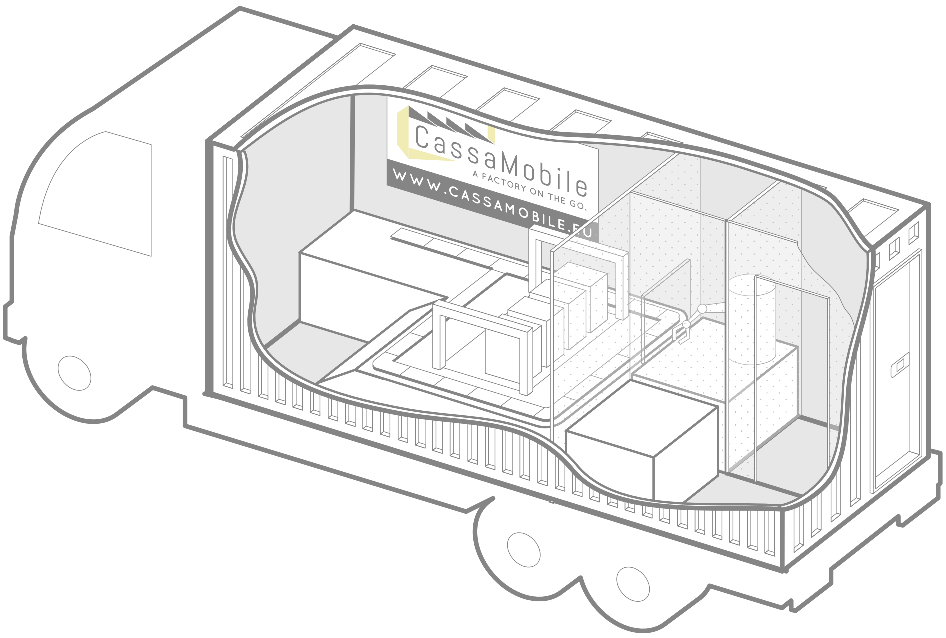
CassaMobile
A FACTORY ON THE GO.

Flexible mini-factory for local and customized production in a container

Final Report
Publishable Summary

1 September 2013 - 31 August 2016



Co-funded by
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CassaMobile
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Advanced production equipment and innovative systems are needed to enable ultra-fast and cost-effective manufacturing of fully customised products at the location of need, at exactly the required time.

CassaMobile investigated a mobile, flexible, modular, small-footprint manufacturing system in a transportable container that can be easily configured for different products and processes. The container format allows on-site manufacturing anywhere, enabling the benefits of localised service delivery without duplication of equipment at multiple locations.

The integrated modular manufacturing system with standard interfaces allows an easy exchange of process modules. The process modules are inherently intelligent. Each module is equipped with its own control equipment and features a self-description, which in combination with the integrated control system allows automatic configuration of the whole assembly system. The whole container can be controlled centrally and includes an easy to use human-machine interface, work-flow manager and safety controls. The container has been designed to clean room standards enabling the production of even the most demanding products such as medical devices.

Incorporating an additive manufacturing module enables the system to '3D print' customised components. In-process inspection will improve accuracy, reduce waste and eliminate manual quality control tasks. A computer-numerically-controlled milling module enables high quality surfaces and high tolerance features to be achieved. A pick-and-place assembly module allows the integration of discrete components into the products. Other modules provide additional processes, such as cleaning and sterilisation. In the future other modules could be easily integrated using the standard interfaces and modular structure.

The concept has been designed to fulfil demanding criteria for the production of customised, high value, high quality products including medical devices. The container has been developed to demonstrate three different use cases addressing (I) maker and educational communities, (II) medical orthotics and (III) individual industrial gripping and clamping products.

CassaMobile consortium

The CassaMobile consortium gathers 11 partners – research institutes, SMEs, companies, universities and is composed of the following organisations:

1. **Fraunhofer Institute for Manufacturing Engineering and Automation**
2. **AFT Automation & Feinwerktechnik GmbH**
3. **University of Stuttgart**
4. **Critical Manufacturing**
5. **Materialise**
6. **TNO**
7. **Loughborough University**
8. **SCHUNK GmbH & Co. KG**
9. **COLANDIS GmbH**
10. **Peacocks Medical Group Ltd.**
11. **SCIPROM**

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The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement No. 609146 (Project CassaMobile).

The successful demonstration of the complete, fully functional container will lead to significant impact by enabling manufacturers to respond to rapidly changing market dynamics with high value-added products whilst reducing time-to-market, cost, environmental footprint and set-up time. The scientific and technical achievements of the project have been disseminated in academic papers and to industrial audiences through articles and exhibitions. More demonstration and dissemination activities are planned over the coming months.

Project context and the main objectives

Background

European industry is very active in nearly all fields of production systems. This makes Europe one of the strongest outfitters and operators for factories. One of the key elements of this great success is the high quality of the produced components and production systems. However, European manufacturing industries are at a turning point, as they are confronted with new challenges. Companies are facing rapidly changing customer and production requirements. Mass customization and make-to-order lead to smaller lot sizes and requires highly flexible production systems.

'Plug & Produce' production systems for industrial and consumer goods need to be developed that provide high flexibility with respect to products, production volumes, processes and production environments. These systems need to be easily reconfigurable, so need to be equipped with intelligent, self-adaptive process modules that can be brought into operation by simply inserting them into adaptable production systems.

With increasing cost for global transport and mass production (overproduction, failed products, etc.) and the increasing demand for customised products, local fabrication solutions become increasingly important. Such local fabrication solutions should not just bring mass production closer to the customer, but also provide products maximally adapted to the customer requirements at, or close to, the required location and at the right time.

Many sectors, such as medical technology, biotechnology or electronics have increasing requirements on the production processes and the environment where these take place. A modular, rapidly configurable and local production system must therefore also be adaptable to the very specific requirements of different industries and thus allow implementation of Good Manufacturing Practice (GMP) as required for manufacturers of foods and medications, cleanliness or clean-room requirements.

These challenges cannot be regarded individually and must be addressed by a holistic approach. The CassaMobile project proposed such a holistic approach and aimed to demonstrate it based on three industrial use cases.

General concept

The CassaMobile concept aimed to provide a local, flexible and environmentally friendly production of highly customised parts. The production system is based on a truly modular architecture, allowing an instant adaptation to rapidly changing requirements. This 'plug

The CassaMobile container is being unloaded at the Fraunhofer campus in Stuttgart.

& produce' architecture includes mechanical and control system adaptation. The production concept aimed to achieve minimal volume allowing transport to and deployment in severely constraint spaces whilst minimizing investment and infrastructure costs.

A comprehensive pool of interchangeable process modules provides adaptable configuration of the process chain. This includes modules for additive manufacturing (also known as 3D Printing), CNC-milling, automated assembly, cleaning and sterilisation, which enables continuous-flow production of one-of-a-kind products.

An easy-to-use system for human-machine-interface and software for direct manufacturing of custom designed products supports this one-of-a-kind-production for end-users, operators and engineers.

All these components are designed to be embedded together into a container that can be easily transported and deployed wherever required. A comprehensive cleanliness concept allows system adaptation to different requirements onto the process environment enabling production of even the most demanding high quality products.

Objectives

Based on this general concept, CassaMobile derives specific objectives for a transportable, reconfigurable, modular mini-factory prototype

Objective 1 – Modular mini-factory system architecture

a. Plug & Produce architecture for process modules to enable continuous adaptation to changing requirements imposed by products and processes
b. Standardised mechanical, supply and control interfaces for process modules
c. Every process module equipped with its own control (SoftPLC-based)
d. Concept to support scale reduction and localized production
e. Concept to support implementation of cleanliness, cleanroom mini-environments and hygienic requirements
f. Screening of existing standards, inclusion of relevant standards into the project, deriving pre-normative proposals from the project results

Objective 2 – Easy-to-use product customization and system configuration using an advanced HMI

a. Product customization based on CAD models for customers
b. (Semi-) automatic translation of design into process task description
c. Configuration and optimization of production system based on self-description and inherent logic of process modules
d. Collaboration environment allows the exchange of knowledge between localized production systems including CAD and CAM data

Objective 3 – A task-driven adaptive automation system for rapid reconfiguration

a. Service-oriented Architecture; based on human-readable documents (XML)
b. Module control features a knowledge-based self-description; self-description is processed by the system control and allows autonomous configuration
c. Assembly Process Description supports configuration and parametrisation of assembly system
d. Parameter Set / Recipe is transparent and can be easily understood and adapted by an operator

Objective 4 – Integrated modular manufacturing system and process modules

a. Modular manufacturing system integrated into technical container

The container side wall is removed allowing the first tests modules to be installed.

b. Review, selection and development of a number of relevant process modules and associated materials, which implement the Plug & Produce interfaces
c. Built in, efficient, automatic quality control and assurance methods (in-process inspection)
d. Process modules equipped with self-description (capability description), inherent analysis logic and HMI
e. Modules include: Additive manufacturing, CNC milling, assembly and cleaning

Objective 5 – Container for localized production systems under defined environmental conditions

a. Self-contained production systems, which support production requirements like temperature, pressure, gas supply, cleanliness
b. Container is easily transportable, by being compliant with transport requirements

Objective 6 – Use case demonstration and validation of concept

a. Adapted process modules for each of the three use cases
b. Outline of the mini-factory for each of the three use cases
c. Demonstration and validation of working principle and potential of CassaMobile concept, including local demonstration at the use case partners or their end-users

Scientific and Technical Achievements

The main goal of the CassaMobile project was to develop a new kind of local, flexible and environmentally friendly production system for highly customised parts based on a combination of different manufacturing processes including Additive Manufacturing (3D printing), CNC-milling and assembly technologies within a cleanroom environment inside a transportable container. Major developments were achieved within the first period of the project including the 'Integration Methodology Workshop' and establishing the 'Industrial requirements' leading to process module specifications and the first system concept and architecture. These developments resulted in specifications for each process module as well as the complete container. The processes were developed to meet the needs of the use cases as well as the necessary boundary conditions to achieve the complete system integration of all processes into an all-in-one flexible manufacturing system.

To facilitate research and development a generic 'Product Demonstrator' object was designed that enabled testing of all the necessary processes. The 'Product Demonstrator' had all the necessary features needed from the technical requirements and enabled testing of each module with a repeatable standard part that was free to disseminate in public.

By month 18, halfway through the project, all of the process modules were available with basic functions and system integration began and the first version of the software, which included the Human Machine Interface (HMI), main control and a workflow manager, were available.

In its second half the project moved into the physical realisation and integration stages. By month 30, the container and all of the process modules were built, delivered to the coordinator site and the software had been developed and tested in a virtual environment. Over the final 6 months the individual modules were installed in the container and mechanical and electrical integration achieved. The project then entered the integration stage, where the software and process flow was implemented and tested.

In March 2014 (month 6), the official project website was launched and during the project the content has been updated and presented to a broad audience. Results have been published in a wide range of academic and industry journals and presented at conferences in order to address the wider community.

Highlights

- Self-configuring 'plug & produce' modular control system
- Easy to use human-machine interface
- Easy to use process control and workflow management
- Standardised module design with common hardware connections
- Transportable, safe, clean room standard container with six available module spaces
- Five fully functional process modules developed for Additive Manufacture, CNC Milling, Automated Assembly, Cleaning and Sterilisation
- Bespoke Additive Manufacturing module developed including unique in-process monitoring
- Future high performance CNC Milling module designed
- Quality control and monitoring functions built-in
- Future-proofed design enables full automation using pallet transport system
- Future developments for continuous production and AM process improvement investigated and planned

Modular System Architecture (WP1)

Work package 1 'Modular System Architecture' consisted of four distinct tasks that formed the framework for the whole project. As a fundamental basis for the project, the industrial requirements from the three use cases were collected and summarized in a report. Based on those requirements the necessary production processes for the use cases were analysed, the modular design of the complete CassaMobile processes chain was specified and the 'System concept' was developed. The comprehensive overall system concept was implemented in all R&D work packages (WP2, 3, 4, 5). The project was scientifically coordinated and supervised out of work package 1 to ensure successful cooperation of all participants. Relevant standardisation, regulation and pre-normative research aspects were considered throughout the industrial requirements and the system concept.

The final assembly module is being installed in the container.

User Machine Interface and CAM software –UMICAM (WP2)

Work Package 2 was composed of three primary tasks: establishing a Human Machine Interface (HMI), a CAD/CAM system and a Quality module. Activities performed up to month 18 focused on defining the UMICAM concept, software architecture design and specification, concepts for integrating these systems as well as the specification required for implementation of the various identified components and software systems.

The HMI is a single page application that evolved over the second half of the project. Project partner Materialise (MAT) extended their software components to support the manufacturing, with specific focus on establishing a Build Processor (BP) framework, which has been broadened to generate specific files for the CassaMobile process modules. A CAD/CAM converter tool was developed to provide the HMI and Main Control with specific CAM data, depending on which modules are required to provide the specified part. Integration of the HMI, CAD/CAM and Main Control system within the CassaMobile container was achieved by month 30 with optimisation activities taking place up to M36.

Self-Adaptive Control System (WP3)

State-of-the-art control systems have been designed. Within work package 3, a self-adaptive control system for the CassaMobile container has been developed that is capable of handling the demands associated with the modular CassaMobile concept featuring interchangeable process modules.

The Main Control of the CassaMobile container facilitates communication between the HMI/CAD-CAM conversion systems and the individual process modules. Specifically, it comprises the Configuration Manager, Workflow Database and the Workflow Manager, enabling easy configuration of the overall CassaMobile production system. Central to the Main Control is the Workflow Manager. This central software system orchestrates the individual process modules via the ModuleViewer (MV) located within each module control. The MV is a general-purpose software solution used to visualise, control and automate server applications, while the Workflow-Manager co-ordinates the process modules to perform appropriate job related processes.

The CassaMobile Central Control System (CCS) enables operation of the various process modules without the need for their own control system. A Configuration and Information Memory (CIMory) system has been developed to enable each process module to provide information to the Configuration Manager – subsequently using the CCS module to implement a real-time software-based control system.

In addition, a separate safety system was designed and implemented into the container enabling safe close down of either individual modules or the whole container as needed.

Process Module Development (WP4)

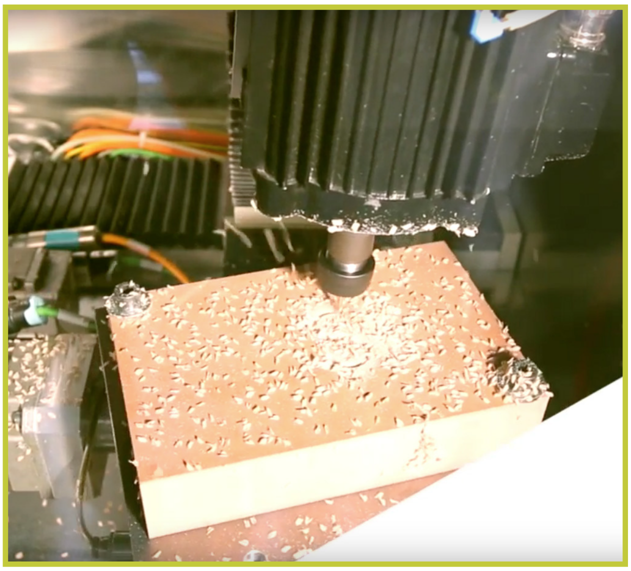
Work Package 4 consisted of five distinct tasks. Activities performed in the first half of the project were focused on the development, set-up and preliminary testing of the four core process modules, Additive Manufacturing, CNC-milling, Assembly and Cleaning.

A module is inserted into the container using a rail system.

Through the identification of key use-case and operational requirements, the specification of each process module was established. Individual module developers were also able to identify and benchmark appropriate hardware and software components. A generic demonstrator component was established to test the performance of the various process modules during development. This also enabled public demonstration and dissemination without using use case examples. Initial testing performed within each process module demonstrated successful results, with scope for further development and process optimisation in the second half of the project.

To facilitate the 'plug and produce' integration of modules within the CassaMobile container architecture, a reference design for process modules was proposed. This reference design is a template for the development of CassaMobile process equipment, which simplifies the implementation and integration of hardware and software components.

Five modules were successfully integrated. The Additive Manufacturing (AM) module is capable of producing high quality parts with a range of engineering thermoplastics. The module includes high temperature material extrusion, variable nozzles, a heated platform and a heated build chamber. This enables the highest possible quality and flexibility. Uniquely the AM module also incorporates in-process inspection. A vision-based system compares any given layer built by the machine to the original computer-aided design data. Any discrepancy between the layer built and the reference data can be calculated and if beyond user specified tolerances will trigger an alert. The build process can then be aborted or remedial action taken in subsequent process modules. The in-process inspection saves time, reduces waste and ensures high quality parts.



A snapshot from the CassaMobile video showing the CNC mill module at work.

The milling module contains well-proven, high specification computer-numerically controlled 5 axis milling. The high speed, flexibility of 5 axes and high quality of the construction enable very high quality surface finishes and high tolerance features to be achieved.

The computer controlled assembly module utilises a 'pick-and-place' method to assemble inserts and/or encapsulate parts and components. A vision system and force feedback control ensures high accuracy and quality.

Cleaning and sterilisation modules remove support materials, particles and other contaminants. In conjunction with the clean room features of the container even demanding products such as medical devices can be achieved.

All of the modules can be controlled centrally by the main controller or as needed directly at the module. This includes facilities for safety and maintenance.

Over the last 6 months of the project each process module was installed in the container and the integration and validation of the various hardware and software elements relating to each process module was performed culminating in a fully functional container by the end of the project.

System Integration (WP5)

Work Package 5 focused on the development, design, manufacturing and assembly of the module platform racks and the design of the overall CassaMobile container system.

A container system design integrating the modular machines and providing supply and filtered air conditioning has been realised. Air management and filter fan units ensure the container can act as a clean room for the production of medical devices. A modular machine design was proposed with each rack facilitating the easy exchange of the various process modules. The modular racking proposal was developed and it has been used as the basis for the incorporation of hardware components within the various process modules.

The integration of the various process modules was performed over the second half of the project. Electrical hardware, PLC, software and safety components were identified and appropriately installed and set up. Further optimisation of the module workflow within the container environment was performed with appropriate modifications to the supporting hardware made where necessary leading to the fully functional container by the end of the project.

Use case 1 (WP6)

The primary goal of Work Package 6 was to demonstrate the working principle and the potential of the CassaMobile mini-factory for the localised production of bone drill guides.

During the early phase of the CassaMobile project, a number of workshops and meetings were held to discuss and identify the industrial requirements relating to the specified use-case. Requirements relating to material properties, software and equipment were established and formalised.

During the fourth Consortium Meeting in month 21, a proposal to change the specific use-case within was put forward and agreed by the consortium. Although the specific outcome had been changed, the agreed technical demands and specifications relating to the manufacturing and technical aspects of the use-case remained unchanged. This ensured that the CassaMobile system remained capable of producing the widest range of customised products including regulated medical devices. The agreed new platform for the WP6 case study focussed on an 'Idea's Worth Making' system in which the complete CassaMobile container will be used for the localised manufacturing of components for maker-base communities and educational institutions.

Further development was performed to evaluate the quality of products and assess the performance of the overall CassaMobile container.

Use case 2 (WP7)

Work Package 7 involved Peacocks utilising the CassaMobile mini-factory for the production of orthotic devices. In the first stage, a comprehensive product and material in-

The container outside with its sticker showing the positioning of the modules inside.

vestigation was performed to establish the requirements for the orthotic products and appropriately disseminated to the CassaMobile module developers.

To achieve 'A preliminary description or the modular orthotic concept', Peacocks considered a number of Additive Manufacturing (AM) processes. Preliminary design concepts were developed for both foot orthotic (FO) and modular ankle-foot orthotic (AFO) devices, with initial prototypes built for validation with both the AM printer and Milling apparatus. In order to validate the performance and fatigue properties of the manufactured components, a number of test methods and rigs were designed and established in-line with the performance requirements of the FO & AFO's.

Following the fourth Consortium Meeting in month 21, it was agreed by the consortium that due to manufacturing limitations, this use-case would focus on the design and manufacture of the FO components; all manufacturing requirements remained unchanged. Validation of the CassaMobile concept was performed by manufacturing appropriate FO prototypes. Further validation in relation to the fatigue performance of FO's and digital data acquisition methods was also performed.

Use case 3 (WP8)

Work Package 8 focused on the requirements and specifications for individual grippers and the development of concepts for generic customizable grippers. Through the identification of key use-case requirements, the specification for customisable grippers was established. This enabled Schunk to define the range of expected grippers and the definition of a process leading to an automated virtual adaption of the tools depending on the handling object.

Schunk performed further development on the planned use-case featuring three different concepts for individual grippers. The CassaMobile generic demonstrator component was also manufactured to assess the various processing and handling steps required for the production of the gripper concepts. Additional activities were performed to further optimise the identified gripper concepts for realisation within the CassaMobile process flow.

The container inside with all working modules installed.

CassaMobile coordinator Christian Seifarth introducing the project during the final workshop.

Future Work

The CassaMobile container has been designed to facilitate future development and improvement and some future development work was included in work packages 4 and 5.

The container concept and modular design included the possibility of adding a fully automated work-piece transport system using well-proven work-piece carriers and automation products. The space required for the transport system was allocated in the container design and the working height of each module is consistent. Therefore, full automation could be achieved easily and quickly as an option in future configurations of CassaMobile.

Different combinations and permutations of modules were explored that could be designed to suit different hypothetical use cases. In addition new modules were also investigated that could be designed to meet specific use cases and optimise performance. For example, a configuration for industrial products might involve multiple AM modules but not require a sterilisation module.

Some work has been done on AM process improvement to ensure parts are stronger, tougher or have higher quality finish. These developments could be adapted within a future AM module.

The in-process monitoring functionality within the AM module can be improved to add higher levels of accuracy and more data on part quality. Future developments might also enable feedback and closed loop control to optimise AM machine performance in addition to quality control monitoring.

More ambitiously and looking further ahead work was done to propose a continuous 3D Printing production process that could radically improve productivity and efficiency whilst remaining within the transportable container concept.

Potential Impact

The aim of the project was to create significant impact by enabling manufacturers to respond to rapidly changing market dynamics with high value-added products whilst reducing time-to-market, cost, environmental footprint and set-up time. This is to improve European machinery and equipment manufacturing sectors and specifically SMEs' and competitiveness against USA and Asia.

CassaMobile has managed to achieve all its objectives resulting in a truly modular and adaptable manufacturing system. The plug and produce capability demonstrated in CassaMobile allows manufacturers to be as flexible as the market and to carry out production at the location of need and 'just in time'. It can significantly reduce the lead-time by reducing required infrastructure as well as reducing the transport time, cost and environmental effects related to transport. This can significantly increase the manufacturers' competitiveness within the market as well as increasing manufacturing efficiency.

The container has been equipped with an intelligent control system, workflow manager and safety control. Additionally, each module has been designed to have its own control equipment. Combined, they result in an automatic assembly system configuration. This increases the value of modularity of the system, allowing manufacturers to modify the system when and how required. The container's intelligent and highly intuitive human-machine interface allows the operator to effectively and efficiently communicate with the process flow manager.

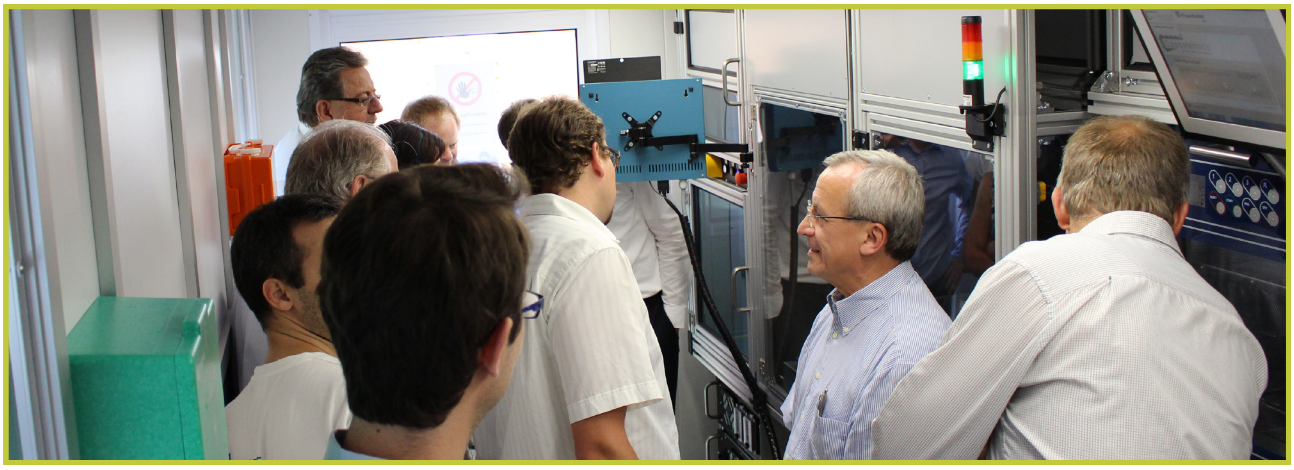
In the current container, five fully functional process modules have been demonstrated. Each module has been designed to industrial requirements specified by the project's high demanding use cases. Each module has been designed to the same standard featuring identical hardware connection, resulting in an efficient module change when required, reducing cost and downtime.

The bespoke additive manufacturing module combined with in-process inspection allows manufacturers to 3D print highly customised and accurate products, resulting in increased efficiency and reduced waste. Moreover, presence of the in-process inspection eliminates manual quality control tasks, which reduces human error as well as manufacturing time and cost. The requirements imposed by the whole range from standard up to high-tech products are covered by the CassaMobile process equipment. The high performance five-axis CNC module enables the manufacturer to produce parts with high quality surfaces and tolerance features expanding its capabilities. These are even further expanded by assembly, cleaning and sterilisation modules.

The CassaMobile container has been designed to clean room standards, which fulfil requirements of high demanding products such as medical devices. Additionally, the small footprint of CassaMobile allows manufacturing in space-limited environments such as hospitals, close to the place of need.

Industrial impact of the CassaMobile system was illustrated by the aid of three use cases during the project. Highly demanding products, bone drill guides and orthoses from medical sector and industrial grippers from the automation industry were chosen. During the project, the system's ability to meet these demanding product requirements was demonstrated. The exploitation outcome, impact and unique selling point (USP) of CassaMobile within the selected industries as well as others were identified.

The CassaMobile live demonstration of the container and all working modules, highlight of the final workshop.



With respect to the studied use cases, the CassaMobile system helps industrial partners to significantly improve their advantage compared to their competitors. The ability to take the container to the customer is hugely beneficial. For example, the container might be transported directly to potential customers to demonstrate its technical capabilities, to perform testing or even manufacturing on or very close to his own premises.

The same approach can be taken to educate students, the future manufacturers and customers. It can help to give them a realistic and practical view on the possibilities of each individual technology. The long-term effect of such educational use of CassaMobile system can be expected to influence the future of European market. This would enable students to access and utilise the full experiences and benefits of a factory in a safe and convenient manner that would be impossible or impractical for each School to invest in individually.

In the Orthotic use case, the digital CAD/CAM environment provided by the CassaMobile concept, with optical scanning of patient anatomy, will allow manufacturers to engineer the orthotic products utilising Finite Element and musculoskeletal models. This will increase the uptake of more advanced designs based on solid scientific and engineering principles and accelerate the development of new approaches, in particular dynamic devices tailored to the patient's gait cycle. This will result in a more effective orthotic, which hugely benefits the patient. Better outcomes can reduce secondary care costs and increase mobility allowing greater independent living and, in many cases, contributing to enablement for return to active work or other contributions to society.

The small footprint of the CassaMobile container along with its mobility, permit local and on-site manufacturing in hospitals and clinics. Combined with digital data capturing, digital designing and local manufacturing, this will result in significant reduction in lead-time. This reduced lead-time directly impacts the patient. With an aging population, the number of people requiring and depending on orthoses is increasing, therefore the societal impact of a better healthcare service will be more significant.

Additionally, the CassaMobile system can reduce the manufacturing cost of orthoses by at least 30%. The cost reduction is due to using suggested low cost material in the Additive Manufacturing module as well as reduced manufacturing time and transport costs. The overall cost reduction effects both healthcare providers and patients and results in a better public service.

In the case of industrial grippers, novel materials and adapted designs of gripper jaws make it possible to use additive manufacturing, leading to reduced production costs. This enables manufacturers to bring the technology to industrial applications like automation components with the focus on handling tools. This can lead to individualized (customer-specific)

The Container paper model.

A 3D plastic model of the CassaMobile container.

parts with reduced costs, lightweight-constructions and shorter delivery times. Combined, they can result in meeting customers needs in time with a lower cost to differentiate the manufacturer from competitors.

Additionally the additive manufacturing capability of the system allows production of highly customised grippers matching any product shape and size. This increases production efficiency by eliminating the need to reconfigure automated production lines to match the products. The possibility of having such huge flexibility increases the number of potential customers and commercial impacts.

In summary, the CassaMobile system allows manufacturers to follow rapid market dynamics by using a configurable, modular and mobile production facility. The presence of modules such as additive manufacturing, CNC milling and assembly can significantly increase the manufacturing ability for highly customised products. The local, on-site manufacturing reduces the lead-time and cost of final products as well as the environmental impact of shipping and transport. The presence of in-process inspection results in higher accuracy, reduced post-process inspection and less waste.

Digital design combined with additive manufacturing can result in eliminating the need for process stages such as tool making for customised parts while reducing waste compared to some traditional processes hence having lower environmental impacts.

Dissemination activities and the exploitation of results

Dissemination activities have been multifaceted and they have included a website, a video, scientific papers, articles in industry periodicals, presentations at scientific conferences and industry exhibitions, various promotional materials and public demonstrations. Also the

CassaMobile container itself has been branded inline with the project's visual identity.

To date 9 scientific papers have been published with more in preparation or under peer review. There were 9 presentations and 5 posters presented at scientific conferences. 4 articles were published in industry periodicals and there were 3 presentations at industry seminars or exhibitions. Stands were taken at two industry exhibitions. Promotional materials were made and distributed, including a flyer, a foldable container model, a CassaMobile branded folder with project documents and a final project video. A public website was created (M1) and regularly updated, featuring a dedicated 'Container Blog' to follow the assembly of the container. Two public workshops were held, the second including a live demonstration of the fully functional container. The consortium is continuing to pursue dissemination and demonstration activities beyond the completion of the project period.

In total 20 potential exploitable results were identified and documented during the project. Use cases' related exploitation outcomes were evaluated closely and a road map until 2020 was created guiding the next activities to maximise the commercialisation impact.

The final and working container at the Fraunhofer campus in Stuttgart.