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InnoPeer AVM

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InnoPeer AVM Handbook

2020

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Funding

This work is supported by the Interreg CENTRAL EUROPE Programme funded under the European Regional Development Fund (ERDF).
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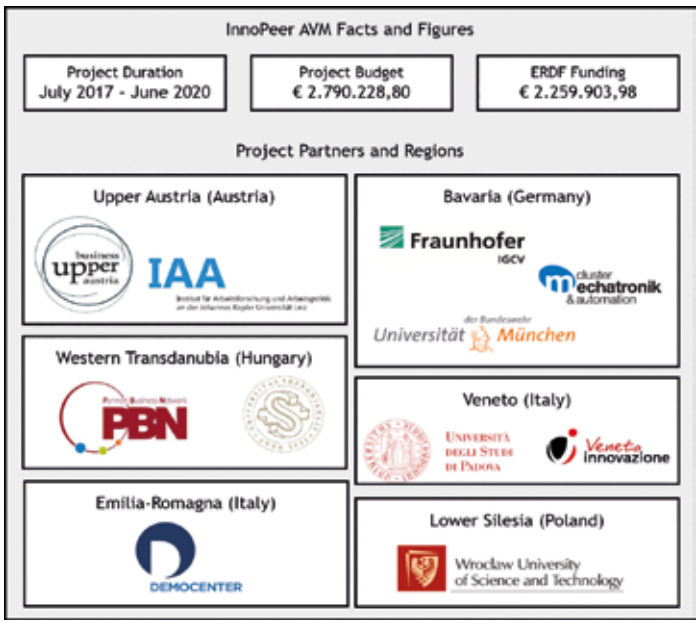
AM	Additive manufacturing
AT	Austria
AVM	Advanced manufacturing
BMC	Business Model Canvas
CAD	Computer-aided design
CE	Central Europe
DE	Germany
ERP	Enterprise Resource Planning
EU	European Union
HPWS	High-performance work system
HR	Human resources
HRM	Human resource management
HU	Hungary
IT	Italy
PL	Poland
PP	Project partner
RAP	Regional action plan
SME	Small- and medium-sized enterprise

Introduction to the InnoPeer AVM Project

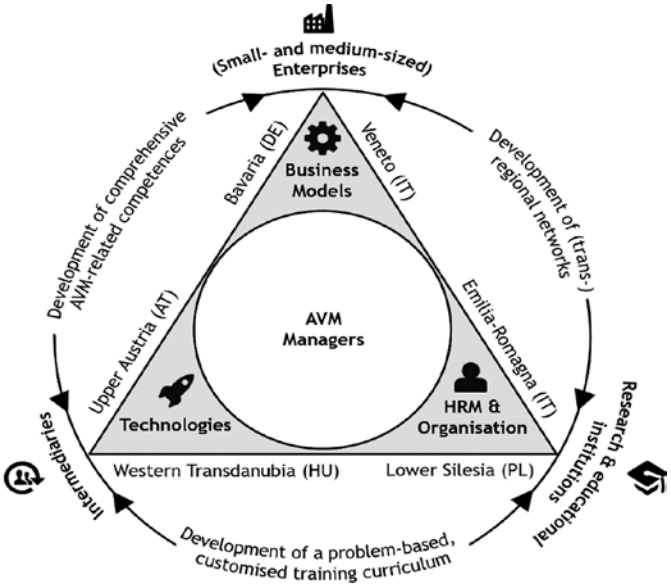
Central Europe (CE) has a strong industrial tradition which is recently offset by an urgent need for modernisation and reindustrialisation. CE companies, specifically SMEs, are challenged to adopt innovative advanced manufacturing (AVM) processes in order to enhance their competitiveness and gain access to transnational AVM value chains. While AVM (AdVanced Manufacturing = Industrie 4.0) is mainly discussed as a technological issue, innovation managers and SME owners face huge organisational and strategic challenges. There is an urgent need to develop a joint qualification basis across CE with new transnational approaches for AVM-related capacity building in local SME and lead companies.

Figure 1 InnoPeer AVM Facts and Figures



Over three years (July 2017 – June 2020), the InnoPeer AVM partnership of 11 organisations from 6 regions in 5 CE countries was committed to develop and pilot the first comprehensive, transnational AVM qualification programme shaped to the needs of CE companies, specifically SMEs (see Figure 1). The developed multi-level programme covers 3 knowledge dimensions – AVM technologies, human resources & organisational management as well as business model development – using a mix of well-proven and novel training formats and methods for basic, advanced and practical trainings, such as Living Lab webinars, practical test runs at Model Factories and AVM Strategy Camps. As an absolute novelty, a compilation of "Teaching Cases", including one CE Mega Case, based on real CE SME challenges has been developed. Based on a commonly defined qualification standard, participants attending the complete curriculum finish the training programme as „InnoPeer-certified AVM managers" (see Figure 2).

Figure 2 The InnoPeer AVM Project Structure



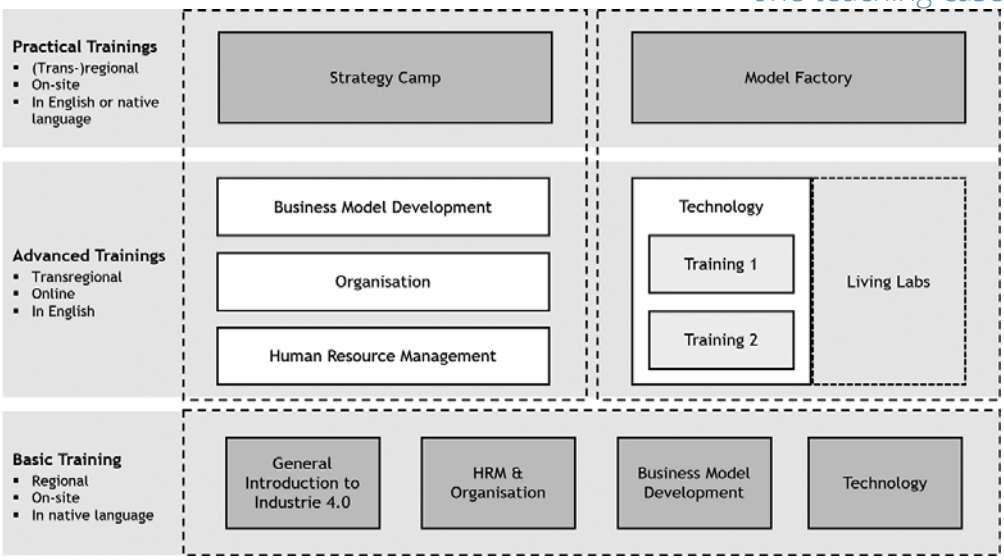
During project implementation, the developed InnoPeer AVM qualification programme was tested in the course of pilot trainings that involved target companies and innovation managers from all PP regions. Thereby, the training was continuously improved with the feedback received in an assessment programme for analysing the impact of AVM capacity building on participating SMEs. The piloted programme is freely available for the sustainable enlargement of peer networks involved in AVM qualification across CE. For the sustainable implementation of the project, PPs elaborated regional action plans and a strategic roadmap on AVM capacity building in CE. The established „InnoPeer AVM Board" of high-ranked experts from industry and academia as well as selected CE innovation policymakers sustainably steer the implementation of project results and promote the AVM agenda of CE at EU level.

The present InnoPeer AVM handbook gives an overview of the training programme and its structure, the core subject areas that make up the programme, the AVM-related case studies used to provide training participants with the possibility to apply their learnt knowledge in real-life examples as well as the results of the regional action planning and the corresponding strategic roadmap.

About the InnoPeer AVM Training Programme

The InnoPeer AVM qualification programme enables the exchange and cooperation of companies within and between project regions as well as the networking with experts in the fields of AVM technologies, HRM and organisational design as well as business model development. It offers participants the opportunity to analyse their companies' own AVM competences in these areas and to further develop their skills in the course of the trainings. Learning is facilitated by the use of best practice examples from the project regions, which are prepared as case studies for the training modules, and by getting to know and applying methods for dealing with the company's own challenges. The InnoPeer AVM training curriculum (see Figure 3) is structured into three consecutive types of courses: (1) basic trainings, (2) advanced trainings and (3) practical trainings (i.e. strategy camps and model factories). The modular structure of the program allows for maximum flexibility, as participants can specialise in specific modules. To be certified as "InnoPeer AVM Manager", participants are required to finish the complete training series, including the participation in the basic training, at least one course of the advanced training and, depending on the chosen specialisation module within the advanced training, the completion of either the strategy camp or the model factory.

Figure 3 Training Modules and Structure of the InnoPeer AVM Training Programme



Basic Trainings

The basic trainings consist of four modules, including: (1) A general introduction to the topic of AVM (= Industrie 4.0), (2) AVM-related Technology, (3) Human Resources and Organisational Management and (4) Business Model Development and Strategy. Basic trainings have a duration of three days and are held as a local, on-site course in each region. There are two possible options on how the basic training can be split up. The first alternative includes 0.5 days for the general introduction and 0.83 days for each of the 3 knowledge dimensions, including the elaboration of one short teaching case per dimension. The second option comprises 0.5 days for each of the 4 modules within the basic training plus 1 day for the first 3 teaching cases in each knowledge dimension.

Advanced Trainings

The advanced trainings of the InnoPeer training programme take place consecutively to the basic trainings. Training participants can choose between five different specialisation courses that are available online on the platform Virtuelle Hochschule Bayern (VHB) and in English. Each course of the advanced training can be completed within a duration of about five hours. The advanced training is structured into five specialisation courses: (1) Human Resources Management, (2) Organisation, (3) Business Model Development, (4) Technology Part 1 and (5) Technology Part 2. Participants can choose to complete one or more of these modules in order to be eligible for the respective practical trainings. Each advanced course offers one teaching case that further imparts the knowledge on the different topics. The elaboration of teaching cases is possible in individual self-study or in group-based local workshops or online webinars. Following the advanced courses on technology, the living labs are held web-based with a maximal duration of 0.5 days. Thereby, training participants not only work with the teaching cases, but also on the definition of technological assignments that are further tested practically in the course of the model factories.

Get access to the InnoPeer Advanced AVM Courses here!

Aspects of Organisation

Aspects of Human Resources Management

Aspects of Business Model Development

Aspects of Technology Advanced, Part 1

Aspects of Technology Advanced, Part 2

Strategy Camps

The InnoPeer AVM Strategy Camps were a series of workshops dedicated to Industry 4.0 to allow private companies to experiment technological, organisational and managerial transformations necessary to become 4.0 and to participate in international and innovative value chains. The main learning goal was teaching how to drive a corporate change for competitiveness by aligning technologies, people and organisation, offering the participants the opportunity to experiment the processes and difficulties underlying a corporate change to be implemented at different levels of a business activity.

The internationally-known 'Design Thinking' was selected as the teaching approach: as in a „Netflix series", the participants were the main characters of an episodic story in which the ultimate goal was to build a European value chain for the production of electric cars. The training activities were primarily directed to professionals with a coordination/supervision role within a corporate organisation and they were implemented in Germany, Hungary, Italy and Poland.

The main characters were 4 fictional companies active in the automotive sector, additive manufacturing and ERP systems. These companies had to introduce a change in their business (e.g. at the level of processes, products, value propositions) in order to build together a new trans-European value chain dedicated to the production of electric cars. During the first four Strategy Camps, the participants had the possibility to work on the challenge of one of these fictional companies, whereas the last episode was dedicated to define the collaboration agreements between all the firms to create the value chain.

Model Factories

The practical aspects of the technology dimensions can be experienced in one of the three InnoPeer AVM Model Factories. They are managed by the project partners from the Wrocław University of Science and Technology in Poland, from the Fondazione Democenter Sipe in Italy and the Fraunhofer IGCV in Germany.

The Model Factory in Poland focusses on the application of Additive Manufacturing technologies, which is a key topic in both technological Advanced Trainings. The Model Factory in Italy, on the other hand, focusses on the topic of Industrial Internet of Things, Digital Transformation and Lean Manufacturing. Examples are the analysis of lean processes with continuous improvement, RFID systems for logistics or the collection of process data and failure prediction. The Model Factory in Germany focusses on flexibility and changeability in manufacturing and shows an example how a batch-size-one-production can be realised.

The duration of this practical courses is one day and the concrete assignments and use cases for the Model Factory are predetermined in a so-called Living Lab after the participants finished the respective technological advanced trainings.

Figure 4 Model Factory @ IGCV in Augsburg

InnoPeer AVM Knowledge Dimensions

The transformation towards "Industrie 4.0" is one of the key challenges for European companies. Traditional factories turn into "smart factories" by adding connectivity and self-intelligence. Components are printed instead of cast or forged, and profit drivers will be data instead of real products. New technologies therefore give important impetuses to change in times of digitalisation and, more precisely, advanced manufacturing. However, not only the adoption of new technologies is important when deciding for AVM-related transformation processes, but companies also need to be aware of the implications that such changes have on human resources management, organisation and, last but not least, their business models and strategic directions. InnoPeer AVM aims at providing a comprehensive and interdisciplinary qualification programme that encompasses these knowledge dimensions.

Aspects of Technology

Industrial enterprises due to the late industrial market transformations and implementation of advanced manufacturing technologies (AVM) have a great demand for flexible automated systems and innovative production solutions. The goal is to help these solutions achieve an efficient workflow in production while minimising the negative impact on employees. These trends have contributed to the rapidly growing interest in technologies like:

(1) Advanced robotics
(2) Additive manufacturing
(3) Reverse engineering

Robotics

Industrial robots are used in various applications at manufacturing companies in specialised robotic production stations. This is dictated by their high performance and ability to continuously perform production operations with high repeatability and precision. The tendency to reduce the costs of industrial robots has also become an important factor increasing their use not only in large companies, but also in small and medium-sized enterprises. However, the demands placed on robots are constantly increasing. One of the disadvantages of robotic stations is the need to isolate robots from the environment where employees work. Another is the desire to simplify the way of programming robots to a level that does not require the involvement of robotics specialists. Ideally, robot programming for new tasks would be feasible by mid-level technical staff handling

production processes. To meet these needs, new, easier ways of programming robots are being developed, enabling rapid reprogramming by production staff. Programming methods should allow the programming of industrial robots directly by production line engineers or service personnel, without involving additional specialists in the field of industrial robotics. In addition to easy programming, another aspect is to ensure flexibility in tasks carried out in shared areas with employees. Significant progress can be seen in this area in recent years. New companies were created - start-ups offering their own new products - collaborative robots (cobots), designed to work directly with people, as well as leading manufacturers of traditional industrial robots have introduced new lines to their product range - cobots. These solutions allow sharing the workspace with operators - workers during the implementation of production tasks. To enable the discussed functionality of cobots, technical features were developed, like built-in drives power sensors, allowing detection of overloads resulting from an accidental contact with production workers or other technical devices. In parallel to the cobots themselves, mobile transport robots with collaborative functions are also produced. Figure 5 below shows an example of an advanced solution from the KUKA robot manufacturer: an integrated KMR iiwa mobile platform and a robotic arm LBR iiwa.

Figure 5 Kuka mobile platform KMR iiwa and robotic arm LBR iiwa

One of the most important functions of cobots in Industry 4.0 is the ability to exchange data through wireless communication in applications related to maintenance, monitoring the correctness of tasks carried out, acquisition, processing and saving of data from implemented processes.

Additive Manufacturing

Additive manufacturing (AM) is increasingly being used in practice as an alternative method for producing various objects: both parts of machines and devices as well as decorative products, or in the household appliances industry. Due to their recent development and the ability to manufacture products from metallic materials, they are recently the subject of interest of the most advanced industries such as the space industry, aviation, advanced medicine and the automotive industry. The rapid development of additive manufacturing methods results from significant savings in production - mainly time. Although in recent applications in the aerospace industry, one can already notice savings in material costs can already be noticed. This is especially important for objects with a complex spatial structure.

The 3D printing process consists of several steps. The first step is to prepare a digital model of the object in CAD software. Then it is exported to STL format. In this type of file, the object is mapped using a triangle mesh. The choice of resolution at which this approximation is made is crucial to the quality of the final product. If it is too large, the spatial printer may not be able to print all the details of the structure. If the resolution is too small, the triangles may be visible on the surface of the printed object. In the next step, the model is „cut" into layers and support structures are being applied where necessary. The ready file is sent to the printer. After printing the item, depending on the production technique, support structures need to be removed. Then it undergoes the necessary finishing treatment, for example, grinding and painting.

One of the most popular methods of additive manufacturing is Fused Deposition Modelling (FDM) another common name for this technologies Fused Filament Fabrication (FFF). Stereolitography (SLA) is another popular AM method. This technology is based on the polymerisation of a liquid resin, which cures under a laser beam. Another AM group is PBF (Powder Bed Fusion). The methods in this category use a heat source that melts the powder particles to connect them together. In this way, subsequent layers of the object are created. Powder losses are constantly replenished. Therefore, when the item is ready, it remains immersed in untreated powder. The PBF category includes the SLS (Selective Laser Sintering) method. Selective laser sintering is a technique that utilises polymeric powders. Objects made of metal are made by SLM (Selective Laser Melting) and DMLS (Direct Metal Laser Sintering) methods. Compared to SLS, SLM consolidation of powders is usually faster but has low energy efficiency. In

contrast to SLS, objects printed with SLM / DMLS methods require support structures to compensate for residual stresses.

Reverse Engineering

Reverse engineering is an area of technical science regarding an inverted approach compared to traditional product development. The starting point is the real object / product and ultimately the goal is to obtain a CAD object geometry model or a further improved product. In many cases, the reverse engineering task ends with obtaining the appropriate class and quality of the tested object's digital model. This is the starting point for the subsequent stages of engineering work related to the development of new products, whose geometry and properties depend on the initial object or the improvement of its structure. The reverse engineering scheme is as follows: acquisition of object data (most often digitisation of the object's external surfaces), data pre-processing, segmentation, classification, surface fitting, CAD model building.
Digitisation can be carried out using various contact, contactless or hybrid methods. Devices dedicated to these applications are called 3D scanners. They use probes for point measurements by physical contact or scanning techniques without the scanner's physical contact with the inspected object. Different radiation sources are used in these methods. One of them is X-ray radiation used in technical computed tomography. Another group of scanners is based on the use of structured light. These solutions are more widely available due to the price and applicability to large objects. As a result of scanning processes, object's data is obtained in the form of a point cloud in 3D space. In the next stages of work during reverse engineering, a wire-frame mesh is built by connecting adjacent points. A special class of CAD software has been developed, enabling processing of point clouds in order to obtain a model in the form of a mesh or as a surface model. The surface model can be used to develop new products, modernise the scanned object. Medicine is an important area of reverse engineering, where through computed tomography, parts of the human body, e.g. the skull, can be digitised. The data can then be used to plan reconstructive operations or design personalised implants.

Aspects of Human Resources Management

In advanced manufacturing, companies operate in a fierce and dynamic environment that forces them to adapt quickly to upcoming changes. To better respond to complex and unpredictable demands, organisations need an holistic human resources management (HRM) approach, flexible processes and appropriate HR practices. Leaders are role models, as they inspire employees and help to overcome resistance to change. Employees, on the other hand, need to improve their individual skills to keep up with the latest developments. The InnoPeer AVM training aims at developing a thorough understanding of these topics in the context of advanced manufacturing. Specifically, the training programme focuses on:

(1) Traditional vs. innovative HRM
(2) High-performance work systems
(3) Leadership for change towards advanced manufacturing
(4) Individual competencies and learning for change in advanced manufacturing

Traditional vs. Innovative HRM

Advanced manufacturing changes industrial work and triggers changes in HRM. To meet today's challenges and generate future growth, companies must implement goal-directed and future-oriented staffing that fits the corporate strategy. HR professionals play a vital role in strategic staffing; they must be business partners by aligning HR and business strategy, ensuring operational excellence, establishing an attractive workplace and supporting transformation and change. Innovative HRM, the management of all human-based value creation, enables companies to respond more flexibly to unpredicted and complex events. This is especially crucial in turbulent environments like "Industrie 4.0". The long-term objective of innovative HRM is to develop an HR-ecosystem in which value is created by employees within the organisation as well as customers, investors and communities outside the organisation. However, efficient HR processes and governance practices remain important in an innovative HR ecosystem. Besides innovative HRM, work designs that enable high performance and creativity help to overcome the challenges of advanced manufacturing. In the context of digitalisation, traditional work systems aiming at execution do, however, not lose their importance as administrative tools for hiring, firing and paying wages. They emphasize a top-down approach, where managers make decisions, supervisors monitor workers, and workers perform routine and repetitive tasks.

High-Performance Work Systems

High-performance work systems (HPWS), also referred to as high-involvement or high-commitment works systems, are a major source of competitive advantage when appropriately aligned with the firm's strategy. The goal of high-performance work systems is to improve employee productivity and well-being. A participative job infrastructure is emphasised. HPWS adapt to the individual features and circumstances of organisations. In today's advanced manufacturing world, companies face growing complexity, new technologies and increased customer demands among others. An HPWS approach helps organisations to meet these challenges by creating effective and participative HRM foundations. Studies in the manufacturing and services show that HPWS improve organisational performance. In particular they increase employee effectiveness, knowledge creation and organisational learning and reduce skills shortage. However, the success of HPWS depends on the quality of the implementation. Companies that have integrated work systems outperform competitors.

Leadership for Change towards Advanced Manufacturing

In times of digitalisation, it is important to understand the role of leadership as well as the dynamics of change in transition processes. To continuously and successfully adapt to changing environments, companies need dynamic capabilities. These include a firm's ability to sense and seize technological opportunities and to reconfigure their resource bases and competences for the efficient implementation and dynamic adaptation to new market demands. The InnoPeer AVM training program gives insights into how effective leadership can support such change processes without having to accept losses in the daily business. Leadership is always a process of interaction. It can be regarded as most effective when both, work and employees' needs, are prioritised. However, leadership is contingent on the readiness of employees in terms of their competence and commitment. Consequently, leaders need to be able to adapt their level of guidance and support – especially in times where employees are required to work with new technologies. In times of digitalisation and increasingly networked processes, self-leadership – a mechanism for self-monitoring and navigation – becomes increasingly important. Leading change involves the choosing of adequate change strategies and intervention techniques at the organisational, group or individual level. The desired effects of change are only expectable if interventions are accepted. Therefore, leaders need to be aware of individual and organisational sources of resistance and different attitudes towards change. While communication and sense-making (i.e. to create a common frame of reference) always are central mechanisms to manage resistance, active participation in change process, using the group as the most important change medium as well as mutual cooperation increase the acceptance for change.
To adequately manage the transition towards advanced manufacturing, it is important to understand common challenges that can occur in such change processes. Not only does the complexity that arises through new technologies lead to a lack of knowledge regarding "Industrie 4.0", but the increasing interaction between humans and machines – to the neglect of direct human interaction – weakens social cohesion, motivation and performance. To tackle these challenges, different solutions can be offered. While a skill-based approach can be used to exploit unused potentials of employees by means of individual training plans, team-building measures are adequate to achieve a continuous and planned development of social skills (e.g. communication and conflict management).

Individual Competencies and Learning for Change in Advanced Manufacturing

In the InnoPeer AVM training, the role of individual skills and learning for changes towards advanced manufacturing is emphasized. Individual competencies are the fundament of organisational competences because only the accumulation of individual learning can eventually result in organisational learning and the improvement of performance. Consequently, companies' actual availability of HR skills must be clarified before developing the individual skills of employees. Two different forms of learning processes can be distinguished - the development of individual skills and the development of collective performance. While the first refers to learning from personal experience, learning with models and learning through synthetic experiences, the latter includes learning through the interplay of individual skills and learning through a new combination of individual skills. In a context where companies have to constantly adapt to new developments, lifelong learning is crucial. Both the individual and the company need to create conditions that promote learning. Lifelong learning must become a part of

everyday life, adapting to working days and lives in order to function properly. Therefore, the individual must follow bottom-up learning, and the company and leaders must strengthen learning in daily work with top-down learning. The InnoPeer AVM programme offers valuable explanations and AVM-related examples regarding these timely issues in the context of human resources management.

Aspects of Organisation

Organisational management is necessary for successful changes towards AVM. The InnoPeer AVM training programme gives valuable insights into the development and implementation of new organisational forms as well as the organisational aspects that need to be considered during the adoption processes of AVM-related technologies. Using sophisticated theories, models and concepts, the phenomena that organisations face in the context of digitalisation and advanced manufacturing are explained. Specifically, training participants learn about the connections between a firm's resources, its (dynamic) capabilities and the environment, how boundaries of the organisation have to be actively managed, how contingency factors affect organisational structures and how organisational design influences innovative behaviour in the context of AVM. Altogether, the aim is to give a comprehensive picture of the role of organisational management in successfully transforming towards AVM. As in every InnoPeer AVM knowledge dimension, the learnt knowledge is solidified by working with practically oriented case studies that give training participants the opportunity to apply their knowledge to real-life examples. Four main areas are the core of AVM-related organisational management:

(1) Environment, capabilities, resources and the organisation
(2) Context and industry as a resource for organising in advanced manufacturing
(3) Organisational design for advanced manufacturing
(4) Innovative behaviour in advanced manufacturing

Environment, Capabilities, Resources and the Organisation

Dealing with questions related to „organisation" in an advanced manufacturing context is relevant because business environments have become increasingly dynamic and competitive and, thus, more complex. Some relevant drivers for this development are megatrends such as globalisation, demographic change and digitalisation. The implementation and efficient use of new technologies require firms to develop capabilities and to adapt the entire organisation accordingly. Companies not only need to understand their environment as a context for strategic action, characterised by opportunities and threats of digitalisation, but also their own strengths and weaknesses of its existing resources and competence bases. Precisely, training participants learn to understand and analyse connections between a firm's resources, its (dynamic) capabilities and the environment and to evaluate which environmental trends affect their companies the most in the short and long term in order to prepare their organisation for constant adaptation to (technological) change.

Context and Industry as a Resource for Organising in Advanced Manufacturing

Organisations can be important drivers for more competitiveness and success by exploiting opportunities and knowledge from the environment. To do so, it is crucial to understand how a well-adjusted organisation can help to extract advantages from the environment of the company through channels, such as open innovation or user integration, to analyse and evaluate organisational boundaries and to get ideas on the usefulness of alliances, networks, platforms and industrial associations. An organisation's environment can be regarded as a resource that needs to be actively managed in order to reduce uncertainty. As organisations are embedded within industries and wider contexts, environments need to be organised in form of alliances, networks, platforms or industrial associations. InnoPeer AVM training participants learn to analyse, evaluate and manage organisational boundaries (i.e. the interfaces between the core of a company and its extra-organisational environment), as these become increasingly permeable and flexible membranes in the context of advanced manufacturing. The concepts of open innovation and open strategy thereby play an important role in integrating customers and suppliers.

Basic Organisational Design for Advanced Manufacturing

Given that companies need to actively analyse and their environment and organisational bounda-

ries, the adaptation of organisational structures and design is important. In the context of AVM, developing a supportive organisational structure is essential and depends on a variety of different circumstances. Managers need to ask themselves things, such as what kind of market is my company situated in? What type of products and services does my company offer? How competitive and dynamic is the environment? What are my company's main resources and competences? Accordingly, effective and adequate organisational design is always dependent on factors, such as environment, technology and firm size. Managers need to be aware that there is no 'best way' of organising, but that structural changes are always contingent on the specific situation a company faces. Central elements that need to be considered at this point are how to redesign chain of commands and span of controls, as the essence of advanced manufacturing includes the trend towards less formalised structures and highly decentralised decision making – as present in agile organisations. Precisely, agile organisations are competitive and sustain growth through new visions and values, adaptive and innovative teams that use collective intelligence inside and from the external environment, adaptive infrastructures and a breakthrough culture that is collaborative inside and outside the enterprise and fosters the idea of a learning organisation.

Innovative Behaviour in Advanced Manufacturing

Innovation can occur through formal or informal processes, innovative cultures as well as creative individuals (and their environment). To govern innovation, organisational design tools for direction and control need to be implemented and aligned with the corporate strategy. InnoPeer AVM training participants specifically learn about approaches for initiating, directing and controlling innovation as well as ways to enhance and manage individual (innovative) performance. A main challenge for organisations is to manage the tensions that exist between the competing objectives of exploration and exploitation, as they require substantially different structures, processes, strategies, capabilities, and cultures. Ambidexterity is the ability to simultaneously balance exploitation (efficiency) and exploration (innovation) at a high level to ensure short term as well as long term success. The InnoPeer AVM training therefore provides participants with important insights on the management of ambidextrous designs that enable the simultaneous pursuit of both explorative and exploitative activities in organisations. Finally, participants learn how to measure performance, determine areas of improvement and align organisational design and innovative behaviour with the help of enterprise analytics.

Aspects of Business Model Development

A business model is a company's plan for making profit. It identifies the products or services the business will sell, the target market and the expenses it anticipates. New businesses and start-ups must have a business model, to attract investment, to recruit talent, and to motivate management and staff. Established businesses, in contrast, must revisit and update their business plans regularly they will to anticipate trends and future challenges. There are several methods for developing a business model:

Business Model Canvas (BMC) is a commonly used strategic management template for developing new or documenting existing business models. It is a visual chart with elements describing a company's or product's value proposition, infrastructure, customers, and finances.

The BMC tool can be printed out on a large surface, so groups of people can jointly start sketching and discussing business model elements with post-it notes or board markers. It is a hands-on tool that fosters understanding, discussion, creativity, and analysis. The starting point are the customer segments, followed by the value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partners, and finally the cost structure.

Figure 6 Business Model Canvas strategic management template

New Methods for Business Model Development

The innovation paradigm is changing. Over the past decade, many studies have shown the inadequacy of the traditional innovation paradigm, which has evolved linearly from research, to concept, to design and development, to market launch. This process does not help the company to manage the main risk of innovation processes, because - contrary to what everybody thinks - it does not lie in the development of the technology, but in the poor attractiveness of the developed products/services for the market.

Meanwhile, a new approach to innovation and a new process of product/service development has emerged, named "Lean Innovation". The value of this method lies in organising the development of innovation in order to "meet the market" very quickly: thus allowing problems with the audience to take place as soon as possible and after a minimum investment - so as to allocate more resources as the project becomes less risky. The Lean Startup Method has its roots in different approaches and disciplines: the two and most important contributions come from Agile Methodology and Design Thinking.

The Agile methodology was originally developed for the software industry (Scrum): its job was to optimise and improve the development process to quickly identify and correct problems and shortcomings, by splitting a development in short-time periods. Within these so-called sprints (2-4 weeks period) the defined tasks are implemented. At the end of each sprint, the results are reviewed, and the next implementation steps are defined, to meet the key product requirements. The Agile methodology allows companies to provide a better product, more quickly, through short and interactive sessions.

On the other hand, Design Thinking revolves around a deep interest in developing an understanding of the people for whom the products or services are designed. It is extremely useful in tackling unknown problems, by re-framing the problem in human-centric ways, evaluating new ideas and adopting a hands-on approach in prototyping and testing that is very useful as companies approach innovation.

Lean Startup offers a methodological approach aimed at satisfying the need to lower the degree of uncertainty in innovation processes and to significantly reduce the risks related to new and innovative ideas, by testing each phase through which a project must be substantiated (from the idea to the launch, passing through the in-depth investigation of the target market, the formulation of the value proposition and the adoption of a promotion strategy). This occurs through the application of the scientific method, understood as a repeatable and systematised process, supported by experiments and validation/monitoring metrics.

Business Strategy

The business strategy for a company defines the path that the business will take to achieve its goals. These goals include the elements of the business model, along with any additional mission or goals. It explains the steps, processes and changes that the business will follow, and it identifies the strategies the business will use to counteract potential upsets and hurdles. Achieving the business strategy requires the efforts of every employee. The business strategy should be contemporary, if not advanced, to meet the current industry demands, as well as the forecasted demands. In general, a business model makes no statements about the competitive situation. In contrast, a strategy describes how a company can differentiate itself from the competition and develop a sustainable competitive advantage. Design Thinking is a commonly used methodology for developing the business strategy. As the underlying digital transformation process is intrinsically complex and deals with uncertainty, design thinking offers the opportunity to explore various options in a permanently changing environment (customer needs, technologies, market, competitors).

The digitalisation of plants and mechanical engineering enables many new business areas. Most of these Industry 4.0 business models affect service providers in the IT industry (such as software developers, software providers, data processors, service providers, web and app designers), and there are many new value-added opportunities for plant and machine builders, as providing infrastructure as a service with pay-per-use / pay-per-hour models. These new business models shift the classic services of the plant and machine manufacturer to IT-based services.

To ease the handling of all business-relevant data, internally in the companies, an **ERP - Enterprise Resource Planning** system can be introduced. An ERP is an information system that can handle all technical, production, trade, warehousing, stocking, financial, management and various other processes in the company, using a consistent, integrated approach. Integration is therefore key in ERP applications, which extends the business

functions to the whole company in order to better serve the needs of the customers in the following areas:

- the ERP organises and integrates the business and information processes in order to achieve an optimal use of physical assets and human resources;
- it coordinates the demands of key business partners with the operations of the company;
- finally, it helps finding optimal solutions when implementing various business processes.

What are the **advantages** for a business when using an Enterprise Resource Planning system?

First, there are **internal** advantages that support the operations of the company:

- the integration of data sources offers a more efficient operation and reduced administration workload
- using common databases helps eliminating redundancies
- it is a real-time system. Every transaction immediately shows up in all areas of operation.
- the use of ERP results in increased productivity, since the integrated system fosters more efficient processes, which also results in:
- decreased operation costs.
- Various components of the system automatically communicate with one another, which results in a dramatically improved internal communication in the company.
- ERP suppliers continually improve their systems, which provides a way for future advancements to be incorporated in the ERP system.

External advantages will enhance the experience of the company partners in the following areas:

- placing fulfilling orders will become simpler and more efficient;
- the system offers an improved way of communicating with clients and end-users;
- this will lead to a more competitive market position, and eventually manifest in
- increased sales and profits.

InnoPeer AVM Case Studies

The compilation of various case studies is an essential part of the InnoPeer AVM training programme. Precisely, based on an analysis of the potentials of local SMEs and lead companies and their need for AVM-specific qualification and support for getting involved in AVM-related value chains, real-life and problem-based case studies (i.e. use cases, teaching cases and the CE Mega Case) have been developed in the respective knowledge dimensions. While use cases present brief summaries of AVM-related challenges and describe how companies tackled them, teaching cases as well as the CE Mega Case are more comprehensive and complex and require training participants to reflect on different solutions alternatives using a set of predefined training assignments.

Use Cases

Use cases present summaries of AVM-related challenges and how companies have tackled them. Like teaching cases, use cases reflect real-life challenges in one of the three knowledge dimensions - AVM technologies, HRM and organisational design or business model development. This section gives an overview of a selection of use cases that were developed for InnoPeer AVM.

Get access to the full set of use cases here!

Use Cases

Use Case: Implementation of an Industry 4.0 Infrastructure

Knowledge Dimension: Technology
March 2019
Authors: Gergely Bencsik, Attila Gludovátz & Zoltán Pödör
(University of Sopron, Western Hungary)

The case study deals with an Industry 4.0 infrastructure implementation in order to get more precise data and make better the decisions, based on that data. First, the initiate infrastructure of the company will be summarized, then the solution itself will be presented. There are two plants at the company's park. In the plants, the machines do their different manufacturing jobs. These machines are connecting to three computer servers, which make surveys and monitoring functions principally. First, there is a "MOVEX operator" server. This is a self-developed hardware and software tool, which is counting the workpieces, which go through the production machines. Given the databases' structures, the MOVEX operator servers are different in the plants. Therefore, for the two plants different data collecting solutions must be implemented. There is another server named "MOVEX ERP system". The corporate processes' data structures in the ERP are the same in the plants. These data are synchronizing continually to the center server of the multinational company. There is working a building supervisory system at the company, however, this system can partially handle the complex problems such as the consumption of electricity for example. However, there is necessary to do additional calculation. The supervisory system gives us the summation data, from which the set of raw data can be obtained (technically, an SQL server is used). The company's experts can monitor or modify the production machines' management. The system's data storage is working like a black box; however, incremental saves can be made, which are exported to the MySQL databases (or tables). Our self-developed solution's data are also stored in a MySQL database. The Industry 4.0 framework is designed and implemented from the bottom to the top. At the basis of the framework, there are the selected production lines, machines and other units. Smart meters and sensors are installed to these devices. At the company, the managers have already knew the information about the production's main parameters, so the main task is to extend their communication network for the transmission of the data. "Power Meter Series PM9" smart meters are used, that can connect to the system core. In addition, these IoT-compatible smart meters can measure multiple parameters, and they have computational abilities. They connect to the data transmitting network through a Modbus (RS-485) output. At the company, there is a gateway that transmits the data to the right system. Thus, the data go to the Supervisory Control and Data Acquisition (SCADA) system, which monitors the data in real-time (or in a trend diagram). The SCADA system's inner database is not available with any management tools, but a routine can be defined, a scheduled process or job, with that, we are able to make an incremental saving into an external database, which works beside of the SCADA system. Thus, there is configured a process that saves data every 10 minutes. Furthermore, the production data go into the production- related database from the gateway. These data are also managed in the ERP system now. With this infrastructure, almost all the machines are connected into one network.

Use Case: Cloud-Based Production Monitoring

Knowledge Dimension: Technology
June 2019
Author: Universität der Bundeswehr München (Bavaria)

The CPT (computer chip manufacturing) company is a producer of small series computer chips and electronics components based in southern Germany. The main customers of CPT are mainly producers of prototypes for the automobile and aeronautics industry, requiring highly specialized small series of chips and other electronic components. To meet the customer expectations, 97 employees work for CPT of which the larger part are highly skilled technicians and electrical engineers. The actual production of computer chips is nearly completely done by high end machines because high precision is an absolute requirement.
The observation of the production line is of great importance as the production manager C. Banks explains: "The machines work highly self-sufficient but if any machine along the production line has a problem, and works imprecisely or fails completely, it will produce a high damage. This can go unnoticed for hours, producing large costs to the company. Being on top of the production line and identifying malfunctioning machines early or even prevent machines from malfunctioning will lead to smaller costs and higher quality products." Since

the CPT company only produces small series, the production line must be recalibrated and tested more often than most other production lines. To support the production manager and his staff, especially after having opened a second plant, the CPT company installed a cloud-based platform solution to help C. Banks oversee his production lines and receive information almost in real time.
"The capability of evaluating every machine along all production lines simultaneously helps me improve the productivity of our plants. Not only can I prevent the production line from standing still, but I can also better monitor the quality of the product and ensure a high standard." – C. Banks (Production Manager)
Unfortunately, there are not only advantages to the new system. C. Banks points out: "The requirements for security are enormous, the protection of the broad data collected is of utter importance. Also, the implementation is a rather complex process, luckily the platform is compatible with many different machines and types of interfaces." The CPT company mainly uses the new infrastructure to monitor the machines on the production line, but there are additional advantages. The productivity and efficiency of the production line can be observed and improved based on a large variety of available analytics. The platform can also be used to create a virtual twin of a plant, allowing better planning for future production series or the establishment of additional plants. Further advantages lie in the local flexibility possible through the cloud technology. It is no longer required to have personnel observing the entire production line or being present in the different plants.

Use Case: AM Part Identifier

Knowledge Dimension: Technology
July 2019
Author: Dominik Lindenberger
(WRUT, Lower Silesia)

3YOURMIND provides software for additive manufacturing workflows. Their solutions are designed to standardize, automate and optimize processes within companies that are starting to implement or ready to scale their industrial 3D printing. Their products standardize every aspect of the supply chain from analysing historical part data to efficient order management to scheduling agile production. The award-winning company is headquartered in Berlin with offices in the USA, France, and Poland. Five years ago, 3YOURMIND began offering a digital platform to order 3D parts from professional 3D service bureaus. This made it much simpler and cost effective for designers and engineers to submit file for production. Unfortunately, it quickly became clear that there was a low level of knowledge in understanding what parts were a good fit for 3D printing since the technology is new and the first real courses and standards for this type of production are becoming formalized in software or in education curriculums.
The 3YOURMIND order management software, our initial product, derives its main value when a high volume of orders is being sent through the software and then the parts are coming from a large number of employees and departments in large OEMs (Original Equipment Manufacturers) companies. Because there is a long timeline before employees achieve a level of knowledge and training to be able to make those decisions directly, 3YOURMIND began working on the conceptual design for the AM Part Identifier, a software module to help employees and AM experts analyze technical and economic part data to highlight the parts our customers should produce in additive. Each new part represents a new AM use case that can bring additional savings to their company so the faster companies can find those parts, the faster they can scale.
3YOURMIND assigned a small "programming task force" consisting of two programmers and a part-time product manager to create an initial MVP (Minimum Viable Product). The product team carried on a series of interviews with consultants out in the field who are currently doing this type of part analysis manually. The current process uses an export from a company's part database and applies a series of sorting formulas and analysis algorithms to identify parts that have highpotential for AM. The project team identified the most important part characteristics with industry consultants and developed a software that could provide the initial evaluation based on the relative importance of each criteria to the core business. After a 3 month field trial, 3YOURMIND received positive initial feedback about the baseline functionality, but the specificity of the results was too low to provide confidence in the final report. The 3YOURMIND team did a full reprogramming of the software to create a new MVP that used more complex algorithms associated with each variable. This meant significantly more work for teams at the outset of a project, but provided much finer differentiation in the results. With a functioning, market-validated

product, they were ready to start taking on paying customers.
One of 3YOURMIND's long-time customers, the Deutsche Bahn (DB, German Railways), expressed an immediate interest in the product but had an interesting challenge - unlike the "innovation companies" whose digital part portfolios could quickly be analyzed by consultants, DB has a large logistic network consisting of parts and components that are anywhere from 6 months to 60 years old. The parts that are over 15 or 20 years don't have digital information and sometimes not even physical plans for each part. A digital inventory analysis was going to miss between 50-80% of the interesting use cases.
3YOURMIND did their next development cycle in direct partnership with Deutsche Bahn to create what they named Use Case Screening, an online module to collect part submissions from the field and build a real-time AM part inventory using the eyes and ears of the DB employees. The software collected the smallest, common denominator of part data to create an initial assessment. The report would then be forwarded to the AM expert team for further analysis. The product team did a series of interactions directly with DB to refine the software functionality, the collected criteria and the analysis algorithms to optimize each stage of the software. They were able to use historically strong AM parts from DB who had also been doing manual analysis for almost 5 years and refine with data input from the employees over a three month contest to gather employee ideas. Deutsche Bahn received over 200 submissions of which 25 ended up as strong matches for 3D printing. 3YOURMIND had a second, market-validated product functionality.

Use Case: OPC UA in Food Production

Knowledge Dimension: Technology
June 2019
Author: Patrick Zimmermann (FhG, Bavaria)

Weber Maschinenbau GmbH produces ground-breaking systems to process, refine, and slice sausages, meat, cheese, and other food: Slicer, Food Robotics, and Skinner. Weber is world market leader in the field of Slicer technology. Its customers are amongst others large meat companies, dairy factories and system catering businesses. Special innovations from the current product portfolio are the Weber Slicer, equipped with circular or curved blades, and the Weber Pick Robot for assembling sliced sausage or cheese in packages. The new Weber Variety Pack provides fully automatic combination of several varieties of sausage, cheese, or snacks in a single package. The modular system combines several Slicers with a conveyor belt system and additionally provides different infeeding variants. The central machine, the so-called Slicer, is always surrounded by various different models of Weber machines. Hereby, the Slicer is always combined with one or more machine modules, like scanner, peeling machine, (optical) scale, interleaver, underleaver, multi-layer puffer, Infeeder, robot or similar.
Weber's aim was to equip the machines with a new SCADA system, whereby existing machinery should use the new functionality of updated modules right away. The new architecture should be based on a backbone, providing a middleware on an industrial PC, which is able to map all business processes of the machine(s). Existing "classic" applications should be encapsulated where necessary and linked up with new features. In parallel, new functionality should be provided. In short, Weber wanted to develop a modern SCADA system, which forms a reliable basis for process control systems and, first of all, provides a standardized interface for clients.
In search for a standard which is able to connect machine building and IT, Weber discovered OPC UA. It contains all components which are required for software engineering within machine and plant engineering at the moment. The in the meantime implemented OPC UA interface forms the link to all clients communicating with the machines. This can be e.g. local or remote clients to operate machines, business software (MES/ERP), or (own) process control systems. By strictly separating communication from mapping of business processes in the middleware, it has been possible to develop the particular software layers of the application almost independently. Thanks to OPC UA it has been possible to fulfill all requirements and create a futureproof backbone for the machine software of Weber Maschinenbau GmbH.

Use Case: PM S.p.A. - Making Business Effective and Efficient Thanks to Digital Integration

Knowledge Dimension: HR/Organisation
May 2019
Authors: PM S.p.A. & Fondazione Democenter-Sipe (Emilia Romagna)

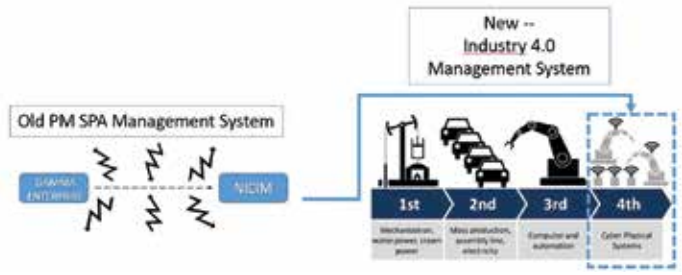
'Italian Group Manufacturing of Precision-Machined Complex Systems for High-end mechanical industries Company' (PM S.p.A.) is a Leading European Group active in manufacturing Precision-Machined Engine and Transmissions Parts and Components especially for Automotive, Motorcycle and other high-end mechanical industries, supplying OEM and Tier-1 Players. The Company – established in the late '70s in the Emilian Motor Valley – is an Italy-based Group, run by the second-generation ownership and a highly skilled Top- and Middle-Management. The Group works on an integrated value chain. It implements all the activities of the development of new component from co-design to series production. For this reason, PM is the sole long-term supplier for most of its customers on the specific components they order, since they are developed through a strong partnership between the customer and PM. PM employs 174 persons whose over 130 are highly skilled blue-collars.

PM is specialized in supplying massive production of Extremely High-Precision Machined Components and Parts mainly for gearbox, transmissions and clutch – mainly for the Automotive and Motorcycle industries –, but also for marine motors, hydraulics and cycling thanks to its manufacturing plants equipped with state-of-the-art and advanced CNC machineries and equipment. Its production comprises mainly: Gearbox and Differential Housings for the Automotive sector (e.g. Daimler and especially for its division focusing on high-end cars such as AMG, Getrag--MAGNA); Engine Crankcase, Rear swingarms and Wheel spindles for the Motorcycle industry (e.g. Ducati, Ducati Corse, Harley Davidson); Sterndrives and Marine Gears for ZF; Housings and Valve Bodies installed on Lifting vehicles and digging machineries for Parker Hannifin and Dana Rexroth. All these products are made of a wide range of aluminium alloys, stainless steels and cast iron.

Until few years ago, the ERP system and the scheduling & production system were disconnected and working independently. The communication between people could lead to many mistakes with a huge waste of time spent on activities without any value. There were no real-time checks even. All that had a negative impact on the overall production efficiency. Moreover, each division had its own management software and there was not a pool of practices shared among the employees in using them. That caused:

- dispersion,
- the loss or erasing of documents (connected to potential human error) and
- the creation of the same documents several times.

Figure 7 Old and New Management System at PM S.p.A.



To solve this problem and boost the efficiency and the effectiveness of the company, PM opted for adopting a software based on the same Standard Legacy System shared by all the corporate divisions plus its partners and suppliers. The choice went for Sinergest Suite. Sinergest Suite is at the core of how PM interpreted and implemented the Industry 4.0 paradigm. The system has been integrated throughout the firm and used to collect, save, share all the data – which are ready for reporting, scheduling and analysis of decision-making. Real-time KPI's are displaying in dedicated dashboards and andons.

Advantages of the Sinergest's web-based platform are:

- Innovation of business processes;
- Growth of „internal-outside" efficiency leading to cost-effective solutions. Users do not spend their time in activities without added value any longer. Furthermore, the in-process supply chain controls permit to have a better response time and fewer costs;
- Fewer management costs, increasing flexibility and efficiency as a consequence;
- Multi-company management and production networking;
- On-time control of company performance anywhere using tablets or laptops

PM has invested in innovation and digitalization with the aim of continuously improving its performance on the basis of big data, data binding, data warehouse, flat files and so on. That has led to grow the quality of its services (e.g. on-time delivery, planning, forecasting), efficiency, reliability (e.g. ppm, cst%, etc.). All that was obtained thanks to an all-in-one digital system integrating ERP, CMP, MES, MOM in a unique Legacy System software. Consequently, the information related to the system integration is shown and monitored through the different steps of production (e.g. internal; from suppliers to the customers) in a smart, easy,

fast and intuitive way. For example, PM is able to have an integrated and automated vendor list with the qualitative and logistics KPIs shown in specific dashboards: the dashboards provide a great telematics service for monitoring the own products in real-time, without being „physically" there.
Furthermore, considering the lean manufacturing, the predictive analysis of advanced maintenance (data provided in real-time using IT tools such as tablets, RFID technology, desktop PCs close to the CNC machines and in every production departments) has permitted to share the monitoring and the improvement of the corporate performance throughout the firm, increasing the involvement of the human resources belonging to all the business functions (i.e. continuous and constant monitoring of any processes).
The process of digital transformation within PM has provided:

- All its users a better quality, simplicity and speed during the daily work activities (user-friendly system);
- A new concept of system integration in a multi-company, reducing the time spent to organize and manage the processes used so far (more results and targets, fewer costs);
- A better performance thanks to real-time data visualization;
- Cutting-edge tools essential for corporate management aimed at continuous improvement in terms of lean manufacturing, increasing the commitment and the collaboration throughout the entire company.

Use Case: The Implementation of an e-Portal Service System

Knowledge Dimension:
Business Model Development
October 2019
Author: University of Padova (Veneto)

GALDI SRL manufactures filling machines and offers added-value solutions for the filling and packaging of milk, dairy products and fruit juice, and are committed to ensure the satisfaction of our customers through ongoing relationships. It has cooperation agreements signed with leading international suppliers in the filling sector, as well as collaborations with universities, e.g. University of Padova and Udine, Polytechnic University of Milan, University of Venice, and other packaging producers. The key activities include R&D to build new products and improve existing ones, production, marketing, personnel training and after-sales services. The firm maintains its relationships with customers by providing personal assistance, creating service centres in existing markets, using salespeople that have strong technical capabilities to propose the most suitable solutions for each customer. Its customer segments are the worldwide producers of liquid products in the food sector (e.g. milk, dairy products and fruit juice) and they are reached through different channels like Salesforce, distributors, agents, business units located in the target market, and international fairs.
The main strategic issue behind the implementation of the project is that maintenance and post-sale services play a major role in the choice of the supplier. Therefore, clients evaluate potential suppliers not only based on the product but also on the associated services. As far as post-sale services are concerned, the possibility of offering an e-portal significantly contributes to bridging the gap of capillary presence within and outside the Italian borders, which is typical of SMEs compared to large firms that are more likely to have different branches in different countries.
To solve this issue, the firm needs to find an alternative way of providing clients with a high-level service that is easily accessible from everywhere. To this purpose, an e-portal is created, through which clients could get access to post-sales services that exploit also the potential of some Industry 4.0 technologies, as augmented reality to instruct clients on actions to maintain their machines or change some parts, among many others.
The top management believed in the project and pushed it forward very strongly, trying to change the culture of how the firm could create value for the clients. The implementation of the project is affecting the growth of the firm because offering a wider range of services allows the firm to acquire new clients and increase client retention, which also leads to a change in the business model as depicted below.
The projects modified the business model along different components:

- The value proposition pushes offering service solutions along different formula beyond the selling of products.
- New partners become important for the firm, mainly providers of digital solutions.
- Activities other than the production are included among the key activities, i.e. design of the service, development of the e-portal, analysis of data collected through the e-portal.
- Some new key human resources have been hired with the specific purpose to work on this and other related projects.

- The relationship with customers is fostered overall after the sale experience through the e-portal and in the future an associated app will be added.
- This project is attracting new clients, basically located more distant from the headquarter, or simply interested in the service offered together with the product.
- The e-portal becomes another channel through which the firm can sell spare parts, as well as share materials and information with customers and there is room for further improvement in this sense.
- Some new costs emerge, as licensing of the software, costs for the development of the platform (both internal and for consultants). At the same time, there are some costs that are saved thanks to the project, that are costs associated to the handling of order management and costs for covering travel expenses for technicians going to clients for after-sales services
- The revenues related to the services the firm can offer through the e-portal are increasing significantly.

Use Case: The Client at the Core with Digital Transformation

Knowledge Dimension:
Business Model Development
November 2019
Author: University of Padova (Veneto)

CARON A&D, founded in 1988 Giovanni Caron, is a leading construction company of hydraulic systems, in particular in the construction of shaped, flexible tubes, fittings and hydraulic systems with main headquarter in Pianezze (VI). The owner decided to take over the company of one of its suppliers, which then became precisely the CARON A&D. This step was crucial in deciding to set up the business exactly as they, as customers, had asked for years. The company has two key principles taken from the lean philosophy, i.e. identifying what creates value for customers and eliminating what does not create added value for the customer.

AVM related challenges of the firm:

- Digital transformation of the company's business model and get comparative advantage in the sector.
- Transforming the company from being a small subcontracting company to becoming an industry leader with the ability to attract important customers nationwide and internationally.

Among the most important steps towards transformation the main two are the following:

- The creation of the so-called Caron Production System (CPS) that, inspired by the Toyota Production System, brought the company to adopt all business management techniques according to lean principles, following a model of organization that has the client at the core. Digitization has played a fundamental role in supporting the change, starting from the kanban bar code reader to the customer-supplier kanban that allows pre-assembled kits to reach the plant of the customer in a synchronized way with the progress of the production line, cancelling stocks for both the customer and the company. In 2011, this system is further improved, thus having a digitized/online kanban for the management of activities and projects taking advantage of a visual component through big screens. This solution has allowed visualizing, controlling and optimizing the workflow in real-time. On this bases, an EDI web (Electronic Data Interchange) is developed, obtaining a twofold advantage: the first internally, making processes more efficient in terms of costs and waste reduction, and the second externally, increasing integration with B2B customers and thus improving the service offered. In fact, „virtual rooms" are created with the customer where they can exchange and manage shared electronic documents using any electronic device. In this way, the service is maximized as the lead-time to execute the customer's request is shortened, errors are reduced and the customer experience is enhanced, and, at the same time, resources are called to perform less low added value activities and they can be dedicated to activities having a higher added value.
- The second step in the transformation process of CARON A&D takes shape in the revolutionary CARON-TE project that is modifying the business model of the company. The acronym TE derives from the terms Technology and Evolution which represent the cornerstones of this project that combines technology and organization, since the two things alone could not stand. It is also undeniable to say that CARON-TE gives the immediate perception that it is something built on you (TE in Italian means "you"), where „you" repre-

sents the customer. This project consists of a small factory located in close proximity to an important client to offer the highest service level possible for the client itself. This approach is gaining much interest both in Italy than abroad, which suggests that CARON A&D has found a correct interpretation to expand its market in and beyond the national borders, sewing up the solutions offered by Industry 4.0 used as a support to the firm strategy and business model innovation.

Use Case: Management as a Team

Knowledge Dimension: HR/Organisation
July 2019
Author:
Universität der Bundeswehr München (Bavaria)

The OpTIX GmbH is a medium sized company based in the east of Germany founded in 1967 and has developed to a manufacturer of components for precision lasers and other optical measurement equipment. The company employs 230 people mainly working at the headquarter and the production facility. The production line is highly automated, but the market is very competitive. Offering good service in addition to high quality products is one of OpTIX key selling points. Maintaining high standards and customer satisfaction is a high value, keeping the OpTIX competitive. This high level of product quality and service requires excellent personnel, on all management levels and on the shopfloor.
Maintaining its market position and its competitiveness is one of the main goals of almost any company, but especially in a market this competitive, highly trained and highly motivated personal is essential. Unfortunately finding successors or additional managers and other personnel in leading positions turned out to be a difficult task for the company. An innovative solution, maintaining the high quality and ideally also maintaining the company values had to be found.
"The best managers come from within the company. They know the company, the values and culture." – K. Heinz (HR Manager)
Instead of hiring managers with a high degree of experience demanding high wages, OpTIX decided to train their own managers using a tandem system and exploiting generational knowledge. Senior managers, who were interested in reducing their workload or fading into retirement, were offered to reduce time and share it with a junior manager who would either have been recruited directly from universities or selected from existing staff. Each of the tandem partners works 60 percent, leaving a one day overlap for knowledge exchange and staff meetings. This way there is always at least one manager in the office, so that work does not pile up. Both partners share the responsibilities and work on the same topics using a cloud system to share data and coordinate. The subordinates are not divided, but report to either of the managers equally depending on which manager is currently in the office. This system allows the tandem partners to each play their strengths and profit from their partners knowledge and capabilities. The Senior managers can pass their knowledge on to their successor, so that it is not lost to the company when they retire, and the next generation can introduce innovation to the company within a controlled environment in this way of coworking.
Of course, this way of coworking also has its risks. The tandem partners must be good teamworkers and good communication is essential, the implementation of cloud-based sharing of documents helps ensure that work is not redone by accident. Regarding leadership, both, the senior and junior manager must agree on their strategy and management style towards the employees they lead and must work as one entity. Another topic in the implementation of such a system was the accountability. Even though each of the partners is entitled to make decisions accountability must always be ensured.

Use Case: Paperless Logistics

Knowledge Dimension: HR/Organisation
September 2019
Author:
MMag. Marielis Beham (Biz-Up, Upper Austria)

Hummer GmbH is an upper Austrian SME in the logistics sector. Their main competences are: Transportation of goods, roadside assistance and renting of vehicles. From cars to 3,5t trucks. Their drivers are mostly employed in Austria. This makes them rather expansive in comparison to their competitors. Good performance and high-quality services are the reasons, why customers choose Hummer over rival businesses. It is necessary for them, to keep quality high and in line with technological developments. To emphasis the drastic improvement a digital solution provides – per logistics contract a 2 cm high pile of paper is generated (delivery notes, advice of receipt, carrier's receipt, pallets receipt, etc.), which all have to be

scanned and archived for at least 10 years. Shifting this to a single digital input, many time-consuming tasks could be axed.
Hummer quickly realized that the usability of the available systems on the market is terrible and much too time-consuming for their needs. Therefor they contracted an IT-Consultant to design their own digital solution. It took the consultant two months to get the real time system up and running, which took too long for Hummer GmbH. Also, communication between Hummer GmbH and the consultant was troublesome. A very technical approach is necessary to get the consultant to properly understand the requirements of a product. Luckily on Hummers side, the person responsible for supervising the development understood the subject, therefor could communicate with them better. But it was still a difficult process.
In all the changes Hummer GmbH has gone throughout the years, the first reaction from staff was "I don't need that". Resistance was a common occurrence. Three to four people in the company actively opposed the new digital processes while the rest passively resisted the change. Active opposition ranged from simply not using the system and relying on paper still up to not getting familiar with the app while complaining, that one does not understand how it works. The innovation assistant tried to get people to accept the new system by emphasizing and demonstrating its benefits while keeping any technological barriers low. Also being patient with all alleged "system errors", which were in reality caused by the user, helped a great deal. The new system needed to pe re-explained to employees' countless times.
Now Hummer GmbH is using both systems (digital and paper) simultaneously only where absolutely needed because of regulations and customer wishes. The resistance amongst staff in this section is now gone and staff really like to use the new app. The biggest lesson learned was that sequence matters! Hummer GmbH digitalized pre-existing processes. Through this they discovered many flaws and inefficiencies in these processes which had been implemented into the digital version as well. The first step should have been to optimize the processes and then build the digital system around these already optimized processes. Hummer GmbH did not do this and had to do/pay for redundant work.

Use Case: Virtual Twins & Sales Team at Plant Construction Company

Knowledge Dimension: HR/Organisation
March 2019
Author: Institut für Arbeitsforschung und Arbeitspolitik an der Johannes Kepler Universität Linz (Upper Austria)

Mr Plant is the managing director of Plant Construction Company. The organisation operates in the construction of plants and machinery for the manufacturing sector and was founded around 50 years ago. They have been very successful in their field and list well-known organisations as their customers. Plant Construction Company constructs plants for different industries, such as the automotive industry, the furniture industry or the sports industry. As the machines and plants constructed by the firm are usually integrated into serial production processes, the size and order volume of the machines are both high. Employees of Plant Construction Company have to meet their customers frequently to clarify the demands and create a concept of the machine or plant prototype.

Figure 8 Sales and Production Process at Plant Construction Company

In the early definition stage, deliberate consideration and detailed planning is required in order to define how a machine or plant has to look like, what features have to be added, which criteria of the interface has to be included or what design is necessary. After the first product development stage, the illustration and the detailed description of the plant or machinery help customers to develop another more precise description. At this stage, the adaption of illustrations, descriptions and the detailed enhancement are happening recursively before the actual construction of the plant or machinery can start. Indeed, in some cases a prototype with further attention to details has to be developed. It is thereby insufficient that only people from the sales department are in contact with the customer and employees from production complement the sales team. The process continues with the construction itself and often ends with an initial training at the customer to ensure that employees are able to effectively work

with the newly developed machine or plant. Very often the revision or rectification of the machine or plant is later bought in addition.
Plant Construction Company employs about 900 highly qualified workers. Around 20% of them have worked at the organisation for more than 20 years and most of them had already done their apprenticeship in the company before that. At the moment, around 70 trainees are allocated within different departments of the firm. According to Mr Plant, it is very important for the staff to have a deep and broad knowledge in mechanical engineering nowadays. Therefore, not only the trainees, but also all other employees are encouraged to work in other departments. For instance, the company's organisational job rotation programme offers the possibility that one employee of the distribution department can work in the production line for a few weeks or the other way around. Due to the rotation process, employees learn to truly understand how other areas of the company work and consequently gain a holistic understanding of organisational processes. Thus, the firm tries to ensure both, a high specialisation as well as a general understanding of the organisation among their employees. Although the Plant Construction Company offers a workplace rotation programme, the main challenge for its employees is to meet the needs of customers and to assure that the machines work according to their desired purpose. This is quite a difficult task as the machines are often designed for completely new tasks and future production lines and processes. Especially the fact that most products only exist as prototypes is a challenge for the firm. Sometimes a prototype is even redesigned more than once and consequently the machine has to be adapted to these changes. Therefore, the process of the customers' machine definition is highly complex and affiliated with high costs.
The main challenge for Plant Construction Company is to send the right person with the right knowledge to meetings with its customers in order to define how the machine or plant has to look like, what details have to be added and whether a special design is desired in as few appointments as possible. The challenge for Mr Plant is finding a possibility to shorten the phase of machine or plant planning without the risk of revising machine details which were already agreed on previously. First steps have been taken in order to tackle these challenges. Plant Construction Company has already installed a software programme for virtual twins in which the machine or plant can be designed and evaluated digitally and in real-time well before the construction of the machine starts. This circumstance offers both the costumer and Plant Construction Company the possibility to review every detail of the plant before it is constructed. Consequently, adaptions can be done early on in the definition stage and not like now in the initial training stage. In addition, improvements in the sales process have been made. While previously most of the time only one person held meetings with the customer and was supported by other employees when necessary, it is now a whole team that is available for customer requests. The sales support team consists not only of employees from the sales department, but also from the design and production department as well as employees from the system installation team.

Use Case: Company Brand and Recruitment

Knowledge Dimension: HR/Organisation
July 2019
Author:
Universität der Bundeswehr München (Bavaria)

The Soft GbR is a Munich based software company, which was founded in 1996 and has constantly grown since. The company is a leading service provider for the development of project- and service- management systems for the optimisation of processes especially concerned with machinery and plant engineering. The company has 56 constant employees of which the largest part are software engineers. The Soft GbR is a service-oriented company, its employees develop easy to use and individualised software solutions together with the customer. This means, that the software engineers are simultaneously also account managers with a high volume of customer contact. The employees are the companies most important assets but finding qualified personnel and maintaining the staff is not an easy task. Software engineers are scarce on the labour market and the selection of suitable candidates is crucial to the company's success.
"Our customers come to us because we can offer highly individualised software solutions and the customer can co-design their product together with our developers. This requires very good personnel which is not always easy to find." R. Klotz (CEO)
To display the attractiveness of the company, the Soft GbR created a video giving a virtual tour

through the office and work environment, introducing the advantages and the future colleagues to potential applicants. This video was shared via social networks, technology blogs, technology forums and displayed on tech-events to create a company brand and introduce the company to the minds of young software talents. Finally, the Soft GbR invited software engineers to participate in an online coding challenge, using those same channels, offering job interviews to the best applicants.

This innovative approach gave the company access to a pool of young talents and created a sustaining attractive company brand within the mindset of the technology community. In order to maintain its attractive standing, the company regularly makes appearances on technology related online platforms and participates in discussions and coding events. The number of applications grew rapidly, and the recruitment of high-quality personnel became much easier due to the well-known company brand.

Teaching Cases

Teaching Cases describe complex real-world situations where a decision maker has to solve a particular problem. These situations are often told from one manager's point of view and contain more than one challenge. Information is often incomplete, conflicting, ambiguous, redundant or irrelevant. Through these characteristics, teaching cases represent the day-to-day tasks of real-world managers as they try to make sense of a complex and dynamic world in order to make decisions for an unpredictable future. The InnoPeer AVM programme aims at engaging participants to develop alternative solutions for the described issues and thereby allow working on real problems and solutions close to participants' experiences and challenges. Apart from the experiences and knowledge that can be shared among participants, teaching cases enable the practical application of concepts taught in the basic and advanced courses of the training programme. Participants gain meta-level competences necessary for any kind of managerial decision-making. The method used for solving a teaching case (i.e. problem identification, development of alternative problem solutions, assessment of alternatives, selection of one alternative, development of implementation strategies) can be used as guiding principle for any kind of problem and therefore improves the capacity for analytical thinking and enhances solution competence in complex settings.

A set of basic and advanced teaching cases comprising the three knowledge dimensions – technology, human resources & organisational management and business model development – has been developed as an absolute novelty for all levels of the InnoPeer AVM qualification programme. The cases reflect AVM challenges of regional SMEs in CE and allow for problem-based teaching through a well-designed set of training assignments. While basic teaching cases were developed for the use in the InnoPeer AVM basic trainings, the advanced teaching cases contain more complex information and are used in the online advanced courses. The teaching cases were prepared by collecting empirical data (i.e. interviews) and secondary sources (e.g. homepages, press releases, news articles) from selected CE case firms. Each teaching case describes an AVM-related project and the challenges that firms encountered in its implementation as well as possible solutions to resolve the problems. Additionally, questions for discussion – based on theoretical concepts – aim at giving training participants the opportunity to work on the identified problems in an applied fashion. Basic teaching cases additionally include teaching notes (i.e. possible solutions to solving the teaching cases). For the advanced teaching cases, commented explanations in the form of moderated webinars that were held together with training participants are available on the VHB learning platform.

Get access to the set of basic teaching cases and teaching notes here!

Basic Teaching Cases

Get access to the set of advanced teaching cases here!

Advanced Teaching Case: Aspects of Organisation

Advanced Teaching Case : Aspects of HRM

Advanced Teaching Case: Aspects of Business Model Dev.

Advanced Teaching Case: Technology Advanced, Part 1

Advanced Teaching Case: Technology Advanced, Part 2

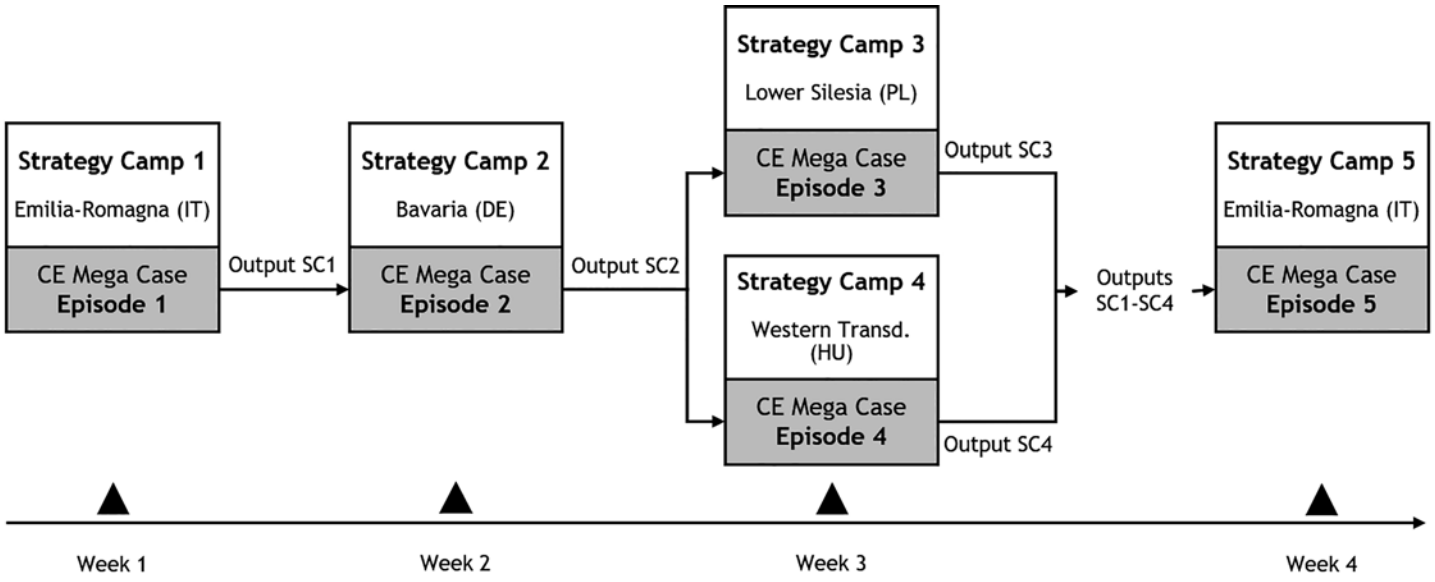
CE Mega Case

The Central European Mega Case illustrates challenges of SMEs in a transnational AVM value chain and has been specifically developed for the practically focused InnoPeer AVM strategy camps. The strategy camps are based on five interconnected "episodes" of an interactive game (i.e. the CE Mega Case), which takes place in different Central European regions. Figure 9 shows the general logic of the AVM Strategy Camps and their connection to the Mega Case and depicts an exemplary illustration for the piloting of Strategy Camps in Emilia-Romagna, Bavaria, Lower Silesia and Western Transdanubia during the InnoPeer AVM project.

Get access to the CE Mega Case here!

CE Mega Case

Figure 9 Exemplary Logic of the CE Mega Case



The general plotline of the CE Mega Case (see Figure 10) is a short depiction of the different firms in each episode and their interconnection with each other in the frame of a transnational value chain. The general plotline helps participants to understand the connections of firms with each other in order to be able to generate output that is useful for other the respective subsequent strategy camps. Precisely, within the Mega Case, each episode deals with one (fictional) firm in one region that faces an explicit challenge in a defined operational setting. All firms are part of a transnational AVM value chain. The goal of each strategy camp is the formulation of a strategy that includes the definition of potential solutions to the predefined challenges in each episode. Challenges vary and concern different actors and operators in a value chain that spans across different countries of Central Europe. Using a design thinking approach, the conceptualisation of the problems and challenges as well as the corresponding solutions respectively are developed by the strategy camp participants during each episode.

Figure 10 General Plotline of the CE Mega Case

CE Mega Case Episode 1

Meccanica Avanzata
Emilia-Romagna (IT)

Meccanica Avanzata S.r.l. is specialised in precision mechanics producing powertrain components (gearbox and clutch mechanical elements). The firm is able to deliver customised high-performance components with a 5% faster time-to-market than the average, mainly because of its flexible manufacturing systems and the use of additive manufacturing for fast prototyping. One of its main customers, *Bavarian Powertrain*, wants to shift its production focus towards the electric car market and to establish a more flexible production system. How can *Meccanica Avanzata* rethink its value proposition and business model to remain part of *Bavarian Powertrain*'s new value chain as well as the global car sector?

CE Mega Case Episode 2

Bavarian Powertrain
Bavaria (DE)

Bavarian Powertrain GmbH (BPT) is a powertrain manufacturer and Tier-1 supplier for OEMs in the luxury sports car segment who aims at entering the electric car market with the help of additive manufacturing technology to obtain higher production modularity and to reduce the weight and the total number of the components used. Entering the electric car market, *BPT* not only faces a change in product, but also in its production processes. Based on the adapted value proposition of *Meccanica Avanzata*, how can the firm integrate additive manufacturing in their production process with an optimised organisational design for the expansion of the product portfolio and the adaption of the production capacities?

CE Mega Case Episodes 3 & 4

RapidPro
Lower Silesia (PL)

RapidPro Sp. z o.o. is a producer of additive manufactured (AM) complex and lightweight components and is equipped with the most state-of-the-art AM installations. The recent request of *BPT*, a long term customer, to support them in better integrating AM technologies in its production is out of *RapidPro*'s usual offer, but the implementation of a technology transfer support service to consult customers in terms of AM stands for a challenging business opportunity. The challenge is to extend the business model to include a consultancy service for AM technologies integration while maintaining the production of high-quality AM components. How can *RapidPro* define a functional strategy for delivering a technology transfer support service based on the demands of *BPT* and for a later extension to different sectors?

Fireball Solution
Western Transd. (HU)

Fireball Solution Kft. is a software firm specialised in the development of ERP systems. There is increasing demand for integrating Industry 4.0 and Internet of Things (IoT) solutions into the customers' ERP systems for condition monitoring and predictive maintenance of (additive manufacturing) machinery. However, the internet connection of the ERP-system raises data security issues amongst client firms because the data are uploaded into *Fireball Solution*'s cloud, where also data analyses (i.e. monitoring and real-time warning) are performed. The acceptance for the modified products consequently needs to be increased. Especially with regard to their long term customer, *BPT*, how could a marketing plan for selling the IoT-supported ERP system look like?

CE Mega Case Episode 5

Transnational Value Chain Wrap-Up
Emilia-Romagna (IT)

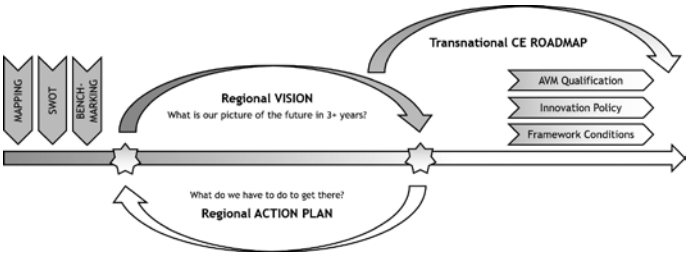
In a strategic meeting, representatives of *Meccanica Avanzata*, *Bavarian Powertrain*, *RapidPro and Fireball Solution* gather together to discuss the entire value chain that spans across the involved Central European firms. Together, the firm representatives provide a description of the updated value chain that encompasses the changes that occurred within and between the firms and define possible collaboration agreements between the four European companies that can optimise their interactions in order to increase the added value they can offer on the market.

About Regional Action Plans

Regional action plans present an elaborated set of proposed innovation support actions for each of the project partner regions to ensure a sustainable transfer of the InnoPeer AVM project results into the regional innovation ecosystems of CE partner countries. The action plans are based on former project activities and results, such as the local framework conditions, the mapping of relevant key stakeholders and the analysis of strengths and weaknesses in the relevant knowledge dimensions (technologies, human resources/organisation and business model development) that were performed for each partner region and summarised in a joint benchmarking study in earlier project phases. Further inputs for action planning result from local pilot actions that were implemented within the frame of the project for testing the multi-level InnoPeer AVM training curriculum in order to enable CE SMEs to become part of transnational advanced manufacturing value chains.

The action plans are structured into three analytical steps: the development of regional visions which describe the pursued picture of the future situation in the relevant field in a mid- to long-term perspective, the elaboration and description of recommended innovation support actions to disseminate the project results at the level of the partner region's innovation ecosystem in a short-term perspective and finally the presentation of conclusions from the partner region's perspectives on innovation policy actions that are needed for a sustainable transfer of the InnoPeer AVM results at the transnational CE level. In peer review processes with project partners, AVM board members and other stakeholders, the action plan documents were continuously revised and improved. The inputs from the regional action plans of all CE partner regions were finally accumulated to develop a transnational Central European Roadmap that recommends joint innovation policy action in order to improve the qualification of SMEs in the AVM-related knowledge dimensions and to raise their involvement in transnational innovative value chains (see Figure 11).

Figure 11 Overview of the InnoPeer AVM Action Planning and Road Mapping Process



Upper Austria

In Upper Austria, three challenges and according action plans to tackle them have been identified. First, while there are world market leaders in providing or applying innovative technological AVM solutions present in the region, the knowledge transfer from these front-runners to less innovative companies (typically SMEs) is not consistent. To close this gap, it is necessary to overcome SMEs' restraints to design or apply innovative technologies by developing services in the fields of information gathering and capacity building related to innovation management. Second, Upper Austrian SMEs face challenges not only with implementing, but also with operating, maintaining and further developing AVM technologies due to a shortage of skilled workers (e.g. software and IT experts). In order to compete on the market and to counter a skill deficit in the long term, SMEs have to invest in their innovative capacities by creating networks that are open to outside labour integration as well as develop their HRM capacities that emphasise new recruiting, development and organisational design practices. The InnoPeer AVM project, together with supporting regional initiatives to secure skilled labour, can advance SMEs' AVM qualification and knowledge transfer. Third, high-potential patents in highly competitive markets with expected relevant revenue are crucial for regional innovativeness. This is contrary to the prevailing assumption that the quantity of patents alone can be taken as an indicator for the innovative capacity of a region. A positive long-term economic impact can only be achieved through the development of innovations and according intellectual property rights that have sustainable and valuable benefits for its applicants.

Bavaria

The Bavarian Region has a very strong position in Germany when it comes to machine building,

car manufacturing and Industry 4.0. This is due to large enterprises having their headquarters in Bavaria, such as Siemens or BMW in Munich and Audi in Ingolstadt. But while these companies have a very competitive position worldwide, there are two major issues: On the one hand, there are already strong competitors such as the USA or Japan and rising nations such as China, on the other hand there is a huge gap regarding the application of Industry 4.0 technology between larger and the small or medium enterprises (SME). With these issues in mind, the Bavarian project partners worked out a Regional Action Plan with concrete challenges, visions and actions. The challenges are about improving the already strong position in artificial intelligence and cybersecurity worldwide, improving the knowledge transfer between large enterprises or "front runners" towards smaller enterprises, the so called "laggards". Another challenge refers to the strong focus on technological progress in Germany instead of thinking about the changes in terms of organizational and HR management. The visions are therefore to become the worldwide market leader in applying Advanced Manufacturing Technologies and being a "unicorn factory", which means to have lots of innovative start-ups with huge market capitalisations following the example in the Silicon Valley. It is also important to have a strong market base and stay one of the market leaders in automation technology. To achieve these visions, the Bavarian partners suggested actions on how to transfer AVM knowledge by using stimulating cooperation, a clusterforum and the MechatronikAkademie. To tackle the challenge regarding lacking organisational and HR knowledge, the capabilities in these knowledge dimensions could be improved by establishing a culture of continuous change and flexibility, which is open to dynamic changes through technology.

Emilia-Romagna

Emilia-Romagna is the third most exporting region of Italy. Europe, USA and Asia count among the region's main reference markets. Mechatronics is the core industrial asset of the regional economy and Industry 4.0 is an evolution of this manufacturing specialisation as necessary as it is natural. The Regional Action Plan defined for Emilia-Romagna within the InnoPeer AVM project aims mainly at supporting the local industries to implement the digital transformation of their business activities. The defined interventions focus on three main issues. First of all, there is the necessity to improve the level of digitalisation of the production processes of the single local firms and of the value chains which they belong to. To this end, the Regional Action Plan proposes to build two supporting tools for the local companies. On the one hand, a training programme blending theoretical knowledge on Industry 4.0 technical and organisational solutions provided through an on-line course and practical experimentation relied on experiential labs. Secondly, digital tools and capacities should be also exploit in the organisation and management of the personnel itself. For this reason, the Regional Action Plan foresees a training course on Human Resources Analytics and change management of work habits and the development of a network of practitioners of HR and change management to share managerial best practices. Finally, the digital transformation envisioned by Industry 4.0 is not simply a further optimisation of the industrial productions, but a structural redefinition of the business models and strategies of the companies. A specific action is then present in the Regional Action Plan, which targets the management level of the local firms to help them to innovate their business models through training courses and personalised/open-innovation-based supporting programmes focused on business design and testing.

Veneto

The RAP for Veneto Region has identified two main challenges: one related to the technological field and aiming to extend the application of I4.0 from processes to products, the other related to the human resources and organisational dimensions and linked to the need to increase innovation level in SMEs. Connected to these challenges, the plan outlined three main visions: one aiming to promote support actions for training, related to the new needs that I4.0 is presenting, the second targeted to increase opportunities for aggregation, launch of transversal fertilisation processes and the creation of long-lasting collaborative relationships among companies and between companies and research organisations, the last one aiming to increase the export percentages of regional companies, facilitating the purchase of support services for internationalisation. To reach its objectives the plan foresees to gather together the local business support organisations and the research organisations in the implementation of an awareness campaign aimed to support companies and their aggregations in the development of initiatives in line with the visions identified. These initiatives should be possibly financially supported by

the Region. There is also an opportunity to open this process to an international framework, thus allowing for a Central Europe dimension. Actually, this would mean to develop the existing regional instruments in order to open them to the participation in an international context. In doing this it would be very much useful to utilise the experiences gained by the implementation of the InnoPeer AVM pilot actions.

Lower Silesia

Three main challenges for the development of the AVM industry have been identified in the regional action plan for Lower Silesia in Poland. The first concerns the achievement of a high level of investment in R&D by local SMEs. It was noticed that companies are reluctant to cooperate with external R&D centres, which is related to investing in some financial resources. Equally, with high resistance, the costs associated with creating own research and development departments within companies are perceived. A precise vision has been defined: reaching the level of 50-60% of SMEs investing over 2.5% of revenues in R&D activities. In order to achieve this vision, actions related to raising awareness in companies about the long-term benefits of investing in R&D are proposed. This will be done through specialised training for local companies' employees. The next two visions are related to raising the competences of employees in the area of IoT and enhancing the establishment of partnerships among SMEs from the Lower Silesia region. Expanding IoT skills can be accomplished through specialised training containing theoretical knowledge and practical skills. In order to establish a regional partnership between companies, it is suggested to implement an educational program combined with workshops, consulting in the field of fundraising, ideas market and mutual development.
Summing up the regional action plan, suggestions were made for the Central European Strategy Roadmap. The first concerns increasing the level of awareness of the importance of advanced manufacturing technologies and deepening expertise in the field of these technologies. The second concerns the increase in the competitiveness of SMEs, which will contribute to the increase of their value in the long-term development perspective.

Western Transdanubia

The RAP for Western Transdanubia region has identified three main challenges: one of them is the shortage of production capacity caused by the crisis in 2008 when plenty of SMEs went bankrupt or minimised their production. Since then, the demand for production has increased again, but the technology became outdated and applying novel technologies is available only at some companies. The second main challenge in this region is the shortage of labour force, which is strongly connected to the shortage of production capacity, therefore it is requiring simultaneous interventions at various levels of the businesses – not just on a micro-level, but also on the policy level. The last challenge which had been identified in the RAP is the lack of business process integration it is really hard to ensure that SMEs recognise the importance of collecting, evaluating and integrating data because the datasets are born in different systems and these so-called islands of information are independent and not connected to each other. Therefore, the development of the process-integration procedures is crucial. Connected to these challenges, the plan outlined three main visions: one aiming to improve the level of smart production among Hungarian SMEs; the second targeted to improve the level of automatization with special attention on human resources the last one aiming to increase the innovation capacity among SMEs. Based on the identified challenges and visions within the RAP has defined three innovation support activity that could be implemented in the region. These activities' main aim is to provide a solution for the labour shortage and to improve the level of innovation within SMEs through training services by applying the latest digital technology to create value for the manufacturing sector in a financially, socially and technically sustainable way.

Strategy Roadmap

The InnoPeer AVM Roadmap is based on research done and stakeholder workshops held by the partnership as well as consultations with the InnoPeer AVM Advisory board. The main goals of the roadmap are:

- to generate sustainable AVM/I4.0 business cases in CE companies
- based on successful digital transformation and change management
- enabling CE companies for enhanced integration in transnational Industry 4.0 value chains
- in order to strengthen the position of Central Europe within the European Digital Single Market

The strategic frame for InnoPeer AVM roadmapping is formed by the megatrends in digitalisation, the European strategies for the digitalisa-

tion of industry and a Central-European strategic perspective up to 2030 and beyond on who to reach the expected impact on Central European companies in terms of implemented digital business cases and return on investment as well as increased competitiveness and strengthened positioning in digital value chains. In line with the Interreg DTP programme goals and the specific objectives of the InnoPeer AVM project the roadmap is focused on the development and sustainable establishment of strategic qualification paths to build up the capacities of Central European companies in the process of digital transformation.

The roadmap recommends further development and mainstreaming of the qualification programme developed by the InnoPeer AVM project in two directions:

- InnoPeer AVM basic courses with focus on three key competences (i.e. in the fields of digital technologies, human resources development and business models for SMEs) proved to be a suitable instrument to (1) provide general orientation for newcomer companies at the beginning of their digital transformation and (2) use add-on modules in vocational training or as upskilling lessons for unemployed workers etc. Therefore, further widening of dissemination target groups is the recommended strategic approach to spread basic digitalisation knowledge across Central Europe.
- For the advanced online courses and specialised practical courses developed by InnoPeer AVM, the piloting experience shows that further specialisation and demand-orientation will be useful to generate enhanced benefit for participating companies e.g. in in-house trainings. The same advanced level of teaching material will be needed for integrating InnoPeer AVM modules in existing or adapted higher education or academic trainings. On this basis, the project partnership recommends to (1) implement the dual InnoPeer AVM approach of combining advanced theoretical training modules with practice-oriented knowledge transfer in the higher education system and (2) continue offering InnoPeer AVM trainings (advanced + practical modules) for the specific upskilling demand of Central European companies, for instance in a cooperation between innovation agencies and regional further education institutions.

In support of national digitalisation strategies of Central European countries, the InnoPeer AVM partnership delivers recommendations and suggestions for improved SME support in the Regional Action Plans for each of the partner countries. Consultations and joint activities with the newly established InnoPeer AVM Board are sustained at partner region level and in annual tele-conferences organised by the InnoPeer AVM partners. Further enlargement of the AVM board is also foreseen in the context of new EU-funded projects to enlarge the number of high-ranked advisors and scope of board activities in order to further increase the visibility of the Central European agenda in digitalisation of SMEs at the European level.

As a step towards sustainable positioning of InnoPeer AVM project results at the transnational Central-European and European level, the project consortium has set up cooperation links with ongoing EU-level initiatives, e.g. with Digital Innovation Hubs which started their operation in many Central European countries during the lifetime of InnoPeer AVM. Further sustainability actions concern the development of follow-up projects to be submitted in future calls of European and national programmes.

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