for Finnish researchers and companies. US National Science Foundation's (NSF) I/UCRC (Industry/University Cooperative Research Centers Program) provides a unique possibility for co-creation between research and industry. The National Science Foundation (NSF) is an independent federal agency created by the US Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense...". NSF is vital because it supports basic research and people to create knowledge that transforms the future.

Starting from 2015 Finland has participated (as the fifth country outside USA) in the Program in the field of Big Data in the CVDI-center (Center for Visual and Decision Informatics). CVDI conducts research on data science, big data, analytics, including visual analytics, augmented intelligence, and decision informatics. Finnish Site of CVDI center was created within DIMECC Data to Intelligence program. Currently 11 industry members participate in the work of the center. Tampere University of Technology is working as the Finnish Site for the center and all Finnish Universities may participate in the center through TUT.

The United States of America and Finland have also agreed on a significant cyber security partnership based on DIMECC's Cyber Trust program. In 2017 site of Security and Software Engineering Research Center (S2ERC) was opened at University of Oulu. The center is conducting applied and basic research on software security, system security, and software engineering problems in order to enable technology gains in member organizations. Currently 24 industry partners are involved in the work of the center. Similarly to CVDI center other Finnish universities may participate in the center as well.

DIMECC Strategic Partnerships

DIMECC supports its shareholders and program participants in increasing their international research collaboration, especially together with strategic cooperation partners:

DIMECC was member in co-operation networks in 2018 as follows:

Artemis Industry Association
EIT Raw Materials KIC
IIC Industrial Internet Consortium (U.S.)
FIIF Finnish Industrial Internet Forum
ECSEL Joint Undertaking
ManuFuture European Technology Platform
EFFRA (European Factories of the Future Research Association)
A.Spire (Sustainable Process Industry through Resource and Energy efficiency)
The Industry Innovation Center for Future Network, China (IICFNC)

In these networks, DIMECC's goal is to ensure that these networks' research priorities are of interest for DIMECC's shareholders. DIMECC also seeks to be a major node in European Digital Industry Hub landscape. DIMECC organises excursions to various foreign innovation locations and organisations regularly. All DIMECC programs include systematic and continuous researcher exchange.

SHAREHOLDERS 2018

SHAREHOLDER	N. OF SHARES
Aalto-korkeakoulusäätiö	150
ABB Oy	120
Andritz Oy	50
Bittium Technologies Oy	120
Boliden Kokkola Oy	50
Cargotec Oyj	120
Centria Ammattikorkeakoulu Oy	12
CSC-Tieteen tietotekniikan keskus Oy	12
Cybercom Finland Oy	12
Digita Oy	52
Elisa Oyj	120
Oy L M Ericsson Ab	120
EXFO Oy	12
Fastems Oy Ab	50
FIMA Forum for Intelligent Machines ry	50
Finn-Power Oy	50
F-Secure Oyj	12
Haaga-Helia Oy Ab	12
Helsingin yliopiston rahastot	24
Innovaatio Oy Uusi Tehdas	64
Inno-W Oy	12
Itä-Suomen Yliopisto	12
Juridiska Personen Åbo Akademi	40
Jyväskylän ammattikorkeakoulu	12
Jyväskylän yliopisto	52
Kaakkois-Suomen ammattikorkeakoulu	12
KONE Oyj	120
Konecranes Oyj	120
Kumera Oy	50
Lapin Ammattikorkeakoulu Oy	40
Lapin Yliopisto	24
Lappeenrannan teknillinen yliopisto	64
Laurea Ammattikorkeakoulu Oy	52
Medialiitto	12
Metropolia Ammattikorkeakoulu Oy	52
Metso Oyj	120
Meyer Turku Oy	120
Murata Electronics Oy	24
Nokia Oyj	120
Nokia Solutions and Networks Oy	84
Oulun yliopisto	64
Outokumpu Oyj	120
Outotec Oyj	50
Prizztech Oy	12
Rautaruukki Oyj	120
Raute Oyj	50
Reaktor Innovations Oy	12
Rolls-Royce Oy Ab	50
SalWe Oy	9
Sanoma Oyj	120
SSH Communications Security Oyj	12
Stiftelsen Arcada	9
Stiftelsen Svenska Handelshögskolan	40
Suunto Oy	12
Tampereen Ammattikorkeakoulu Oy	40
Tampereen yliopisto	12
Technopolis Oyj	60
Teknologian tutkimuskeskus VTT Oy	210
Teleste Oyj	12
TeliaSonera Finland Oyj	120
Tieto Finland Oy	120
Turun Ammattikorkeakoulu	52
Turun yliopisto	64
TTY-säätiö	64
Vaasan yliopisto	40
Wapice Oy	50
Wärtsilä Finland Oy	120
Åbo Akademi	24
Älykkään liikenteen verkosto - ITS Finland ry	12

68 shareholders

23 research institutes

45 companies

BOARD OF DIRECTORS

Board of directors was elected in the annual general meeting in April 27th, 2018. The board had ten meetings in 2018.

In 2018, the remuneration paid to board members was 150€/meeting (200€ for the chairman). Due to the challenges with the profitability, the board decided to work without the remuneration. PricewaterhouseCoopers Oy, and Mr. Jouko Malinen as the auditor in charge, continued as the auditor of the company.

Members

Ilari Kallio (chair)

Lauri Oksanen (vice chair)

Karno Tenovuo

Tapani Kiiski

Mika Hannula

Samu Salmelin

Deputies

Tomas Hedenborg
Timo Kotilainen
Petri Kalliokoski
Joonas Lyytinen
Erja Turunen
Kari Knuutila

MANAGEMENT

Dr. Harri Kulmala
Chief Executive Officer

External positions in 2018:

- Member of H2020 evaluation and renewal high-level group, EC
- Finnish Academy of Technical Sciences, member of the board
- Member of The Royal Society of Arts
- Member of high level group, EU ManuFuture technology platform
- Associate professor (docent), LUT
- Member of innovation council, Finnish Technology Industries
- Demola Global Ltd. member of the board
- Member of the Danish Innovation Fund evaluation group

Dr. Ülo Parts
EVP Operations (until 30.11.2018)

External positions in 2018:

- Member of Future internet forum coordination group for H2020
- National contact point of next generation internet (NGI) forum

Essi Huttu (M.Sc.Eng)
VP Co-creation

External positions in 2018:

- Member of Factory2Fit external advisory board

PERSONNEL

Kari Aunola (B.Sc.Econ.)
Financial manager

Dr. Arto Peltomaa
Program Manager

Päivi Haikkola (M.Sc. Nav. Arch, M.Sc. Econ.)
Ecosystem Lead

Prof. Reijo Tuokko
Manager, international relationships (part-time)

Antti Karjaluoto (M.Sc. Econ., M.Sc. Admin.)
Disruptive Renewal Officer

Marika Moilanen (BBA)
Manager, marketing and communications (maternity leave)

Risto Lehtinen (B.Sc.Eng.)
Program manager

Doris Pryjma (M.Sc. Eng.)
Manager, marketing and communications (maternity leave, substitute for Marika Moilanen 9/2017–10/2018)

Jukka Merenluoto (M.Sc. Tech., MBA)
Ecosystem Lead

Kaisa Kaukovirta (M.A.)
Manager, marketing and communications (maternity leave substitute for Marika Moilanen from 10/2018–

PROGRAM MANAGERS

Outsourced program management at the end of 2018:

FLEX:
Ingmar Baarman,
Tammet

DIMECC FELLOW 2018

DIMECC Fellow is a public recognition to a person, who represents the official set of DIMECC values in force at the time of nomination and forwards these with his/her behaviour. In 2017, the title was rewarded to the following people:

#9
Professor Miia Martinsuo
Tampere University of Technology

#10
President & CEO
Tomas Hedenborg, Fastems

#11
Professor Yrjö Neuvo
Aalto University

Previously the title has been awarded to the following people		Nomination year
#1	Prof. Pentti Karjalainen, University of Oulu	2013
#2	Director Ilkka Niemelä, The Federation of Finnish Technology Industries	2013
#3	CTO Matti Sommarberg, Cargotec Oyj	2013
#4	Arto Ranta-Eskola, R&D director, SSAB	2015
#5	Ismo Vessonen, senior research scientist, VTT	2015
#6	Janne Järvinen, R&D director, F-Secure	2017
#7	Markku Korkiakoski, Director, Sales and Business Development, Bittium	2017
#8	Sauli Eloranta, EVP, Rolls-Royce	2017

RESULTS – A SELECTION OF NEW DIMECC RESULTS AND OUTCOMES

This chapter introduces new 2018 results and outcomes from DIMECC activities. The names of the authors refer to people behind the specific result at hand, not the whole program. All the results introduced here are strongly related to the industry digitalisation and eco-efficiency work carried out by DIMECC.

DIMECC Prize winner – NAPA and Norsepower partnership in data verification and analysis of Norsepower's Rotor Sail Solution

NAPA, the leading maritime data analysis, software and services provider, and Finnish engineering company Norsepower won the DIMECC Prize 2018, for their partnership in data verification and analysis of Norsepower's Rotor Sail Solution technology.

Norsepower's Rotor Sail Solution is a modernised version of the Flettner rotor – a spinning cylinder which uses the Magnus effect to harness wind power to propel a ship forward, delivering fuel-savings and a reduction in all related emissions. Through DIMECC's REBUS-programme, NAPA conducted a randomised trial of Norsepower's first installation of the Rotor Sail technology onboard the M/S Estraden. NAPA concluded that through robust data collection and advanced analytics, the Rotor Sail offered clear and significant fuel savings of up to 10%.

Objective data and impartial verification of the fuel savings delivered by Norsepower's technology has been absolutely critical to the company's growth and position within the growing wind technology market. There has been significant interest and investment in the Rotor Sails. In April 2018, Norsepower's

Figure 13: Tuomas Riski, the CEO of Norsepower, and the Director, Services, Shipping Solutions at NAPA, Risto-Juhani Kariranta, accepted the DIMECC Prize 2018 handed by the CEO of DIMECC, Harri Kulmala. Photo: Ingmar Baarman, DIMECC

technology was installed onboard the M/S Viking Grace, making her the first passenger ship in the world using auxiliary wind propulsion. Separately, in partnership with Maersk, Shell, and the UK's Energy Technologies Institute (ETI), a Maersk P-class 109,647 deadweight tonne (DWT) oil product tanker, was retrofitted with two 30m tall by 5m diameter Norsepower Rotor Sails at the end of August 2018. The project is the first installation of wind-assisted technology on a product tanker vessel. Data analysis and verification by NAPA, has been fundamental to these developments by proving the effectiveness of Norsepower's technology.

Commenting on the partnership, Tuomas Riski, CEO, Norsepower, said: "Following the first test installation of our Rotor Sail solution onboard the M/S Estraden, NAPA recorded a 6.1% reduction in fuel consumption. Based on the test results, our technology enables average fuel savings of up to 20% for vessels with multiple, large rotors travelling in favourable wind routes

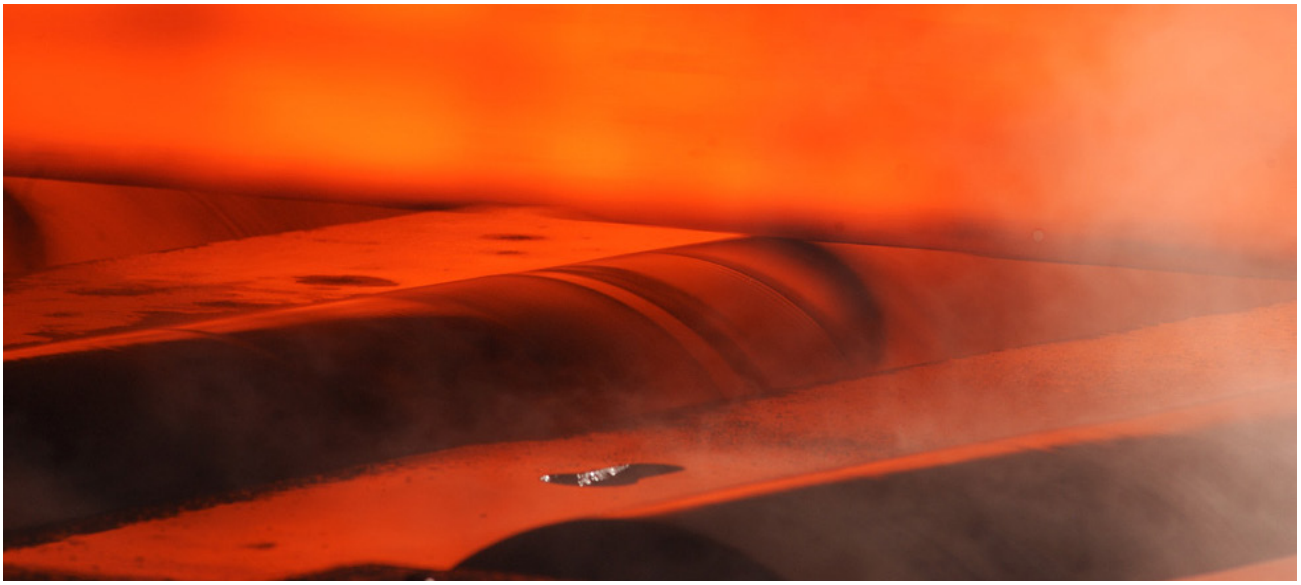


Figure 14: FLEX took Finnish metal industry toward zero-waste plant and CO2-lean metal productionPhoto: SSAB

– making it a commercially-viable solution that can reduce fuel and emissions in the industry."

FLEX program took metal industry towards zero-waste plant

Metal production is facing major economic and environmental challenges globally. **FLEX–Flexible and Adaptive Operations in Metal Production** program targeted in moving the Finnish metal industry toward zero-waste plant and CO2-lean metal production. This brings an increased responding flexibility to changing demands and the ability to produce metal at high cost-efficiency with a reduced environmental load.

In the FLEX program, two doctoral theses and 29 publications were produced, and more than 36 tools were developed. The work was divided into three work packages: proactive metal production, adaptive refining metallurgy and intelligent rolling. In proactive metal production the key results and impacts were:

- A full-scale trial with cement-bonded briquettes was successfully conducted in a SAF in Outokumpu ferrochrome production.
- Sapotech's Reveal360 was installed to monitor the refractories of hot blast furnace ladles at SSAB Raahe Steel Works.
- A 200kW pilot DC furnace was built at Outotec Research Center in Pori to conduct smelting tests on a smaller scale, improving safety and research efficiency.
- Laboratory-scale microwave treatments showed that zinc removal from dust and sludge was rapid and selective. The residue material can be recycled in steelmaking furnaces.
- A high prediction accuracy of hot metal desulfurization was obtained with a parametrized mathematical model.
- A variety of methods were found to increase material and cost efficiency, as well as to reduce the environmental load of hot metal desulfurization.
- A more stable, predictable, and efficient desulfurization process enabled a decrease in the sulfurtarget in primary desulfurization, leading to released secondary desulfurization and vacuum degasser capacity.

Figure 15: Hundred doctors have been doing research in companies through PoDoCO program..

Cancer research is boosted by PoDoCo

The Finnish pharmaceutical company Orion has found a new way to enhance its high quality oncological research. Doctor Julia Lindqvist joined Orion to study and develop a new drug molecule and its use especially in individual treatments of breast cancer. Orion and Lindqvist found each other through PoDoCo.

Orion is the globally operating flagship of Finland's pharmaceutical industry. Orion ambitiously seeks new better treatments, even for the most severe diseases such as various types of cancers. That is why the Principle Research Scientist of oncology at Orion, Anu Moilanen, rejoices over the brand new channel through which to strengthen the broad research activities of the company.

"This has been an entirely positive experience for us! Julia is the first PhD we have found through PoDoCo, this was a brand new opening for us. Now we already have another PoDoCo-PhD in another research project, and we're already negotiating with a third", Moilanen tells.

Julia Lindqvist examines how cancer drugs work on a molecular level. "That's how we will gain a better understanding of which drugs work for whom. With cancer drugs it's possible to have a better treatment response, if the drugs are combined. An individual combination may be significantly more effective than any single drug", describes Lindqvist the context of her research.

"We have already found several drug combinations, which seem to work in breast cancer cells", reveals Lindqvist. She warns about jumping into conclusions. The research has been carried out on a cellular level and there's still a long way to actually treating patients. Orion is performing tests with the molecule on Phase 1, which in practice means securing the safety of the new drug before further testing.

Vibrol's Resonance Killer is further developed in LIFEX

LIFEX program's IVM project focuses on new innovative vibration management solutions.

Based on earlier successful marine applications a novel damping and design concept is applied to several new industry applications.

Vibrol Oy's product ReKi™ Resonance Killer is being developed further in IVM. The companies involved in using the breakthrough technology in this program are Wärtsilä, Meyer Turku, Sampo Rosenlew, BRP-Finland and SimulOne. The research organizations are Aalto University and VTT. The goal is to improve mathematical simulation model of the ReKi™ to be available in structural design and do feasibility studies in new applications.

In ships the reduction of vibration levels will give and advantage in passenger comfort. There's a possibility to reduce ship mass and bring reliability and maintenance advantages.

In harvesting technology and snowmobilies resonance killer reduces the vibration levels of the driver and critical parts.

Design For Value: Automated Cranes In Bulk Unloading

MacGregor, marine cargo handling specialists, and ESL Shipping Ltd, leading carrier of dry bulk cargoes in the Baltic region, have developed an autonomous discharging crane. The first cranes were installed on ESL's two new liquefied natural gas (LNG)-powered bulk carriers, Viikki and Haaga, which will operate on a year-round schedule, regardless of weather and ice conditions.

"On the outside, the crane looks like all other cranes, but on the inside it is unique," says Janne Suominen, MacGregor Cargo Handling Development Manager. "It includes new technology and software specifically designed for unloading cargo autonomously; cargo loading is achieved using conveyor belts."

The unloading operation takes place in a controlled area, which is safe and has restricted personnel access. "Firstly, we define whether the cargo is unloaded into a pile or shore-side hopper for onward conveying or truck loading," continues Mr Suominen. "Then, using advanced sensor technology, material distribution in the hold can be analysed and a topographical map is created to ensure optimal unloading.

"As the crane starts unloading cargo from the ship, it constantly scans and analyses where cargo is in relation to the hold. The crane then grabs the cargo and unloads it at its shore-side. A ship can have two or three cranes operating simultaneously and parallel to each other." Each crane pre-calculates suggested routes using MacGregor's command input shaping technology to optimise paths, ensure pendulum-free motion and minimise the total discharging time.

MacGregor has extensive knowledge in crane motion technology. In the the D4V program, its experts focused on defining the surface levels of the cargo in a ship's hold using new technologies, a specialist camera and an optical Lidar radar.

The autonomous discharging features will soon be ready for commercial trials. "The advantages of these cranes are irrefutable," says Mr Suominen. "They do not have to pause or stop, making unloading operations continuous. At the same time, the quality of work will reach new levels of consistency as unloading operations are no longer dependent on the skill of one crane operator. "Many have expressed their interest in our autonomous discharging cranes and I foresee a significant future shift in traditional operating and working cultures in ports," Mr Suominen concludes.

Design for Value: Intelligent Port

There is a large number of companies operating at an ordinary port. The port owns the land, the

Figure 16: Design for Value focused on door-to-door supply chain which is under digital disruptions and is rapidly changing towards an ecosystem of fully autonomous system-of-systems.

shipping companies own the ships and the cargo is handled by operators. There are also plenty of other logistics providers operating at the port. New technology is available, but how does it benefit everyone at the port? How should a smart port be constructed and what information do different operators need? In Design for Value program ships' arrival at the port was a particular point of interest.

The D4V program studied how the sharing of information between different stakeholders would work with the help of the situational awareness system developed by Rolls-Royce. Rolls-Royce released it's system in the spring of 2018. It utilises sensors and intelligent software that are a prerequisite for an autonomous ship. The safety and efficiency of ships that are currently sailing can also be improved with the situational awareness system. It can significantly improve a ship's navigation safety and produce a large amount of data on the ship's environment. It relies on an INS navigation system, day and night vision cameras, a radar, LIDAR detection (Light Detection and Ranging) and AIS (Automatic Identification System). LIDAR is an optical detector that measures distances using visible, near infrared and ultraviolet light. The system draws a 3D map and creates a detailed bird's-eye view of the surrounding area.

Rolls-Royce's Intelligent Awareness (IA) system is the only one of its kind on the market. Even though IA was developed to help control autonomous ships, it was discovered that the technology should be taken into use even before autonomous ships are ready to start operating. It can provide benefits to existing port environments.

The D4V program studied the operating principles of a smart port. Information on IT requirements and data needs for saving data and sharing it between companies was collected from different port operators. The smart port will be tested at a real port in 2019.

"Shipping has been very conventional. Now, new technology is coming and changing the operating environment. Machine vision, sensors and cloud-based services are entering ports. A successful intelligent harbour can be achieved with the help of the IA system," says Anssi Lappalainen, R&D Project Manager of Rolls-Royce's unit in Turku.

They worked together with Tampere University of Technology to develop smart port sensor technology and cameras that enable machine

vision and machine learning. During the DIMECC D4V program, other research institutes have surveyed which companies operating at the port could create an ecosystem that would utilise the same infrastructure and allow the sharing of information.

"Companies operating at the port do not share enough data with each other and there is demand for a new intelligent platform. Important questions include: who produces the data, how is the data shared, what data will be available and who can access the data."

In the D4V program, researchers have compared the operations and logistics of ports in Singapore, Estonia, Italy, the UK and Finland. The goal is to use the collected data to carry out a smart port demo in Finland in 2019.

"The Finns are pioneers in developing intelligent sea traffic. We have an opportunity to be the best in the world at this," Anssi Lappalainen applauds.

University of Turku, Aalto University, VTT, Lappeenranta University of Technology and Tampere University of Technology took part in the study on the sharing of information at a smart port.

Design For Value: Edge computing in autonomous sailing

During the D4V program, Ericsson sought new solutions to combine different players into the ecosystems, using cloud, IoT and edge computing. For example, during the operational phase, an autonomous ship is under the control of a fleet operator, but multiple system users can use its sensors and data. This would mean a new data-sharing ecosystem in the maritime industry.

Autonomous sailing is creating a new ecosystem, and new technologies are changing the ecosystem. Also, new players are coming, such as technology and service providers. This means that the maritime, logistics and manufacturing industry are modifying the ecosystem into a more horizontal structure.

So, what technology is needed for the ecosystem?

"Daily internet connectivity is paradigm in cloud computing even in data processing, but not fully feasible on ships. There are challenges related to latency, unreliable satellite connection, and limited mobile connections. However, internet connectivity is just one aspect of the problem. There are other aspects to consider, such as Ericsson has been developing different Internet of Things (IoT) solutions processing capacity and interoperability between vendors," says senior researcher Edgar Ramos from Ericsson Finland.

During the D4V-program, Ericsson has been developing a distributed cloud solution that can bring connectivity and different platforms to IoT. Ships can use data storage and data sharing provided by the distributed cloud. "The cloud system can use edge computing to synchronise data." In edge computing, the computation is normally performed on distributed smart device nodes. "Edge" refers to the geographic distribution of computing nodes. Edge is usually located in places where there is limited or no connectivity. These places can be, for example, ships.

Autonomous shipping is a good case for using edge computing. An ecosystem based on service providers in a ship environment and with limited connectivity can be created via edge computing. "We have a demonstrator where, e.g., a miniature autonomous ship has an autonomous edge computing environment, where we run ship-control software, as well as machine learning functions to optimise navigation and docking." Says senior researcher Jimmy Kjällman from Ericsson. "The cloud system can use edge computing to synchronise data."

Good examples of applications can be cargo-monitoring software, data sharing platform components, or software that monitors, controls, and optimises the autonomous ship's systems.

STAKEHOLDER RELATIONSHIPS

Support and assistance from following non-shareholder organisations supported in DIMECC strategy and operations:

Beijing Academy of Science and Technology
CECIMO
Chinese Academy of Sciences – Qingdao Academy of Intelligent Industries (CAS-QAII)
Clic Innovation Ltd.
Confederation of Finnish Industries EK
EFFRA
Finnish Marine Industries
Finnish Ministry of Employment and the Economy
Flanders Make
It'sOWL Clustermanagement GmbH
Linz Centre for Competence in Mechatronics (LCM)
Metallinjalostajat ry
Ohjelmistoyrittäjät ry
Orgalime
PiiA, Sweden
Politecnico di Milano
Production2030, Sweden
RWTH Aachen
Upper Austrian Research GmbH
SalWe Ltd.
SPIRE
SYMME, France
Business Finland
Finnish Technology Industries
ZPark

Following suppliers were used for services:

Datalink - PoDoCo™
Fondia Oy - Legal services
Futurice - Machine Learning Academy
Gaia Consulting Oy - Demobooster™
Hopiasepat Oy - Impact analysis & communications
Inno-W Oy - Web pages & research portal
Koodiviidakko Oy - Communication platforms
Meom Oy - Web pages
Triuvare Oy - IT infrastructure
Talenom Oy - Accounting
Management Events Studio - Manufacturing Performance Days™

COMMUNICATIONS

The primary communications between DIMECC and public media were through website www.dimecc.com. Several DIMECC personnel interviews, articles and technology policy comments were published in Finland.

DIMECC was active through following communications:

- DIMECC High Tech section at www.dimecc.com revealed the most impactful research results
- DIMECC In-Brief information package was updated
- Five DIMECC Newsletters were published in digital form
- Co-creation service leaflets were branded and printed
- MPD2019 communications were published.
- One new DIMECC publication series reports was published.
- DIMECC was active in social media channels in Twitter and LinkedIn.
- Intelligent Industry and FIIF websites were founded/renewed
- ÄlySuomi was published
- 10-year party was held 24.10.2018

Figure 17. DIMECC's 10-year party was held in Koskenranta, Helsinki.

KEY FINANCIAL INFORMATION

The financial year 2018 of DIMECC ended December 31st. Due to the special role of DIMECC as a non-profit company, the key financial information is presented in short form and without traditional business performance measures.

Income	
Net sales	995 440,88
DIMECC program management fees	317 000,00
Other income	539 063,55
Total income	**1 851 504,43**
Expenses	
Materials and services	-204 517,74
Staff costs	-1 058 487,10
External program management cost	-28 572,00
Other expenses from operations	-620 761,86
Total expenses	**-1 912 338,70**
Operating loss	**-60 834,27**
Financial income	4 542,64
Loss for the year	**-56 291,63**

Assets	
Stocks, shares, and fixed assets	1 031 049,16
Long-term investments	10 593,00
Short-term receivables	488 047,63
Cash and bank balances	1 816 267,26
Total assets	**3 345 957,05**
Liabilities and shareholders' equity	
Restricted equity	1 146 500,00
Non-restricted equity	2 302 113,91
Net losses from previous years	-368 216,45
Net loss for the year	-56 291,63
Liabilities	321 851,22
Total liabilities and shareholders' equity	**3 345 957,05**

DIMECC

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