DIMECC

ANNUAL REPORT 2016

CONTENT

NTRODUCTION

This annual report summarizes 2016, the 1st operational year of DIMECC Ltd. 2016 was the year when DIGILE Ltd. was merged into FIMECC Ltd. (both of the companies established in 2008), and the company changed its name to DIMECC Ltd. With the merger, Finnish Technology Industries started a campaign to create 100 000 new jobs. In this campaign, the role of DIMECC is to create and lead a wide industry-led R&D&I portfolio that has both long-term visionary research programs and fast-moving commercial innovation services. During the last two years, DIMECC has extended the private funding scale and scope.

DIMECC – Digital, Internet, Materials and Engineering Co-Creation – Ltd. is a non-profit company, and the form of annual report primarily supports the documentation of the most important 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 2016

- 50M€ Research Portfolio
- 400+ customers
- 3 000+ persons involved in DIMECC activities
- 13 full-time employees
- 3 part-time employees
- 10 program managers
- 4 DIMECC Factories (Espoo, Tampere, Turku, Oulu)
- 42 PoDoCo scholarships by private foundations
- 2 Doctoral Schools (Breakthrough Materials & CEESIMP)
- 4 Demo days, 34 Demobooster customers
- 150 student participants & 6 companies at Innovation Camp
- 7 FiDiPro professors
- 5 Academy of Finland projects linked to DIMECC

WIDE AND DEEP INDUSTRIAL COMMITMENT STRENGTHENS DIMECC'S FORERUNNING ROLE IN EU AFTER THE MERGER

During the last two years, we have witnessed an extraordinary period in Finnish R&D&I landscape. The development has been like a double-edged sword: On one hand the European Commission and our cooperation partners all over Europe have identified Finland as the European forerunner in the implementation of public private partnership (PPP) model. On the other hand, challenges in the Finnish public economy has led us to a situation where Finland is one of the few countries in EU without outspoken industry-led and publicly supported digitalization strategy.

Industry and academic world have taken their responsibility in the structural renewal. We created DIMECC Ltd. by merging Digile Ltd. into Fimecc Ltd. Since 2008, we have led industrial renewal and dedicated PPP platforms in Finland. The platforms have enlarged, widened, and increased the impact and efficiency of collaboration between companies, universities and research institutions. The results are significant: Companies participating in our platform totally outperform the outsiders. Global breakthrough concepts and innovations are reported in our programs on a continuous basis, Smart Steel (SSAB), ultimately protected vehicle (Protolab), and 72% weight reduction in component design (Metso) to be mentioned as examples.

All this will now be transferred to serve the next generation PPP-model: We connect the manufacturing and ICT-industries through DIMECC. We move to DIMECC era, and speed-up the development of new co-creation methods and work in three cross-disciplinary and cross-industrial co-creation themes with a research portfolio of 50M€. DIMECC has 69 shareholders, ca. 400 customers, and ca. 40 significant international partner and stakeholder organisations. Our stakeholders benefit from DIMECC as the leading co-creation platform in digital transformations.

Some highlights of our research results are reported in this annual report. In addition, a lot of co-creation services were enlarged by us. As examples, I would like to focus on the establishment of the Autonomous Ships Alliance, on the fast growth of three of our trademarked co-creation services, namely Demobooster, PoDoCo, and MPD, and on the strong support to our co-creation platform from partners that do not directly participate in our activities.

Finnish maritime industries launched an Alliance for autonomous ships. The objective of the Alliance is to create the world's first autonomous marine transport system to the Baltic Sea. Ships will be fully autonomous in 2025. The first pilots and applications in months to come are cargo ships and freight. Finland has world-class marine technologies and ICT competencies. This DIMECC-led Alliance is a natural continuum to our long-term and determined R&D&I facilitation, where we boost cross-industrial innovations and lead the industry's digital transformation. DIMECC co-creation platform makes significant innovation-based investment wave happen. This has been seen e.g. in Turku, where Meyer now invests in physical equipment while the needed intangible investments were made in our programs during 2009-2014. We create competitiveness, jobs, and well-being through innovations. Ever faster.

Private investment within DIMECC services has increased significantly last two years. Our Demobooster sold about 100 000€ in 2016: 34 companies have already used Demobooster to produce 20 demos. PoDoCo private foundation funding reached about one million euros in 2016. First PoDoCo post docs have moved from academia to industry. PoDoCo is the

most efficient European method in technology transfer. Technology transfer takes place without any public investment, it increases the impact of foundation funding, and the companies take higher risks in R&D with the new post docs than they would do alone. What a win-win-win!

Technology Industries Finland announced in September 1st, that DIMECC is the platform to create 100 000 new jobs in Finland. MPIDEA competition for these jobs is now open, and the winner will be awarded at Manufacturing Performance Days 2017 event through a jury chaired by Finnish minister of employment. MPD2017 is the one and only manufacturing industry's official celebration event in "Finland 100 years" program led by Prime Minister's Office. MPD2017 has now specific high-level political recognition, and with the theme "Towards Outcome Economy" we expect next year to witness the best and biggest ever MPD.

Even though the national economy is struggling, we have confidence on the government in finding ways to support the most impactful, effective, and efficient co-creation mechanisms. Our role in the European innovation landscape and PPP pioneering has been not only recognized by our customers, but also by labour unions, by economists from many perspectives, and by the highest possible level: EU Commission. We have all the digital competencies, and industry's digitalization agenda ready to be executed, but the non-systemic mechanisms of current public innovation funding slow down the speed with which our country would in normal conditions step forward. However, there is wide and common understanding and measured facts supporting PPP leadership in digital transformations.

I would like to thank DIMECC's customers, program participants, investors, shareholders, stakeholders, service suppliers, and our personnel for the challenging and integrative year 2016! All over the world, PPP models and alliances including public sector interests and private side leadership have shown their impact and efficiency. DIMECC has a solid basis and excellent track record in creating results. Since outcome is now needed more than ever, we are proud to offer us as a platform for all who want to lead the disruptive digital change.

Harri Kulmala, CEO

DIMECC OPERATIONAL MODEL

DIMECC thematic areas

Digitalization manifests the convergence of industries, which leads manufacturing industry to be fully embedded with software & ICT competences, and software & ICT companies have growth opportunities by increasing the value in traditional industries. Digitalization is a comprehensive approach referring to the changes associated with the application of advanced technological solutions at all levels of organizations and in all aspects of business. Achieving successful digitalization hinges on how industries exploit their potential by building on how they organize their core operations, use digital technologies in products and services and formulate new business models in order to generate growth. Therefore, to unlock the potential of digitalization for the industry digital transformation is vital for sustainable business success. To connect manufacturing and ICT-industries and drive the digital transformation with the most efficient and holistic manner DIGILE Ltd. was merged into FIMECC Ltd, and the company changed its name to DIMECC Ltd during year 2016.

DIMECC's vision is to be the leading co-creation platform for digital transformations. The vision is achieved through private-public-partnership (PPP) based co-creation activities in the 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 have been 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), Innovation Camp (idea crowdsourcing), industry-driven doctoral schools, and effective utilization of partnership networks.

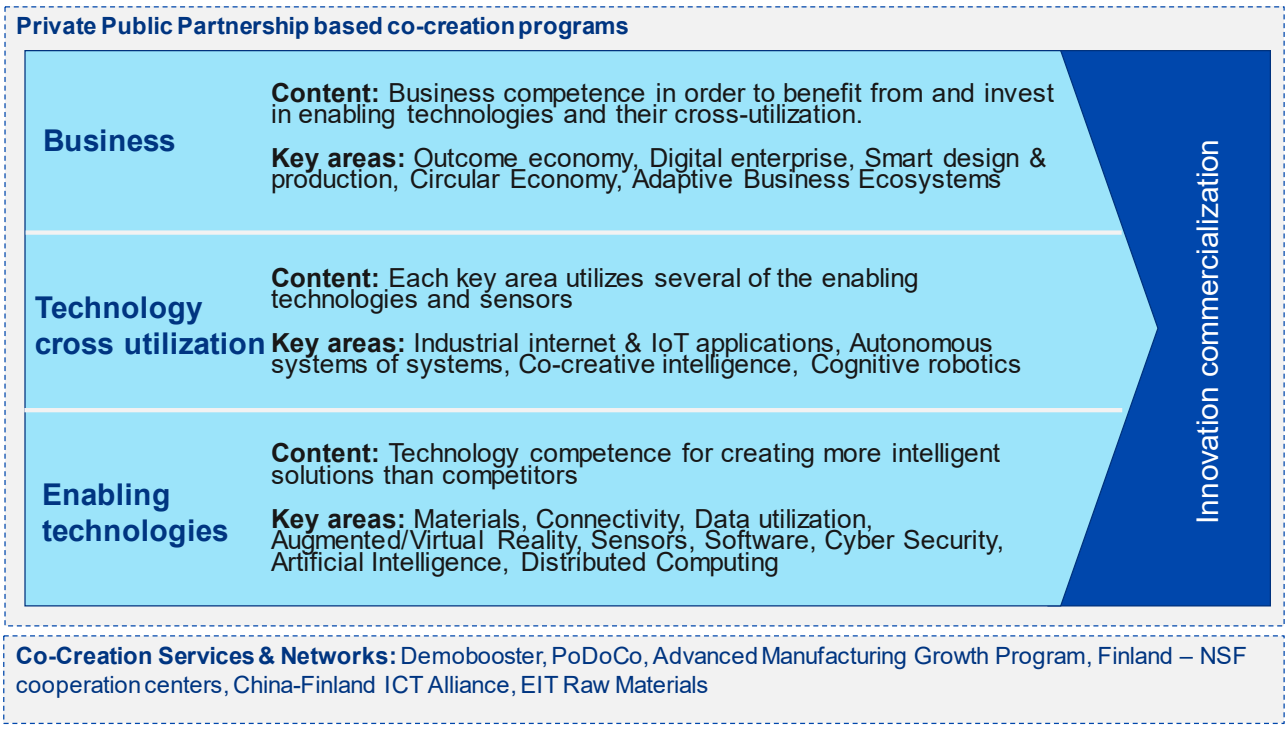


Figure 1: DIMECC thematic areas.

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 results-oriented co-creation. DIMECC accelerates R&D&I activities through three types of services:

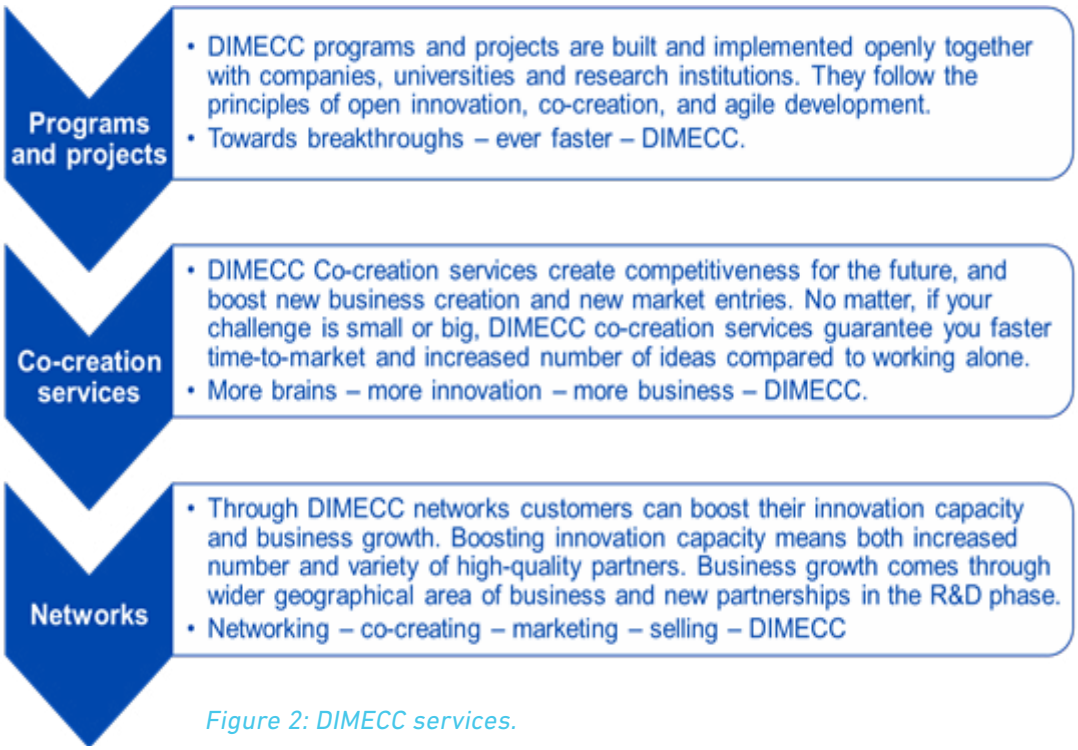


Figure 2: DIMECC services.

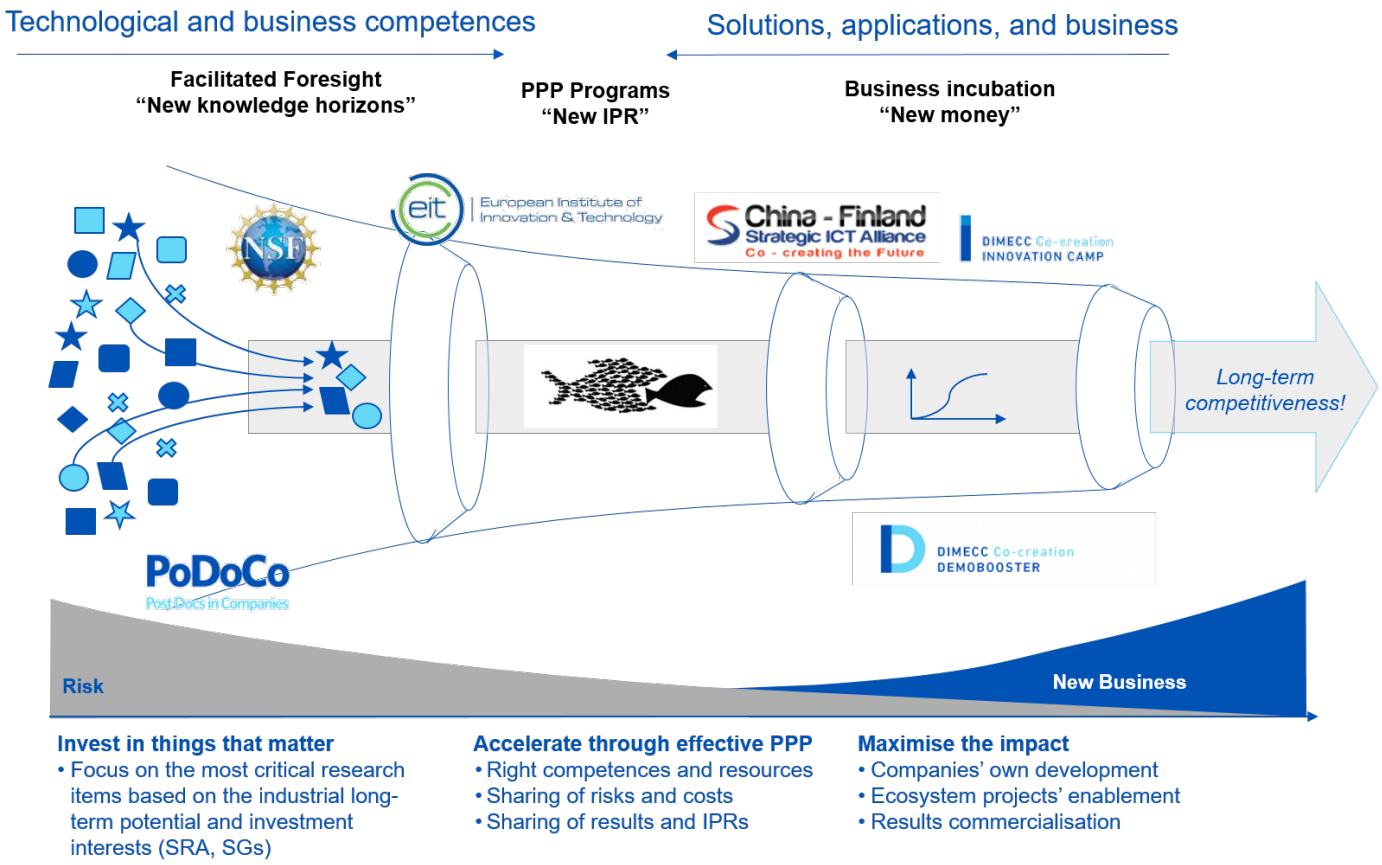


Figure 3: DIMECC innovation funnel.

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". In the first phase the most relevant research questions to solve are identified. The shareholders define the main focus of DIMECC activities. This is organized through an R&D board that is used for foresight activities. Concrete research areas and detail program planning are defined by thematic steering groups formed by experts. Relevant research questions need to fulfil the following criteria: 1) Significant long-term business potential; 2) High scientific ambition; 3) Enough joint industrial interest.

When these criteria are fulfilled, the PPP -program and/or project preparation can be started. DIMECC 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 actions is often transversal with respect to the different thematic areas. The development and growth of individual companies if 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.

Research programs and projects form the backbone of DIMECC innovation funnel activities. DIMECC innovation funnel is accelerated through DIMECC co-creation services and DIMECC Networks. Overall DIMECC emphasizes the development of the ecosystem through which individual companies can develop in collaborative manner. The systemic large R&D&I programs focus mainly on precompetitive research, while many co-creation services are close to market. Since all R&D&I programs 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 organisation 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 operations area is steered by shareholder experts through an R&D council. 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. A 3,5% administration management fees from programs' and projects' total volume are used to maintain DIMECC´s structure and operations. According to DIMECC's analysis in 2015, this is the lowest management fee in any European R&D&I programs.

DIMECC Activities

DIMECC Programs and Projects

This chapter introduces shortly the program map and research volumes of DIMECC in 2016. All on-going research programs 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 2016 was in finalizing, reporting, and showing and disseminating the results of ending programs, and in initiating the creation of DIMECC's new Strategic Research Agenda. The biggest digital business model renewal effort took place through the design of Design for Value (D4V) program.

Tekes' funding in DIMECC's programs was ca. 47 per cent on average. The total cumulative funding from the Academy of Finland to researchers related to DIMECC was 1.0 M€ in 2016, and FIMECC got one new FiDiPro professorship into the programs.

Following figures represent companies' (Figure 5) and research institutes' (Figure 6) DIMECC participation in all programs as planned at the end of 2015. The current planned on-going program budget division of DIMECC program portfolio is presented in Figure 7.

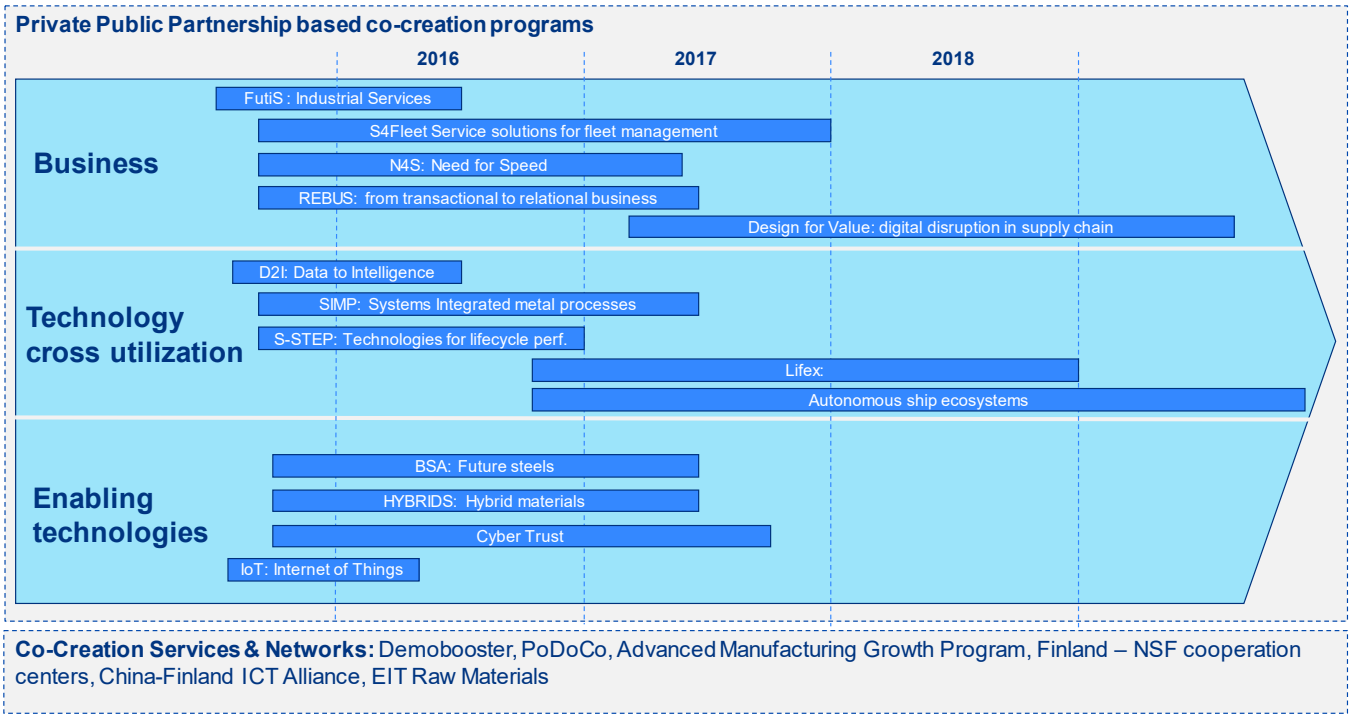
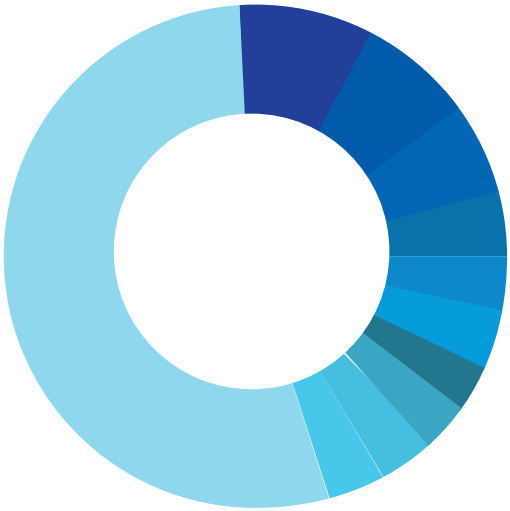
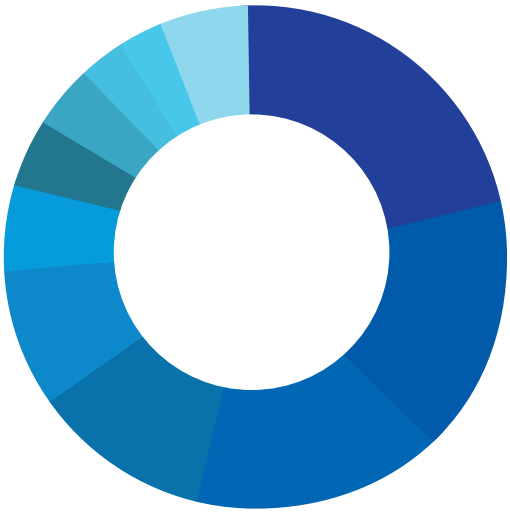


Figure 4: DIMECC program portfolio 2016



Ericsson	15,6
F-Secure Oyj	14,6
SSAB	14,4
Wärtsilä Oyj	10,0
Outotec Oyj	9,8
Valmet Oyj	9,5
Nokia Oyj	8,9
Bittium Wireless Oy	7,1
Cargotec Oyj	6,7
Rolls-Royce Oy	6,7
Others	118,7

Figure 5: Companies' total investments in DIMECC portfolio (M€) in 2016.



Aalto University	31,2
VTT	28,7
Tampere University of Technology	26,9
University of Oulu	15,6
Åbo Akademi	11,4
University of Helsinki	8,1
University of Vaasa	6,1
Lappeenranta University of Tech.	5,4
University of Turku	3,5
University of Jyväskylä	3,3
Other	7,3

Figure 6: Research institutes' total program budgets in DIMECC portfolio (M€) in 2016

N4S	52,3
IoT	50,5
FutIS	40,4
D2I	38,5
BSA	25,5
SIMP	24,2
Cyber Trust	23,0
REBUS	22,9
MANU	22,4
HYBRIDS	20,4
D4V	19,6
S4Fleet	18,9
S-STEP	11,4

Figure 7: Total budget division of on-going DIMECC portfolio (M€) in 2016.

Current DIMECC portfolio

DIMECC Program BSA

DIMECC BSA - Breakthrough steels and applications - builds on the existing strengths to secure the leading position of the Finnish metals and engineering industry. The program answers to major global challenges and end-user needs by taking metals research and design to a new level.

Essential elements:

- DIMECC Breakthrough Materials Doctoral school
- Extensive collaboration both nationally (joint knowledge platform with Hybrid Materials program) and internationally

Impact:

- Renewed and successful Finnish metals and engineering industry based on innovative and sustainable solutions
- Applications of the program results will benefit various fields of industry
- New business opportunities will be opened in new areas
- An extensive international steel competence network will be created

Vision: Finnish metals and engineering companies are key players in global cleantech markets by 2030

The program has proceeded according to the plan. However, the SHOK-funding instrument ramp-down impacts heavily on the program and cuts especially the academic research part. Within the program originally more than 100 researchers are forming an international network concentrating on essential parts of the steel and engineering industry value chain. The BSA program is linked and will be run in close cooperation with another DIMECC materials program HYBRIDS (Hybrid Materials). The BSA and HYBRIDS program form also a platform for the DIMECC's Doctoral School with 34 doctoral projects. Now there is a risk that this network will break out which impact significantly Finnish metal based industry's competitiveness and possibilities to gain EU funding for the area.

DIMECC's BSA and HYBRIDS programs are major efforts in application oriented materials R&D in Finland, they have been built based on the needs from different industry sectors and have close links with the R&D programs in those as well as the fundamental research activities by Academy of Finland (e.g. Programmable Materials). The results can be directly used by the participating material producers in the development of new higher value added steels. The participating equipment and machine manufacturers have access to new steel solutions and can test and apply them fast in their prototypes and products. The results also strengthen the increasingly important service business by providing in addition to improved equipment performance also longer lifetime.

The major industrial partners of BSA have estimated the business potential in terms of future revenues generated or significantly contributed by year 2020 achieve the level of 25-50 times the respective investments into the program. To secure as much as possible of this potential, the program content has been re-focused after the sudden budget cuts. Also the coming period was extended by 6 months in order to ensure time for the most potential result realization.

Schedule: 2014-2017
Volume: 25,2M€

DIMECC Program CYBERTRUST

People are more and more dependent on networks, electricity and data processing while our infrastructure is becoming more dependent on unpredictable risks. **DIMECC Cyber Trust** Program creates a foundation for Finnish research and industry to address the needs emerging in the cyber security domain. The main research objective pf the DIMECC Cyber Trust program is to improve the privacy, trust and decision making in digital infrastructure by monitoring, analysing, virtualizing, and visualizing traffic, objects and events . The program utilizes the strong expertise, extensive knowledge and solid cooperation model in public-private sectors. The consortia consists of 19 companies, and 8 research institutes and universities.

In DIMECC Cyber Trust Program, the cyber security is approached with the following themes: secure services, securing platforms and networks, and Advanced threats and Security Assurance

Schedule: 2015-2017
Volume: 22,9 M€

DIMECC Program DATA TO INTELLIGENCE

DIMECC Data to Intelligence (D2I) was a research program focused on big data, data reserves and user-centric service development. The aim of the program was to develop intelligent tools and methods for managing, refining and utilizing diverse data in order to enable innovative business models and services. The work was guided by the needs and challenges of 7 business sectors, in which existing competencies provided a strong foundation.

D2I was financed by Tekes and coordinated by DIGILE (now DIMECC) together with the management team of the program. The partner organizations included 27 large enterprises, 26 SMEs, and 17 research institutes and universities providing leading edge expertise in research and practical business experience. In addition, D2I collaborated extensively with other organizations and networks in Finland and the EU as well as globally.

D2I enabled teams of experts with complementary skills to work on challenging problems. A major focus was the demonstration of the feasibility of the solutions with real-world data sets and functional prototypes in order to facilitate technology transfer and advanced training of data scientists. In addition to the results achieved during the program, D2I provided the basis for several subsequent research and development projects.

Schedule: 2012-2016
Volume: 38,5 M€

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.

Especially in the autonomous shipping, D4Value program has a critical role as it is the first ecosystem level approach in the area. Although the autonomous shipping has been raised into the focus, D4Value focuses intensively also other critical supply chain parts and their digital value creation questions.

Schedule: 2016-2019
Volume: 19M€

DIMECC Program FUTIS

DIMECC FutIS - Future Industrial Services - research program investigates the future of industrial services in metal and engineering industry in three major topics: service business mindset, integrated service development, and efficient service operations. The program develops new competence and better profitability for participating industrial firms' service business, and with its significant scope promotes the transformation of the entire industry. The long-term orientation in the program means that ideas and opportunities are explored for novel businesses by examining the futures of customers' operations and environments; methods, processes and practices are developed to enable service business transformation over the forthcoming 5-15 years; and bottlenecks and inefficiencies in processes are sought and solved to generate readiness for service business adoption and expansion.

The readiness for future industrial services is sought by integrating knowledge of service business logics with the unique requirements of the technology-based context. The theoretical approach for research is integrative in that FutIS covers the viewpoints of service strategy, marketing, operations and innovations simultaneously, promotes their interplay, and thereby generates new knowledge to the international research community. The unique network of FutIS will work together in an effort to turn service business into a significant success factor in Finnish engineering industry and their broader business network.

The program is running its last year and the focus of the work currently is to up-scale and disseminate the program results for maximum industrial impact. The intensive business dynamics make companies to require shorten lead time for the results utilisation and the program results will be mainly implemented along with the normal business strategy implementation process. Therefore the results will have a clear impact already during the program execution, which ensure results relevance. Due to the effective progress of the program, some companies have achieved their program targets and started to implement the results in their business.

Schedule: 2011-2016
Volume: 36,8 M€

DIMECC Program HYBRIDS

HYBRIDS -Hybrid materials - builds a unique multidisciplinary knowledge platform that will strengthen the manufacturing industry

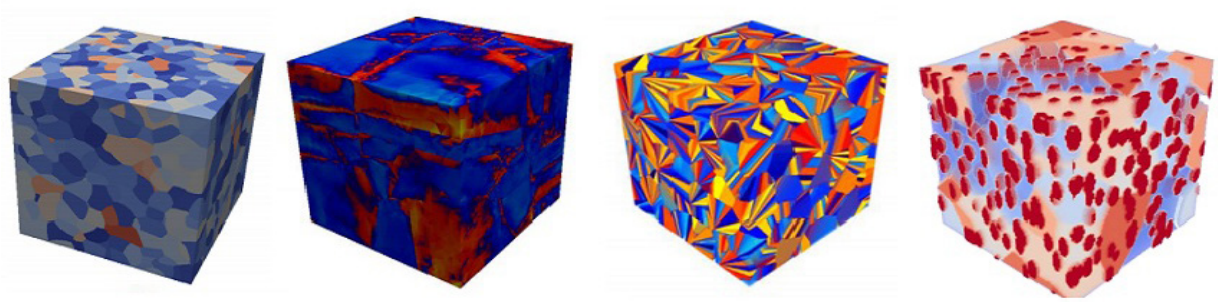
The program solves fundamental challenges in the R&D and application of multi-materials to create advanced property combinations that conventional materials do not possess

Essential elements:

- DIMECC Breakthrough Materials Doctoral school
- Extensive collaboration both nationally (joint knowledge platform with Breakthrough Steels and Applications program) and internationally

materials doctoral school. The program is a key tool to renew the Finnish industry and secure its future competitiveness through knowledge-intensive materials. As a result, a unique multidisciplinary technology platform and a world-class competence network was planned to be created. This would have provided Finnish companies a competitive advantage to apply HYBRID materials effectively in future application which require special material characteristics.

The program proceeds according to the plan. However, the SHOK-funding instrument ramp-down impacts heavily on the program and cuts especially the academic research part. It also risks the business potential which the main industrial participants estimated to be already in 2020 about 23-100 times the total investment



Impact:

- New value-added hybrid material solutions meeting high customer demands (multifunctional, durable, cost efficient and sustainable), creating a competitive advantage
- Digitalisation of manufacturing and material development will decrease the time to market
- A strong manufacturing industry ecosystem and new industrial networks (in contrast to knowledge silos)

budget. To secure as much as possible of this potential, the program content has been re-focused after the sudden budget cuts. Also the coming period was extended by 6 months in order to ensure time for the most potential result realization.

Schedule: 2014-2017
Volume: 18,2 M€

Vision: Growth and improved competitiveness by value added, hard to copy solutions

DIMECC HYBRIDS program is managed in close cooperation with the DIMECC BSA (Breakthrough Steels and Applications) program and is the other main contributor for the DIMECC breakthrough

DIMECC Program INTERNET OF THINGS

Internet of Things and its services are becoming part of our everyday life, ways of working, and business. The long-standing visions of the personal digital assistant, smart home, smart car and the smart environment are now becoming reality with the help of mobile computing and the Internet of Things. Our IoT program was developing crucial building blocks and models for the next generation of Internet services supported by a plethora of connected things.

Our program aimed to ensure that Finland is a recognized leader in the IoT domain. The program started in 2012 and the budget for this four-year program was about 50 Million Euros. Over 40 organizations participated in the program. The research was based on the strategic research agenda.

The program had an over-arching goal of developing a common toolkit and basis for IoT deployments that connects the currently more isolated vertical deployments and offers reusable building blocks for them. Various vertical industry segments have been developed over time to solve challenges in transportation, logistics, public safety, health and so on. Many of the current software and hardware solutions are not interoperable with each other.

Our program aimed to create new ecosystems through the common basis and toolkit and by promoting innovation in the application and service layer thus opening the IoT software development process.

Schedule: 2012-2016
Volume: 50,6 M€

DIMECC Program LIFEX

LIFEX program focus on advancing digitalization and Industrial Internet in Finnish industry. The roots of the program are in recent DIMECC S-STEP program and the common vision is that profitable industrial services require reliable knowledge. 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 two joint projects of companies and research organizations. DYNAVIS project develop and test next generation Product Lifecycle Data Management practices where virtual and augmented product information is efficiently created and used for different business needs.

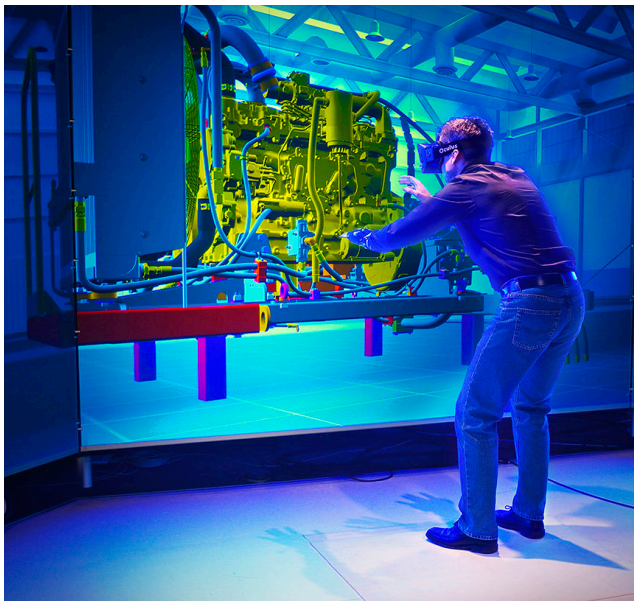
IVM project focus on new innovative vibration management solutions. Based on earlier successful marine applications a novel damping and design concept is applied to several new industry applications.

Schedule: 2016 ->
Volume: 2,7 M€

DIMECC Program MANU

MANU - Future digital manufacturing technologies and systems - program's focus area is manufacturing technology and creating competence in the field of digitalisation and its use in manufacturing. The content of the MANU is divided in six projects:

- Demanding welded structures and their simulation
- Machining of high strength materials and its control through digitalisation
- Change and information management in global manufacturing network
- Manufacturing Execution System for SMEs
- Accelerating and developing operations in supply network by means of digitalisation
- Next generation manufacturing



MANU has shown, which of the novel manufacturing technologies will be developed and how, when DIMECC community enters the next generation PPP-model's time in Finland. Most of the biggest investment news in Finland in 2016 came from manufacturing companies.

Schedule: 2012-2016
Volume: 21,9 M€

DIMECC Program NEED FOR SPEED

DIMECC Need for Speed (N4S) will create the foundation for the Finnish software intensive businesses in the new digital economy. DIMECC N4S adopts a real-time experimental business model, and provides capability for instant value delivery based upon deep customer insight. The program is executed by the forefront Finnish software companies. The consortia consists of 13 large industrial organisations, 16 SMEs and 11 research institutes and universities.

The internet is the first truly global platform for the digital economy and will create significant new business, economic, and social opportunities. Digital resources are constantly available on-line, and for all to use. Increasingly, products and services are not developed by a single company but rather by a network of collaborating companies. This network of companies contribute to the ecosystem through different elements from both established and newly developed products, forming new, even more compelling offerings.

The long-term plan of DIMECC N4S is to serve other companies where software plays a dominant role in engineering—for instance, those associated with the automation industry—by making the program's results, tools, and processes widely available.

Schedule: 2014-2017
Volume: 52,3 M€

DIMECC Program
ONE SEA

One Sea is a high-profile project with a primary aim to lead the way towards an operating autonomous maritime ecosystem in the Baltic Sea 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.

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. 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.

DIMECC Program
REBUS

DIMECC REBUS - Relational business practices - program aims at making scientific breakthroughs in the area of networks and business ecosystems. The program challenges the participating firms to take major leaps in developing these practices as well as fundamentally change their underlying mindsets of managerial behaviour. The particular focus is on those relational business practices that are needed to act as a member in as well as to take advantage of various networks. Big organisational innovations are rather paradigmatic changes in managerial thinking and organisational behavior than small-scale breakthrough innovations with high speed of diffusion. As results of the new research-based practices the REBUS program aims to create a collection of verified relational business practices that are proven in practice and shown to be advantageous in terms of innovation, growth and efficiency for networked firms.

The industrial sectors within the REBUS program are in particular within transportation and energy systems. These two sectors are globally the most investment-intense areas in the coming years and are at the core of the interest of Finnish present and future industry.

The REBUS program is built on a common theoretical framework, within which the four separate projects focus on different network contexts as they implement the actual research and development tasks. The program consists of four projects and one cross-sectional common research task addressing relational business practices.

The four sub-projects are:
- Project business networks
- Logistics networks
- R&D networks
- Value networks

All 22 participating firms have strongly connected the REBUS program with their main growth and development strategies and 7 Finnish research

institutions are committed to explore relational business practices with them. The REBUS program is also highly international and there are collaboration activities with 18 international universities.

The program has been running effectively a two and half year. The program international co-operation has been concretised and the joint effort with the Stanford University's program is active. The program results are already creating impact and gather wider interests. In 2015 REBUS's "Über of the Seas" result received DIMECC Prize. The results focus on novel ways how to improve the performance of marine and cargo business and is a great example of results with wide impact over the whole export industry.

Schedule: 2014-2017
Volume: 22,6 M€

DIMECC Program S4FLEET

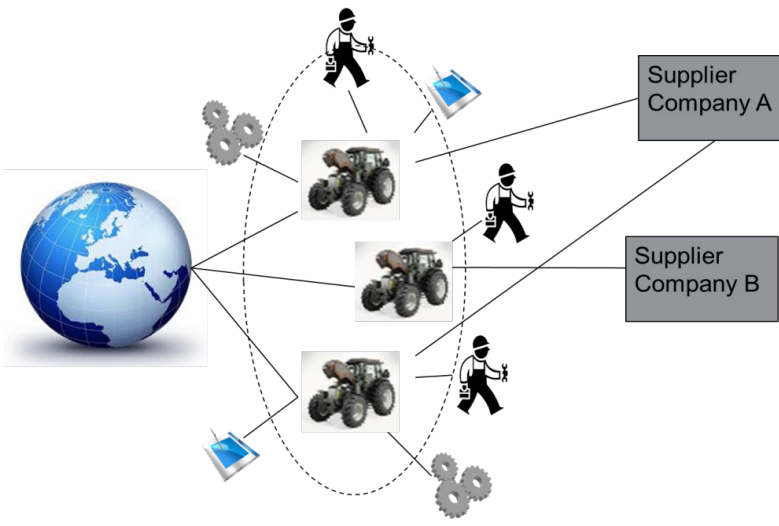
The digitalization of industry is enabling entirely new levels of real-time management of industrial devices, processes, and global fleets of equipment and people. Digitalization has potential to improve resource productivity, process efficiency, flexibility, and large-scale coordination. Digitalization enables new forms of networked cooperation and business models for much greater value creation.

DIMECC S4Fleet - Service solutions for fleet management - program combines the strategic, operations, and technology perspectives to explore and capture the emerging business opportunities of the digitalizing industry. The three focus areas of the program are strategic intelligence in fleet management, operational excellence and dynamic service delivery systems for distributed fleet, and technological solutions for fleet analysis. The program combines resources and skills from 23 industrial and IT companies and six research institutes into a fast-pace three-year research program. Program implementation emphasizes strong collaboration between participating companies by arranging practice benchmarking opportunities and special interest groups programs, in addition to the program level seminars and other collaboration opportunities. The program also emphasises new scientific results creation and dissemination by arranging a yearly doctoral school and engaging leading scholars to evaluate and advice the research teams.

Several studies have found the services building on digitalisation critical to the future competitiveness of the Finnish industry. The purpose and goal of the S4Fleet research program is to explore and capture new innovative, globally scalable, and differentiating service business growth opportunities. The approach to use global fleets as platforms for new business creation is effective way to scale-up new life-cycle service offering. S4Fleet is the Finnish version of the German Smart Service Welt initiative.

DIMECC S4Fleet and DIMECC S-STEP together form the Finnish company-driven Industrial Internet R&D entity, which is designed to be implemented together, with a small timely gap, since there is no new service business without the technologies, but with the technology only, there is no commercial success.

The program is very topical and critical for the industry. Therefore the industry partners gave



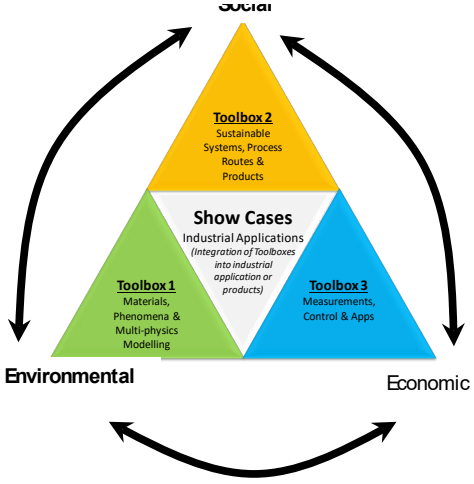
major part of their public funding for the research partners in order to secure the Finnish research of this critical area. Also the program content has been re-focused after the sudden budget cuts while the original schedule was kept as the ecosystem the program forms is seen critical.

Schedule: 2015-2017
Volume: 18,9 M€

DIMECC Program SIMP

Resource efficiency is high on the EU political agenda and plays more and more critical part also in society. Digitalisation of processes, process chains, systems and linking them in a real-time process control systemic is arguably a key component for tackling this global challenge. The objective of the program is to further improve the already low environmental footprint of the 7.8 billion € export "Metals and metal products" Finnish industrial sector and to significantly increase its global competitiveness. The program focus on 3 key Finnish industry sectors i.e. copper, steel and stainless steel.

SIMP - System integrated metal production - program will provide the basis to further innovate the production systems to higher resource efficiency and render the world class export metal



products even more sustainable and CleanTech based. World Class CleanTech systems will therefore be an important product of this program. This is an enormously challenging task to take, but it is also self-evident that if these objectives are achieved, not only will the Finnish metallurgical industry improve its resource footprint but it will provide techniques and technology that places it in a leading global position with regard to enabling increased resource efficient metal production. During 2015 a new industry driven doctoral school with 25 researchers was launched within the program.

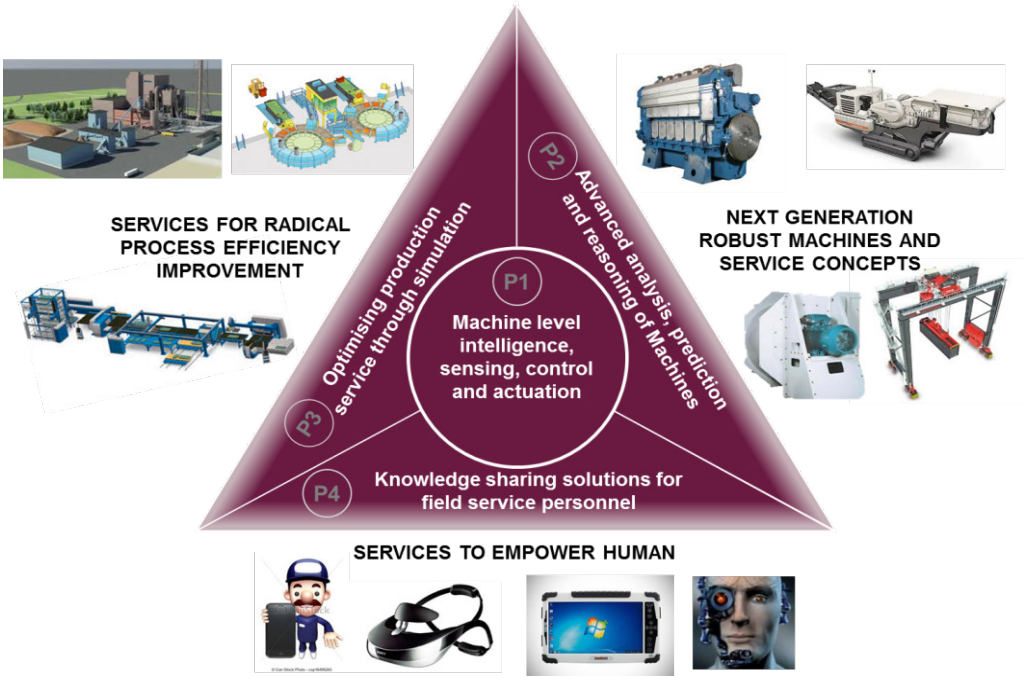
Additional funding for the area was successfully applied from the EIT raw materials KIC in which DIMECC is an associated partner. SIMP program works basically as a platform for the raw material KIC' partners in their KAVA activities and DIMECC is looking for new ways how to offer this kind of platform also in the future.

Schedule: 2014-2017
Volume: 24,0 M€

DIMECC Program S-STEP

Industrial services represent today 50%, or beyond, of the industrial business volumes, and the share is steadily growing. The share of industrial services represents roughly 2/3 of the overall Finnish service exports. The importance of service business in the future is evident as the service business enables revenue flow also after the traditional product sales and, more importantly, the service business is typically many times more profitable than the product sales itself.

The leading industrial services and the related business models are heavily dependent on reliable, accurate, online information and advance prediction capabilities on machine and system level. In the future, the importance of this



information will increase and this will require also radical improvements in machine level intelligence and independency. While the ICT for heavy industry has been a trend already for decades, the future business models will require a revolution also in this area. This revolution is currently known as the emerging industrial internet.

DIMECC S-STEP - Smart technologies for lifecycle performance - program is positioned in the cross roads of these two significant megatrends: 1) the growing importance of industrial service business, and 2) the remarkable emergence of industrial internet or cyber-physical systems. The combination of these trends holds significant advantages for Finnish industries and export. However, before these opportunities can be realised, the problems related to the combination of these opportunities, related technology issues and scientific problems needs to be solved. This is the core of the S-STEP program and it has a clear mission: S-STEP creates the industrial internet technology that enables superior services for the Finnish industry.

The S-STEP program consists of four projects which tackles the research questions from various angles. To ensure both the leading scientific knowledge creation and the respective industrial relevance, the program is orchestrated through technology toolbox oriented work which focuses on creation of the new leading knowledge capital and related tools, and thru industrial showcase work, which covers the experimental part of the capability creation based on real industrial cases. This way we ensure that the created toolboxes and knowledge can be effectively integrated into various industrial problems increasing the impact of the results, whereas, the versatile showcases enable rich experimental data for the toolbox research.

Schedule: 2014-2016
Volume: 11,4 M€

DIMECC Co-creation services

The co-creation activities consist on 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 a new 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 is a registered trademark of DIMECC.

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!

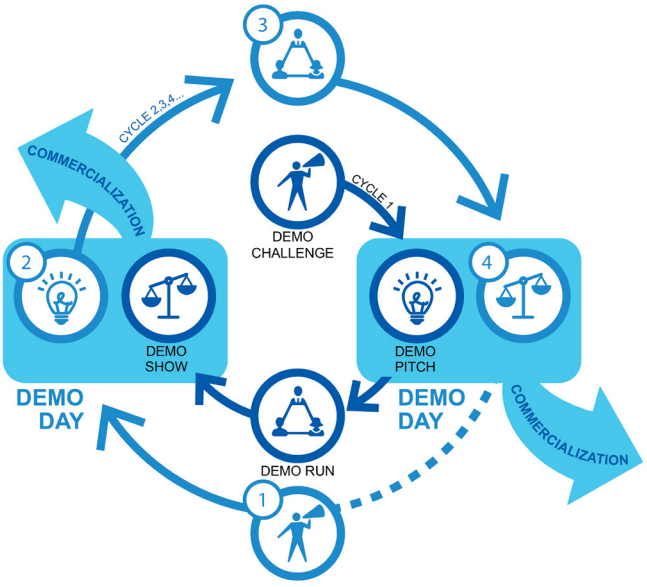


Figure 8: DIMECC Demobooster service cycle.

Demobooster 2016 in numbers:

6	Demodays
34	Companies
22	Challenges
69	Solutions
20	Demos

Demobooster creates a specialists' network for the development and marketing new ideas between Appliers (engineering industry) and Producers (software enterprises and expert organizations). During year 2016 six Demodays have been organized in which in total 34 companies have participated, 22 challenges set, 69 solutions founded and 20 demos developed.

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 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

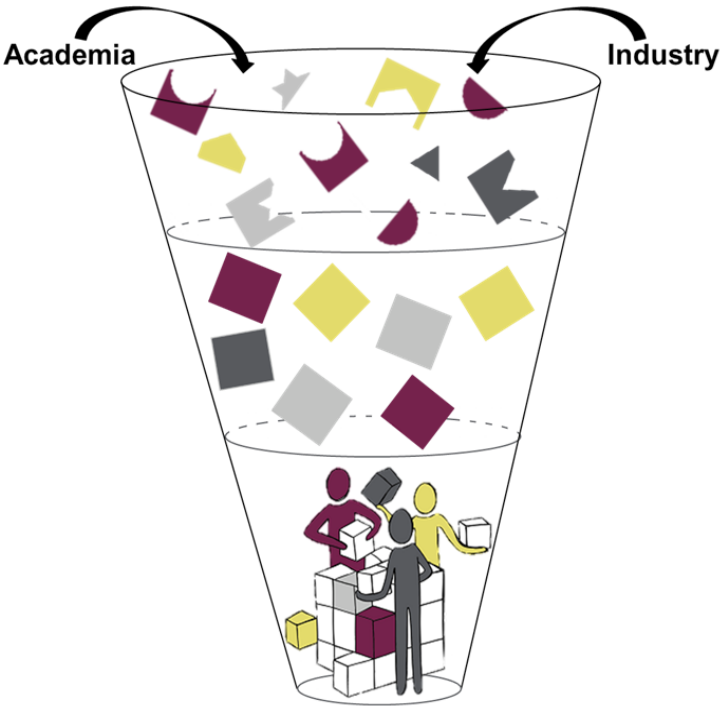


Figure 9: PoDoCo matchmaking.

and foundations. Nine foundations will allocate 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.

In 2016 PoDoCo program has funded 25 collaborative projects between companies and postdocs out of which 16 have started. The rest nine project will start during year 2017. In 2016 three postdocs were employed to the private sector through the PoDoCo program. In 2016 two new foundations joined PoDoCo program and in 2017 the annual volume of PoDoCo will exceed one million euros. More results and the impact of the results will be attained during 2017 when the first projects will be finished.

www.podoco.fi

DIMECC Innovation Camp

DIMECC Innovation Camp is an innovation contest where students work together as multidisciplinary teams searching the best solution to challenges set by companies. The objective is to address company challenges through crowdsourcing of ideas to university students. DIMECC Innovation Camp involves 150 students from three universities and several coaches from companies and universities. In addition, the event includes inspiring keynote presentations on the annual theme. The event will culminate in the evening of the third day when the teams present their results and the judges reward the best teams.

For companies DIMECC Innovation Camp offers innovative and concrete solutions and ideas, networking with companies and universities, opportunitiy to meet makers of the future and company visibility among students. For students Innovation Camp is offering important links to industry and companies and business and team work skills. Students will also get credits (ECTS) and there is a monetary prize for winning teams.

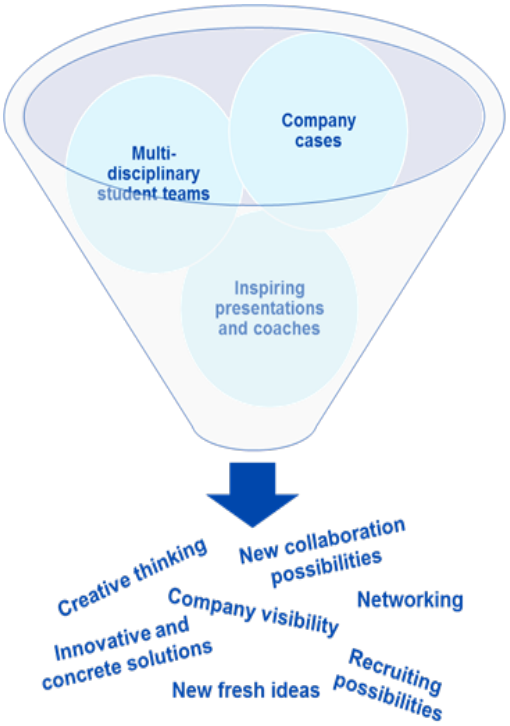


Figure 10: DIMECC Innovation Camp funnel.

In 2016 DIMECC Innovation Camp was organized in Tampere in collaboration with Tampere University of Applied Science, Tampere University of Technology and University of Tampere. The theme for 2016 was new business: "The recent technological advantages and changes in the operating environment of companies bring new opportunities to business leaders. To stay competitive companies need to change the game, not just play the game. The trick is to make a change that is in tune with the changing attitudes and aspirations of customers, with the capabilities of technology. if it can be done, it will be done."

"Advanced Manufacturing in USA" growth program

DIMECC Oy is responsible for the implementation of the "Advanced Manufacturing in USA" growth program (AMGP). The recent growth in USA manufacturing industry and the clear need for manufacturing equipment modernization open significant opportunity for Finnish companies that have developed and offered advanced manufacturing solutions for decades. By offering solutions improving the productivity of American manufacturing industry the Finnish companies can help in bringing US factories to digital era to boost re-industrialization of the USA. With this background the program aims to support the revival of the US manufacturing industry by helping the American factories digitalize their operations through Finnish competences and offerings. The vision is that in digitalization, the Finnish companies are well-recognized and sought-after partners for the American manufacturing industry. Initial target industrial segments are metal processing, production technology, information technology (instrumentation and analysis), as well as automobile industry. Planned duration of the program is two years, i.e. 2017-2018.

Main activities of the program focus on 1) promoting of the Finnish digitalization and process automation expertise; 2) increasing market understanding through focused market studies; 3) creating capabilities for successful USA market-entry through coaching and training services and peer-to-peer learning, and 4) networking Finnish companies with USA companies through US clusters, industry associations and networks.

Figure 11: AMGP main activities

Manufacturing Performance Days – event as a platform

Manufacturing Performance Days is an international top level B2B summit which is organized every second year in Tampere, Finland at the Tampere Hall, the number one Congress Centre in Finland. MPD is an executive and visionary seminar for manufacturing industries, researchers and technology and service providers worldwide. This highly appreciated event brings together internationally recognised experts and academia to discuss and represent industrial best practices and operational excellence, novel business concepts as well as scientific and technological breakthroughs in the field. Company visits, meetings and networking nourishes potential for R&D&I collaboration over the boarders and grows opportunities for new business contacts. MPD is a registered trademark of DIMECC.

www.mpdays.com

MPD MANUFACTURING PERFORMANCE DAYS

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, the Industry–University Cooperative Research Centers Programme of the US National Science Foundation (NSF), and DIMECC is running ICT Alliansse. 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 addition, DIMECC´s CEO is a member of Commissionaire Moedas'the high level group on maximizing the impact of European research and innovation programs.

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 is an associated partner of EIT Raw Materials. 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.

NSF

DIMECC together with partners have created new opportunities of international cooperation for Finnish researchers and companies. US National Science Foundation's (NSF) IUCRC (Industry/University Cooperative Research Centers Program) provides a unique possibility for co-creation between research and industry.

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. 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. During 2016 DIMECC has negotiations to add another center for this mode of international collaboration.

China - Finland ICT Alliance

China-Finland Strategic ICT Alliance is an initiative that dates from 2009. The China – Finland ICT Alliance is an open, scalable and sustainable platform for cooperation in ICT and digital services. While creating new business opportunities it will also help in addressing the future challenges related to environment, energy, traffic, wellbeing, health and aging population, and in creating future urban environments. The jointly chosen key research themes are future wireless access, future networks and energy efficiency, and future mobile and ubiquitous services.

The complementary expertise and capabilities in China and Finland facilitate very rapid creation, testing and scaling up of new innovations in areas of mutual interest. The cooperation will involve key international partners from the EU but is the alliance is open also to other parties.

From the Finnish side the basis of the Alliance has been built by Tekes, the Finnish Funding Agency for Technology and Innovation, who have allocated initial funding and provided expertise through its offices in Beijing and Shanghai. In 2011 Tekes appointed DIGILE (under DIMECC afterwards) to take over this mission

China - Finland
Strategic ICT Alliance
Co - creating the Future

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 2016 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 2016

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 Turbiini Oy	12
Jyväskylän yliopisto	52
KONE Oyj	120
Konecranes Oyj	120
Kumera Oy	50
Lapin Ammattikorkeakoulu Oy	40
Lapin Yliopisto	24
Lappeenrannan teknillinen yliopisto	64
Laurea Ammattikorkeakoulu Oy	52
Metropolia Ammattikorkeakoulu Oy	52
Metso Oyj	120
Meyer Turku Oy	120
Mikkelin Ammattikorkeakoulu Oy	12
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
Stonesoft Oy	12
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
Viestinnän keskusliitto	12
Wapice Oy	50
Wärtsilä Finland Oy	120
Åbo Akademi	24
Älykkään liikenteen verkosto - ITS Finland ry	12

69 shareholders

23 research institutes

46 companies

BOARD OF DIRECTORS

Board of directors was elected in the annual general meeting in March 31st, 2016. The board had ten meetings in 2016.

In 2016, the remuneration paid to board members was 150€/meeting (200€ for the chairman). PricewaterhouseCoopers Oy, and Mr. Jouko Malinen as the auditor in charge, continued as the auditor of the company.

Members

Petri Kalliokoski, VTT
Martti Mäntylä, Aalto University
Lauri Oksanen, Nokia (vice chair)
Markku Hollström, Elisa
Joonas Lyytinen, Reaktor (no deputy)
Timo Kotilainen, FISC
Tomas Hedenborg, Fastems (chair)
Tapani Kiiski, Raute
Sauli Eloranta, Rolls-Royce
Antti Koskelin, KONE

Deputies

Mika Hannula, Tampere University of Technology
Matti Saren, University of Oulu
Harri Oikarinen, Ericsson
Mika Raitola, Sonera
Christian Fredrikson, F-Secure
Kimmo Järvinen, Metallinjalostajat ry
Jari Riihilahti, Metso
Juhani Asunmaa, SSAB
Juha Pankakoski, Konecranes

MANAGEMENT

Dr. Harri Kulmala
Chief Executive Officer

External positions in 2016:

- Member of H2020 evaluation and renewal high-level group, EC
- Member of The Finnish Academy of Technical Sciences
- 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
- Member of Millennium Prize selection management group, Technology Academy of Finland
- Member of advisory board, Tampere University of Technology
- Chairman, EU-US Frontiers of Engineering

Dr. Ülo Parts
EVP Operations

External positions in 2016:

- Member of Future internet forum coordination group for H2020

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

External positions in 2016:

- Member of Factory2Fit external advisory board

PERSONNEL

Marika Moilanen (BBA),
Manager, marketing and communications

Dr. Matti Hämäläinen,
Manager, international relationships

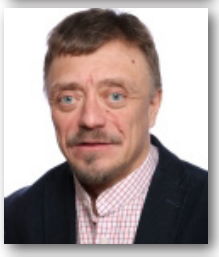
Dr. Jaakko Talvitie
Innovation Scout

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

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

Anu Tengvall (M.Sc.Hum.)
Controller

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



Dr. Pauli Kuosmanen,
Senior advisor (part-time)

Jari Juopperi,
Manager, technology platforms (until 12/2016)

Dr. Kalle Kantola
EVP Strategy (until 12/2016)

Annu Rantanen (B.Sc.Econ.),
Controller (until 7/2016)

Essi Heinänen (LL.M),
Legal Counsel (until 6/2016)

PROGRAM MANAGERS

Outsourced program management at the end of 2016:

BSA, HYBRIDS:
Dr. Markku Heino, Spinverse

MANU:
Dr. Kai Syrjälä, Kaidoc

SIMP:
Ingmar Baarman, Tammet

BSA, HYBRIDS:
Vilja Vara, Spinverse

MemsCat:
Katri Kaipainen, DIMECC

S-STEP: Dr. Arto Peltomaa, T:mi Peltomaa Arto

Cyber Trust:
Markku Korkiakoski, Bittium

Need for Speed:
Janne Järvinen, F-Secure

S4Fleet:
Dr. Pekka Töytäri, Efekto

FutIS:
Pekka Helle, Helle-Kangas Consulting

REBUS:
Dr. Katri Valkokari, VTT

RESULTS – A SELECTION OF NEW DIMECC RESULTS AND OUTCOMES

This chapter introduces new 2016 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 - Knowledge sharing solutions for mobile field service personnel

The industrial internet and service business have potential for radical improvements in field services regarding service quality, work satisfaction, productivity, and risk reduction. Now, service technicians may spend only a few hours each day on value-added work, while most of the time is used on waiting, searching for information, and reporting. In the DIMECC S-STEP program, augmented reality-based concepts of knowledge-sharing solutions for mobile service technicians were developed.

The solutions developed in S-STEP program utilize recent advances in AR and multimodal technologies on lightweight yet powerful mobile and wearable devices. 3D tracking technologies, sensors and depth cameras allow implementation of multimodal AR even in challenging industrial environments. The solutions developed in S-STEP program benefit service technicians in five areas: 1) being better prepared for the maintenance visit, 2) getting contextual guidance during the fault detection and maintenance operation, 3) receiving fluent support for data gathering and reporting, 4) getting hands-on support from remote experts, and 5) giving and getting contextually relevant peer support using social media.

These solutions and bigger foreseen change in maintenance work will generate benefits for maintenance workers, service provider companies, and customers. Maintenance persons can work more fluently, and they can be confident in getting support when needed. The main benefits for the service provider company are faster and more efficient maintenance, as well as better service quality. The service provider company will also benefit from the ownership of the all the knowledge that is related to the maintenance. Customers will gain most benefits from fast, efficient, and predictable maintenance.

Figure 12: Screen capture from omnidirectional video of the Bronto skylift maintenance hall. Users can freely observe the skylift and its location using a headmounted virtual reality solution

Preparing for maintenance: One of the solutions developed in S-STEP program is Amaze360, a head-mounted virtual reality application for

omnidirectional videos, enabling technicians to remotely observe the machine in need of maintenance, as well as the area around it. Videos can be filled with interactive interface elements called hotspots. Hotpots can, for example, display additional textual information about an object in the scene. The solution enables technicians to prepare for the upcoming maintenance tasks by offering the technician an up-to-date view of the location and by offering real-time access to machine data, which logically integrates with the view of the location. Moreover, with omnidirectional videos and embedded information hotspots, technicians will be able to absorb the tacit knowledge from the technician(s) seen in the videos.

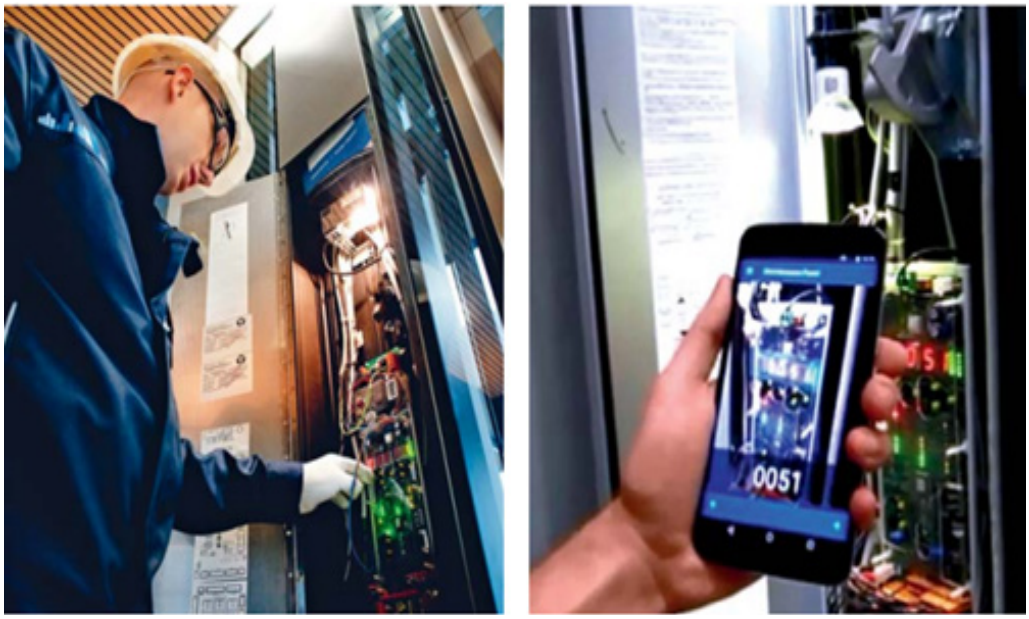


Figure 13: Maintenance panel

Contextual guidance: Solutions based on augmented reality (AR) and wearable technologies were developed and used in the S-STEP program to provide interactive, comprehensive, and situationally relevant guidance to technicians. The solutions were tested in industrial context. In Wärtsilä case, for example, a step-by-step augmented reality guidance during maintenance operations was demonstrated. Animated guidance system provides comprehensive and interactive guidance to the maintenance technician and ensures that all necessary maintenance procedures are performed. Moreover, the system maintains a log of the operations in the customer's system. In KONE case, in turn, a mobile phone application to recognize and track specific maintenance panel was developed. The application automatically recognizes the error code and it records which LEDs are on. With this information, the application can give the service technician guidelines how to proceed with maintenance work.

Remote assistance: Solutions to supports maintenance work remotely were also developed. In the Konecranes case, a novel multimodal user interface to control was studied. The new case was built on top of a haptic controller technology developed at the Lappeenranta University of Technology. The prototype controller can reproduce multiple modalities in all directions, load control, and possibly conceptualizing sway caused by wind.

Data gathering and reporting: Wearable devices, omnidirectional content, and speech-based interaction with a maintenance support system were investigated to improve data gathering and reporting. The concept tested in Konecranes case utilizes a combination of three different wearable devices: a smartphone, a smart watch, and smart glasses. With the smart watch, the maintenance technician can select the maintained object and component from a structured interface, and choose either photo taking or error reporting, which are directly linked to the component

Figure 14: An example of accessing contextual social media during a maintenance task

selected. The smart glasses are used for checking information and taking photos hands-free. The technician can control the smart glasses with gestures. The smartphone is used for adding text to reports and for locating a maintenance object. In addition, an interactive maintenance support system utilizing speech interaction was designed. The system enables the technician to synchronize maintenance and inspection tasks on a smart watch. When on site, the technician can report the conditions of the checked components using speech input into the system. The system can give the user information on the risks of the reported fault, and the recommended action to follow.

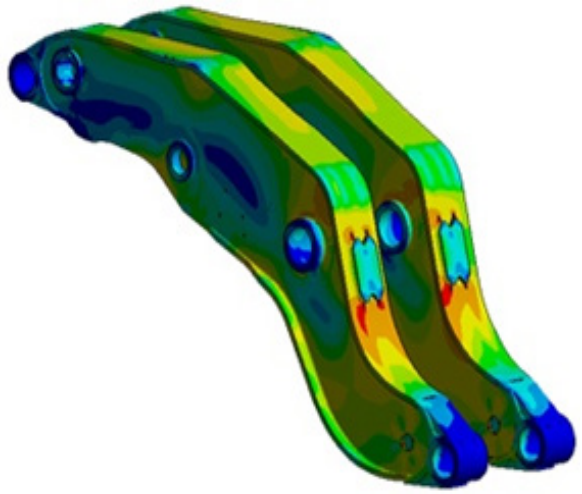
Peer support with social media: Also, opportunities to utilize contextual social media in maintenance works was piloted in S-STEP program. Social media based solutions could complement official maintenance documentation with practical knowledge from the field. The professionals saw that these concepts would facilitate getting actual feedback from the field. The concept could activate technicians to become active information producers instead of passive information users.

Speeding up the new product development process with the digital fatigue strength simulation tool

There is a need for shortening the design and development time spans of new products in the Finnish machinery industry. One way to shorten the time to market is introduce modern integrated digital design tools to support the machinery industry´s product design and development. As a result of the development work done under DIMECC MANU program new digital fatigue strength verification methods and concepts were developed.

An area where the need for the integrated digital design tools emerges particularly is the fatigue design of welded machinery structures with long service life and high structural and operational reliability requirements. The understanding of the fatigue of welded structures is especially important in a case of novel high-strength steel grades as advanced high-strength steels would bring significant benefits for machineries in terms of lighter and harder structures but as a same time present challenges to welding processes. As a result of the development work done in DIMECC MANU program new digital fatigue strength verification tools for welds were developed.

In DIMECC MANU program a new boom structure utilizing high strength steel and new welding methods was designed. The successful introduction of high-strength steel material into boom structure enable a lighter, stronger and more efficient equipment with higher payloads and lower fuel consumption. Lightweight boom construction using high-strength steel material enormously reduced the structural dead weight and increased the lift capacities. The total weight saving was 700 kg which is 25 % of the boom structure. The new boom structure has also reduced number of parts, less welding kilos and increased robot weldability which decreases the overall production costs.



As a part of new boom structure development a new digital fatigue strength verification tools for fatigue-critical welded structures based on the identification of true weld quality were developed. FE modelling and crack analyses for welds as part of the component physical accelerated fatigue testing was done in order to model the mechanical properties of the welded joints of the high-strength steels. Comparison between FEM predicted fracture initiation locations and true fatigue failure locations based on fracture surface analysis verified that the new fatigue stress simulation tools works and the results converge with outcome from very heavy testing program.

Modern integrated digital design tools, such as developed fatigue stress simulation methods, shorten the design and development time spans of new products and offer new tools for designers increasing the competitiveness of the Finnish machinery industry. The role of modern integrated digital design tools is especially important in the fatigue design of welded machinery structures with long service life and high structural and operational reliability requirements.

The importance of fatigue behavior optimization is further emphasized by the recent structural material developments, e.g. introduction of novel high-strength steel grades, and the related attempts for lightweight machinery solutions. Rising fuel prices and environmental issues combined to push machine manufacturers into developing lightweight machines. Novel high-strength steel grades allows meeting of these goals in an economically feasible manner. However, high-strength steel presents challenges to welding processes. In order to deploy the benefits of the recent structural material developments digital fatigue stress simulation tools for fatigue-critical welded structures are needed. The digital fatigue strength simulation methods reduces the time consuming and expensive fatigue stress test programs supporting new product development and enabling the testing of new product features.

The development work done in DIMECC MANU program enabled the development of the new fatigue stress simulation tools for fatigue-critical welded structures. Furthermore, the methods developed were verified and according to the results the model converge with outcome from very heavy testing program.

Full digital fatigue strength simulation tools speed up R&D cycles dramatically saving money and shortening time-to-market. Moreover, solid modeling provide new way to analyze product versions for final selection and enable the development of new products with greater operational flexibility and lower production costs. The new methods will be further utilized, for example in Sandvik's new product development process.

Overall, considerable benefits will be gained through the shortened time-to-market, more precise design that leads into savings in material resource usage and production efforts during manufacture, as well as more economic operating costs through the product service life. On the other hand, failure avoidance through improved fatigue design and the resulting safe and uninterrupted operation decrease the product life-cycle costs even further.

Self-organizing map to optimize a supply chain

IT company Solita, specialized in data analytics, developed a method where the magazine sales are forecasted based on other similar magazines in similar magazine sales points. With this method, it is also possible to predict the sales numbers for a new magazine if it were added to the assortment.

If there are 1,500 items in the product assortment for the supply chain, what should be selected if there is only space for 250 products? Using Solita's method, it is possible to predict the future sales of the magazine.

The method was born when Solita decided to find out what could be extracted from the existing magazine sales data. The method takes into account the sales data of other similar products, which are modeled and visualized. This facilitates decision-making.

In this method, the data is clustered visually, and thereby a map of the data streams for the sale of different products is obtained. The visualizations help to demonstrate problems and the factual relationships hidden in the data mass. This was done with the help of a self-organizing map. The map highlights essential factors in the data, which are visually grouped in an order corresponding with their relations.

The method can predict new products for the assortment with moderate success.

Preliminarily it would seem like the magazines found with this method should be added to the assortment. If, simultaneously, the same magazine is removed from a poorly selling sales outlet and the sales are compared, the sales increase by 29 %. The assortments are already highly optimized. New approach serves as a good addition, as the model is completely different from the current ones.

The method developed is a good example of the culture of experimentation that is supported by the N4S-program. The method was studied in cooperation with the Tampere University of Technology, which is involved in the program. The importance of planning the model and experiment was emphasized in the Big Data research. Such research complements well the business competence in the corporate world. Without the N4S-program, the development work would have ended with the first experiment in 2014. With the support of N4S, it was developed further to the extent that currently we perform business-oriented experiments in cooperation with the client.

Co-development of marine eco-technology solutions – opening new growth to start-ups and SMEs

Many claims are made about the eco-efficiency of various technologies in transportation. But how can suppliers credibly demonstrate the real fuel and cost savings of their products, especially as so many factors such as weather conditions impact the results? With the help of the DIMECC REBUS program, NAPA has developed its capabilities in verifying the commercial credibility of eco-technologies making gut feelings and educated guesses into objective, fact-based sales arguments and quantified value propositions.

During the past year NAPA has collaborated with two eco-technology suppliers to verify the fuel and cost savings their products enable. In one

case, NAPA supported the Finnish engineering start-up Norsepower in proving the effectiveness and the commercial benefit of its rotor sails. Thorough NAPA's independent analysis fuels savings of 2,5% for a one-rotor-installation could be confirmed. As a result of the proven effectiveness of this technology, the customers installed a second rotor sail on the same vessel; the first commercial order of Norsepower's technology. After this second installation, NAPA's software was able to demonstrate that the two rotor sails are now delivering fuel savings of 6.1%, more than doubling previous savings.

In another case, NAPA teamed up with Nanol Technologies, whose lube-oil additive holds the promise of increased fuel-efficiency and prolonged key engine component lifetimes. Advanced statistical analysis conducted by NAPA verified significant fuel savings of 2 %. This has led to a promising relationship between Nanol and its customers who are continuing to use Nanoll Technologies in their vessels as well as considering extending its use to other vessels in the fleet.

Fuel efficiency is an important factor in marine industry and new innovations continue to offer new opportunities all the time. As a result, many claims and promises are made about the eco-efficiency, potential fuel savings and savings in total operating costs. Thus, technology companies need fact-base, quantified and verified value propositions to persuade ship-owners, charterers and financiers of the potential saving s and commercial benefits of the investment. This is a challenge especially to small innovative technology suppliers trying to push their innovations to the market.

With the help of NAPA's analytics capabilities and software factors impacting fuel consumption can normalized. In both above described cases, a few months' trials were used to accumulate data so that the situation with and without the use of the respective technology could modeled and possible differences verified.

This kind of verification reduces risk across the entire industry by demonstrating the benefits of the investment. The value for technology providers is significant as the verification provides the data needed for the industry to make confident and informed progress with the technology. This will enable the significant business growth for technology provider.

In both cases, the commercial credibility of the technologies was significantly advanced. This has smoothened the way for technology adoption and opened new growth avenues for technology providers. For Norsepower, the verification has been fundamental to business development. It contributed to Norsepower's first commercial order and a three-million-euro capital investment in the company. The evidence generated through NAPA verification tools has also helped Norsepower increase its enterprise value and protect the ongoing commercial activities of the company. In the case of Nanol, the verification served as a door opener to meetings with high-profile venture capitalists and converted previous professional experience and ideas into numerical evidence.

These pilots also point at the importance of independent data analysis and third party verification in the case designing credible value propositions for eco-technologies. In this regard, the DIMECC REBUS program has helped NAPA build a viable business around third party verification. The cases have also been widely noticed in international media.

The cases also show how large systematic DIMECC programs have impacts beyond the immediate participants of the programs. As a result, DIMECC run projects contribute to the development of the cluster more broadly enabling the growth of start-ups and SMEs and integrating them into global value chains.

Detach Me Not – DOS attacks against 4G cellular users worldwide from your desk (Cybertrust)

A denial-of-service attack (DoS attack) is an attack where a machine or network resource is made unavailable by disrupting services of a host connected to the internet. In Cybertrust program Nokia's research team together with partners have studied how hackers can conduct DoS attacks on 4G cellular devices around the world.

DoS attacks that can affect any platform or device on mobile LTE (Long-Term Evolution) networks: mobile phones, tablets, and devices connected to the IoT. These attacks can disconnect mobile phone users from their network.

General awareness of security and privacy in telecommunication industry has increased. Misusing the technical features of mobile core network technology – specifically the Signaling System 7 (SS7) – has disclosed numerous ways to locate, track and manipulate the routine cellular activities of cellphone users. In fact, the SMS-based key recovery mechanism is becoming vulnerable because of the SS7 vulnerabilities.

Many mobile network operators rush to upgrade their networks to 4G/LTE from 2G and 3G, not only to improve the service, but also it is believed that 4G provides better security. With relatively more security and privacy features, Diameter protocol – the successor of SS7 in LTE networks are believed to guarantee more protection to the network itself and to the end-users. However, Diameter inherits many functionalities and traits of the SS7 network and attention need to be paid to proper security measures like filtering. Therefore, some attacks are also possible there e.g. location tracking in LTE by abusing the Diameter-based interconnection.

The security researchers in Cybertrust program have provided clear results that we will face similar interconnection weaknesses with LTE/DIAMETER as SS7 if network do not take protection measures. The results have concrete impacts to network operators and governments how to perform security assessments and evaluation of risks for communication infrastructure on country level and implement improvements.

Digitalization brings materials research and design to a new level

DIMECC HYBRIDS and BSA programs bring material research and design to a new level by digitalizing materials R&D. The digital design concept takes full advantage of novel materials and speeds up product design significantly.

A global trend in material research today is to complement material testing with deeper understanding based on characterization, theory and computational modelling and simulation. The merger of different disciplines

in developing, optimizing and troubleshooting material solutions is referred to as Integrated Computational Materials Engineering (ICME). Traditionally material development problems have been solved based on case experiments. The computational modelling and simulation, enabled by rapidly increasing computer capacity, the new material modelling tools and the improved micro and nano level characterization techniques, offers routes to systematic material development by prediction of material performance and optimization.

"With the computer model, we can first see how materials reacts to loading within hours, within days and within day. This means that we do not need calendar time one year to test the material, instead then we can just jump to state the material has after one year with computer. This speeds up product design significantly and leads to better reliability", Kenneth Holmberg, Research Professor, VTT, explains the benefits of digitalized material research.

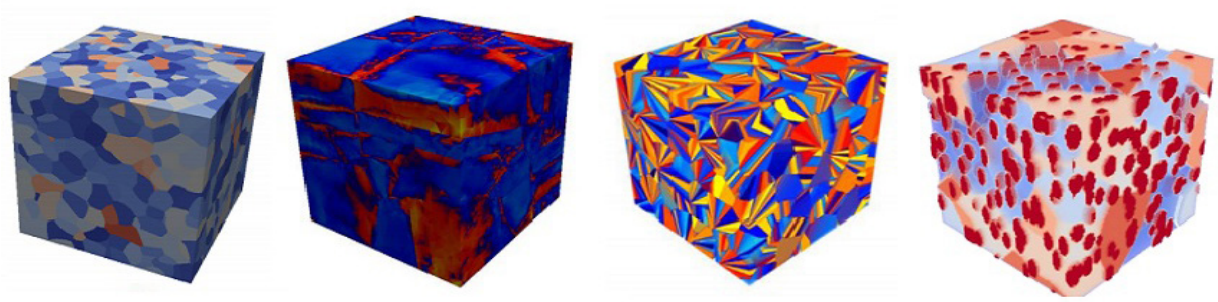
In DIMECC HYBRIDS and BSA programs novel design tools for discovering, developing and deploying materials in a virtual environment have been developed. With the help of the tools material processing parameters can be linked to microstructure, to properties and to material performance enabling optimal component and product design. The ultimate goal is to enable to product specific design of materials, and exploiting detailed models in design of material solutions and solving materials related problems in products.

The development of new breakthrough material solutions for industrial applications requires a deeper fundamental understanding of material processing, structures, properties and behavior, a systematic approach to material development and tools for material structural optimization and design.

With the help of digitalization, the real material performance can be investigated. With the help of this knowledge the material and product properties and performance can be optimized. This results in shorter product design and improved predictability.

The impacts have internationally been acknowledged via industry use cases as 50 % shorter time-to-market of material solutions and decrease of the affiliated development costs (on average to 50-60% of trial-and-error approaches). Moreover, by digitalizing material development companies can systematically drive the solution of problems persisting in developing better materials and products and discovering innovative solutions. This enables the development of better products with increased reliability and longer lifespan and totally new breakthrough materials.

"We are talking about the business potential is tens of billions of euros. For Finnish export industries technology development in material science plays an important role, and thus the digitalization of material research will create a competitive edge for Finnish industry", Program Manager Markku Heino describes the impacts of the research done in DIMECC programs.



Forest Big Data platform

Data to Intelligence program was the starting point in building the foundation for new generation forest resource management system in Finland by developing and applying big data technologies. Better data enables more efficient and higher quality planning and operations in the entire wood supply chain. In Forest Big Data (FBD) development 20 industry, public and research partners were involved.

Numerous methods provide information on forests each with their own time cycles, granularities, accuracies, costs, and viewpoints. Those include the information on aboveground biomass information with accuracy of single trees, terrain and road information. Effective utilization of available forest resources is thus not only based on short-cycled, increasingly accurate, even cost-effective data inventory methods. Instead, by providing easy access to best available up-to-date information on forests is expected to generate new applications and businesses and bring together varying users, thus enhancing the utilization of forest resources.

The Forest Big Data platform provides uniform view to heterogeneous forest data sources by specifying a common data inquiry interface and a data structure for representing data and required metadata, in particular, the uncertainty. To provide easy access to the data sources, the platform offers basic services for updating data with growth prediction models and for combining several up-to-date data estimates by means of Bayesian data fusion. The platform was demonstrated with a real forest data case for testing the data structure, and suitable data updating and data fusion services.

Expected benefits from FBD platform for Finnish forest sector is estimated over 100M€ on yearly basis.

Capillary network Platform introduces connectivity between sensors and cellular networks (IoT)

In the IoT program Ericsson together with its partners has been creating a cloud-based data analytics platform called Capillary Data Fusion. Why it is needed? Computers in modern cars tell you when the maintenance is due, but nobody knows when the gearbox is about to break. What if your car would inform you when it is going to need service so you could act before anything breaks? What if your car would tell you what to get fixed before its time for inspection? Well, it won´t be an if much longer.

In traditional industry on the other hand, there is no good way of knowing how the biggest machines are used during their life circle. Machines are not connected anywhere directly which means that no real remote control is possible. If daily usage could be recorded, it would be much easier to know exactly when a certain part is near its lifespan and should be replaced. This would certainly save money, since the machine would not break because of an old or faulty part.

Even if the big machinery in today´s IoT world would be connected directly to e.g. some cloud, the huge amount of data transfer would be immensely expensive. It would be cheaper to load the big data to memory sticks and transfer it by foot. But not, if a Capillary Network Platform is used.

The Capillary Network Platform is a unique

way to combine technologies. The Capillary Network uses short range radio access (Wi-Fi or Bluetooth to gateway) to services, storage, and applications that are in the cloud. By doing that it offers possibilities to distributed computing. It differs from a normal IoT network by processing parts of data near its source and transferring only the necessary information. The Capillary Network Platform can guarantee a small delay between control and adjustment parameters, which is necessary in industrial automation. This way the service quality can be maintained even if some data processing is done.

So far, the data transfer has been a “byte tube” where information is only moved from A to B. Now, with Capillary Network Platform processing can be done in the net, near its source. Thus, it is only up to us, how to exploit this ground-breaking technology.

STAKEHOLDER RELATIONSHIPS

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

Beijing Academy of Science and Technology
CECIMO
China-Finland Strategic ICT Alliance
Chinese Academy of Sciences – Qingdao Academy of Intelligent Industries (CAS-QAII)
Clic Innovation Ltd.
Confederation of Finnish Industries EK
EFFRA
Finnish Ministry of Employment and the Economy
Flanders Make
It'sOWL Clustermanagement GmbH
Linz Centre for Competence in Mechatronics (LCM)
MDEC, Malaysia
Orgalime
Politecnico di Milano
Production2030, Sweden
RWTH Aachen
Upper Austrian Research GmbH
SalWe Ltd.
SYMME
Tekes
The Industry Innovation Center for Future Network
Finnish Technology Industries
Tredea
ZPark

Following suppliers were used for services:

Fondia Oy - Legal services
Gaia Consulting Oy - Demobooster
Inno-W Oy - Web pages & research portal
Insano Oy - Impact analysis & communications
Kuudes kerros Oy - Corporate image & branding
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 – Most effective innovation in EU" booklet was published in Finnish and in English
- MPD and Demobooster trade marks were registered
- DIMECC High Tech section at www.dimecc.com revealed the most impactful research results
- DIMECC In-Brief information package was published
- DIMECC Newsletter was published in digital form
- Co-creation service leaflets were branded and printed
- MPD2017 event communications were published.
- Three new DIMECC publication series reports were published.
- DIMECC was active in social media channels in Twitter and LinkedIn.

KEY FINANCIAL INFORMATION

The financial year 2016 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	532 498,16
DIMECC program management fees	1 333 313,97
Other income	289 339,06
Total income	**2 155 151,19**
Expenses	
Materials and services	-284 948,97
Staff costs	-798 820,34
Program management cost	-523 871,37
Other expenses from operations	-799 289,62
Total expenses	**-2 406 319,87**
Operating loss	**-251 168,68**
Financial income	71 844,04
Loss for the year	**-179 324,64**

Assets	
Stocks, shares, and fixed assets	824 087,44
Long-term investments	45 780,67
Short-term receivables	1 076 827,49
Cash and bank balances	2 427 175,11
Total assets	**4 373 870,71**
Liabilities and shareholders' equity	
Restricted equity	1 146 500,00
Non-restricted equity	2 302 113,91
Net profits from previous years	68 609,28
Net loss for the year	-179 324,64
Liabilities	1 035 972,16
Total liabilities and shareholders' equity	**4 373 870,71**

DIMECC

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