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Final report on impact analysis of SME participating in pilot actions

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1. Introduction

1.1. Aim of the Report

The aim of this report is to present the findings of the implemented accessory assessment programme for analysing the impact of AVM capacity building on participating SMEs. Precisely, we will show the results of the impact analyses during pilot action implementation to identify typical development paths and key success factors of regional AVM-based businesses. We thereby present an aggregated analysis of *all* trainings (i.e. basic and advanced trainings, strategy camps and model factories), including not only the short-term evaluation (t1), but also the long-term evaluation (t2) of the InnoPeer AVM pilot actions. The analysis is based on the methodology and procedures developed in D.T3.3.2 – jointly developed methodology for analysing pilot action impact on participating SME. In D.T3.3.5 and D.T3.3.6, we assessed adaptations in SME structures and emerging innovation activities in the short-term (t1) for the basic trainings and the strategy camps respectively. Relevant results of these deliverables are highlighted at idiosyncratic points of this report.

This report proceeds as follows. First, we briefly describe the method of the accessory assessment programme. Second, statistics on training participants and participant firms are presented. Third, we will show the results of the short-term evaluation (t1) that was conducted immediately after each training. Fourth, the findings of the long-term pilot action evaluation (t2) that was conducted 3-6 months after each training will be outlined. Finally, we will critically discuss prominent relations and implications for the InnoPeer AVM training programme.

1.2. Methodology of Impact Analysis

Before presenting the results of the impact analysis, this section will describe which evaluation design and tools have been deployed for evaluating the pilot trainings. To assess reaction and learning in the short-term as well as behaviour and results in the long-term, quantitative (i.e. questionnaires) and qualitative tools (i.e. semi-structured interviews) were used within a longitudinal study design carried out at two points in time, at t1 (directly after the trainings) and at t2 (3-6 month after the trainings) (see Figure 1).

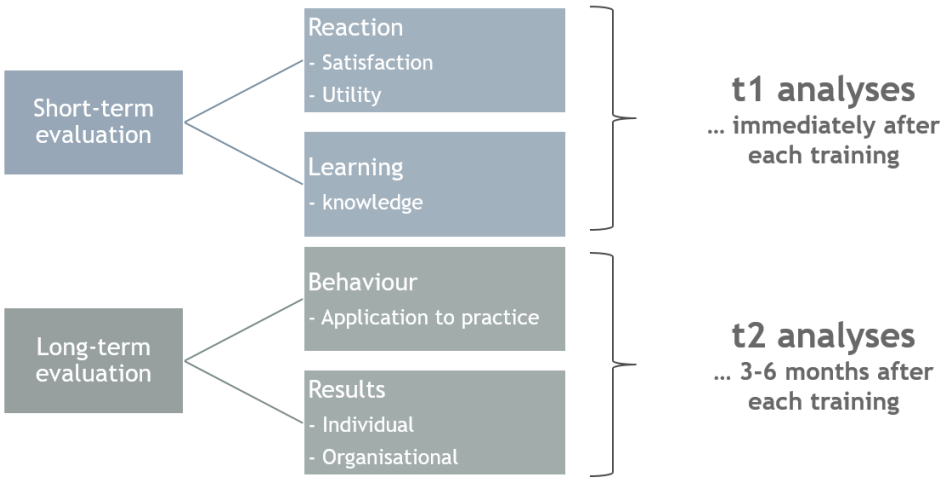


Figure 1 Dimensions of evaluation according to Kirkpatrick's 4-level training evaluation model[1]

[1] Illustration modified from Grohmann, A. & Kauffeld, S. (2013): Evaluating training programs: development and correlates of the questionnaire for professional training evaluation. *International Journal of Training and Development, 17* (2): 135-155.

Table 1-4 provide an overview of the tools that were used for the impact analyses conducted at t1 and t2.

Basic Trainings		
Time of evaluation	**Tool for impact analysis**	**Results reported in…**
t1 (immediately after each training module)	Questionnaires	Mid-term report D.T3.3.5 Final report D.T3.3.3
t2 (3-6 months after the last training module)	Semi-structured interviews	Final report D.T3.3.3

Table 1 Tools for Impact Analysis of Basic Trainings

Advanced Trainings		
Time of evaluation	**Tool for impact analysis**	**Results reported in…**
t1 (immediately after each training)	Online survey	Final report D.T3.3.3
t2 (3-6 months after each training)	Online survey	Final report D.T3.3.3

Table 2 Tools for Impact Analysis of Advanced Trainings

Strategy Camps		
Time of evaluation	**Tool for impact analysis**	**Results reported in…**
t1 (immediately after each training module)	Questionnaires Written Assignments	Mid-term report D.T3.3.6 Final report D.T3.3.3
t2 (3-6 months after the last training module)	Semi-structured interviews	Final report D.T3.3.3

Table 3 Tools for Impact Analysis of Strategy Camps

Model Factories		
Time of evaluation	**Tool for impact analysis**	**Results reported in…**
t1 (immediately after each training module)	Questionnaires Written Assignments	Final report D.T3.3.3
t2 (3-6 months after the last training module)	Semi-structured interviews	Final report D.T3.3.3

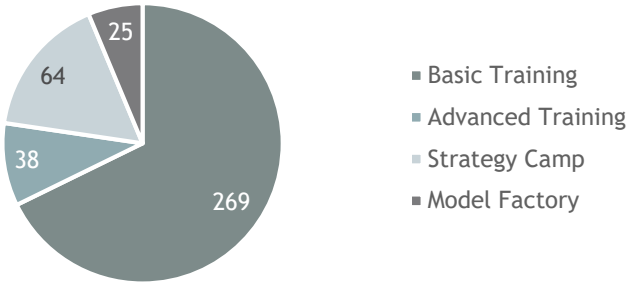
Table 4 Tools for Impact Analysis of Model Factories

During the t1 evaluation of the strategy camps and the model factories, the project partners additionally provided short summary, i.e. a written assignment, to give an overview of prominent contributions of participants from practice, the typical development paths and key success factors of SMEs and lessons learnt from the pilot training.

1.3. Number of Evaluated Responses and Training Participants

In total, 397 questionnaires from the t1 evaluation and 61 responses from the t2 evaluation have been assessed and analysed for this final report. 3% of all received responses were not included because they were incomplete and therefore not suitable for the analysis. Figure 2 shows that around two thirds (269) of all t1 questionnaires were answered by basic training participants. We have furthermore received 64 responses from strategy camp participants, 38 from advanced training participants and 25 from model factory participants. Figure 3 shows the number of responses received in the t2 analysis. As in the t1 evaluation, the highest contribution came from basic training and strategy camp participants, but not in such a high amount as in t1. Unfortunately, the t2 response rate from the advanced trainings and the model factories was lower than initially expected. Partly, this relates to a delay of these trainings during pilot action implementation as well as the exceptional situation that companies found themselves during the COVID-19 crisis.

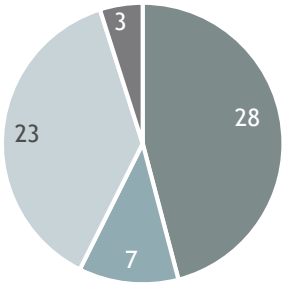
Evaluated number of t1 questionnaires
(according to the type of training)



Total t1: 396 responses

Figure 2 Evaluated questionnaires of t1 depending on the type of training in total numbers

Evaluated number of t2 questionnaires
(according to the type of training)



Total t2: 61 responses

Figure 3 Evaluated questionnaires of t2 depending on the type of training in total numbers

In general, the high response rate of basic training participants can be explained by the fact that all six project regions have organised two basic training rounds (strategy camps and model factories only took place once in the respective regions). Due to a high demand in Upper Austria, even a third round of basic trainings was organised and conducted there right before the COVID-19 lockdown. The low response rate of advanced trainings can be related to a generally low commitment for filling in online surveys – as opposed to the print surveys that were handed out right after the physical trainings. Regarding the model factories, only two of three took place as planned. Due to the regional COVID-19 regulations, the third had to be held via a live online webinar session which took place in the beginning of May. Not only because of the altered conditions of organising this training, but also to remain within the time constraints for finalising this report, we did not conduct t1 nor t2 evaluations for this online model factory session.

Table 5 gives an overview of the different regions in which the InnoPeer AVM trainings took place. As advanced trainings are accessible only online, they cannot be dedicated to a specific region.

Region	Basic training	Advanced training	Strategy camp	Model factory
Upper Austria (AT)	3	Transnational online training		
Bavaria (DE)	2		1	1 (online)
Veneto (IT)	2			
Emilia Romagna (IT)	2		2	1
Lower Silesia (PL)	2		1	1
Western Transdanubia (HU)	2		1	

Table 5 Number of organised trainings per region

The advanced trainings are split up into 5 different modules:

- Aspects of Human Resource Management (HRM)
- Aspects of Organisation (ORGA)
- Aspects of Business Model Development (BMD)
- Aspects of Technology, Part 1 (TECH 1)
- Aspects of Technology, Part 2 (TECH 2)

The participants of the different advanced course modules are located across various regions – mainly within the EU, but also beyond (e.g. Russia). The partner regions in which the on-site trainings took place thereby seem to be particularly densely represented. Figure 4[2] gives an overview of the enrolled advanced training participants according to the thematical modules (HRM, ORGA, BMD, TECH1, TECH2) and shows the distribution of interest of the offered training modules. Moreover, it displays the number of persons who received/downloaded a certificate after successfully completing the training module. The HRM and the ORGA courses – which went online first – show the highest enrolment numbers and also feature the most certificate holders. Interestingly, the TECH 2 course, which went online last, has a higher number of participants than TECH 1 and BMD. Frequent combinations of courses include HRM and TECH 2 (135 times), followed by ORGA and BMD (75 times) and HRM and ORGA (49 times). 33 participants enrolled to all of the 5 InnoPeer AVM training modules.

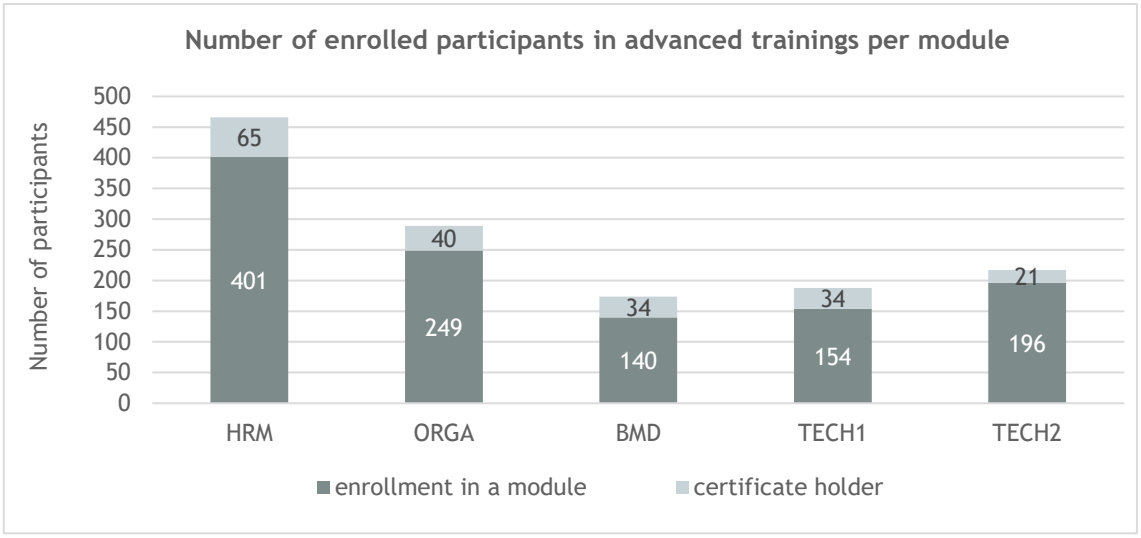


Figure 4 Number of enrolled participants in the advanced training

The interest for the InnoPeer AVM training programme during pilot action implementation was very high as can be seen in Figure 5[2]. In total, 1084 persons have participated in one or more of the offered trainings. Precisely, the participation in the individual trainings splits up as follows:

- Basic trainings: 281 participants
- Advanced Trainings: 713 participants (without double-counting participants who joined more than one course module)
- Strategy Camps: 64 participants
- Model Factories: 25 participants

[2] Effective on May 14, 2020

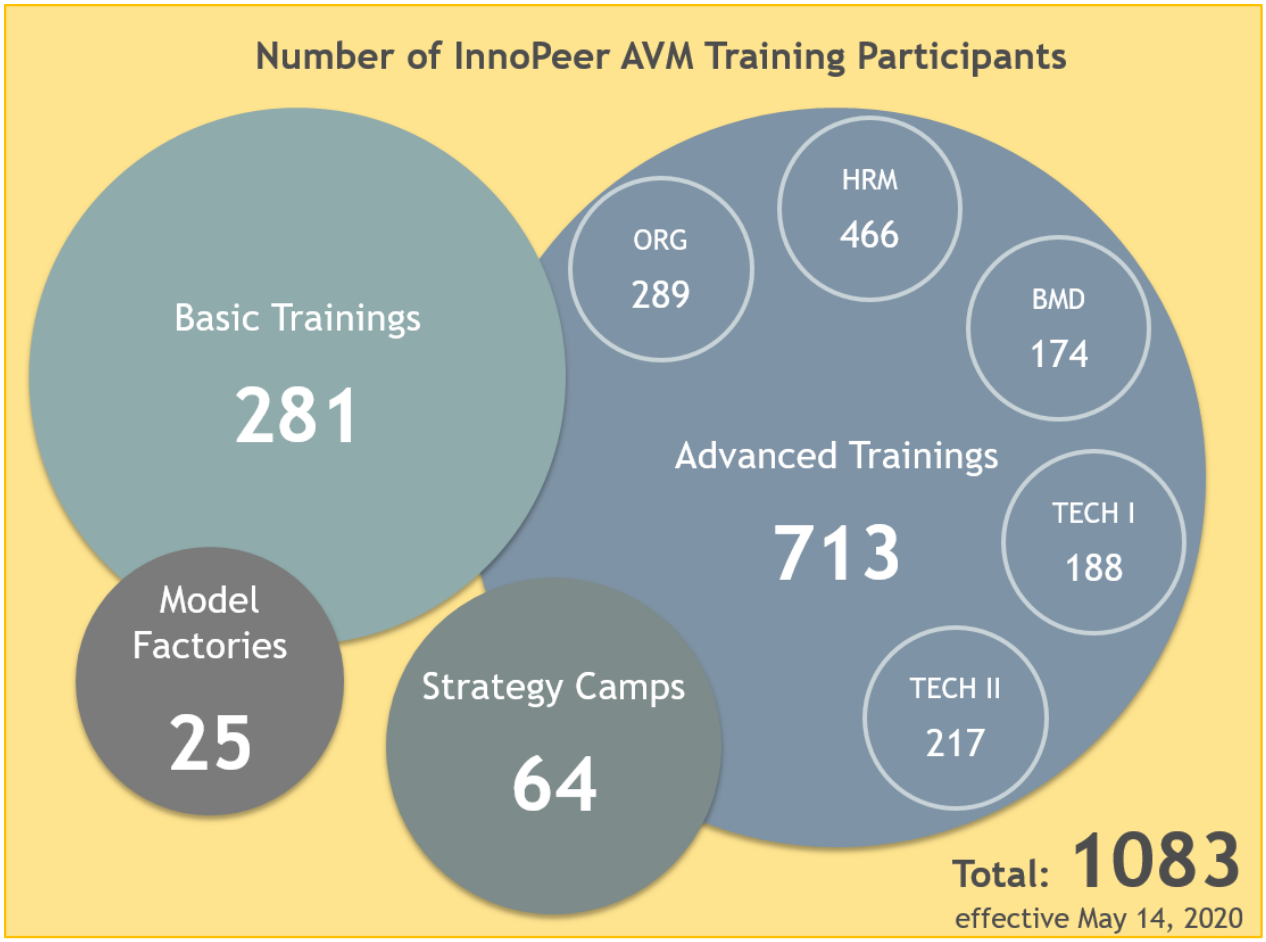


Figure 5 Number of all training participants

2. Statistics on Training Participants and Companies

This chapter deals with the characteristics of the participants, their companies and industries across all trainings.[3]

2.1. Participant Characteristics

The following section describes the proportion of participating men and women, participants' average age, their level of education, the level of their personal work experience, their job function as well as their practical experience related to topics of AVM.

First of all, 80% of the participants were male, while only 20% were female. Looking at regional differences, Lower Silesia had the highest number of male participants (94%) and Upper Austria the lowest (75%). On average, participants are 40 years old, whereas the youngest was 16 and the oldest 62 years. Across trainings, it shows that on average the participants of the model factories are the youngest (33 years) whereas participants of strategy camps are the oldest (42 years). Participants of basic trainings (39 years) and those of advanced trainings (40 years) are slightly younger than strategy camp participants. A quick look

[3] The results refer to data obtained in the t1 evaluation only. The respondents of the t2 evaluation were randomly selected from the respondents of the t1 evaluation, which would have led to a double-counting of results.

on the average age per region reveals that in Emilia Romagna participants are the oldest (43.4 years) and in Western Transdanubia the youngest (34.3 years).

Furthermore, work experience is high with an average of 9.5 years, whereby 42% of all participants have a working experience above 10 years. Only 29% are "newcomers" in their jobs with 0-3 years of work experience. On average, InnoPeer AVM training participants have been dealing with AVM topics for 6.2 years. Only 17% have reported that they have little or no AVM experience at all, whereas nearly the same percentage (16%) stated that they have at least 10 years of AVM experience. In general, it was observed that training participants are highly educated – 80% hold a university level degree (see Figure 6).

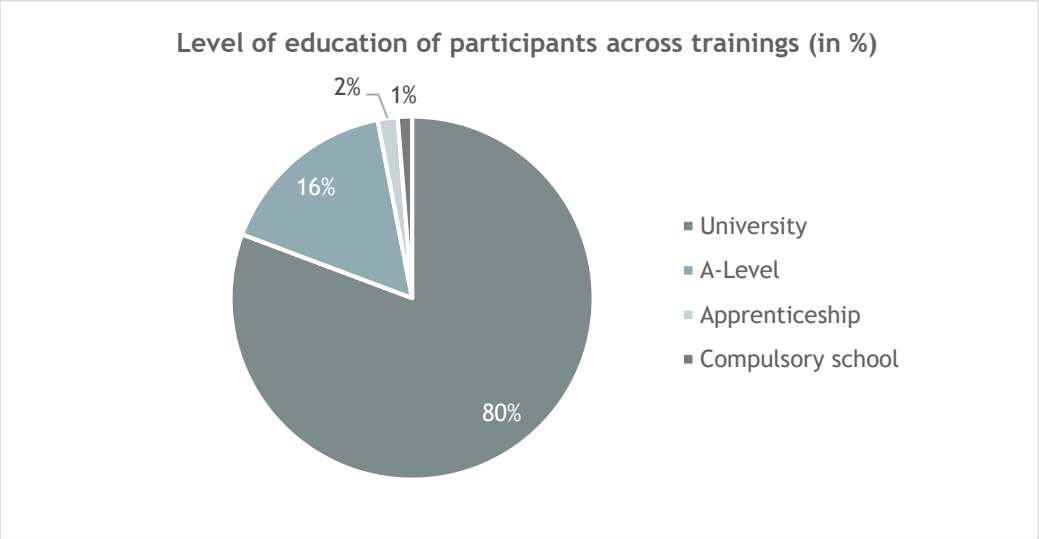


Figure 6 Level of education of participants

Training participants hold diverse positions in their organisations. We have classified these job positions into five different categories. This classification ranges from an employee with classical operative tasks to a top-level manager. The category "first-level manager" encompasses jobs such as office manager, shift supervisor, department manager, foreperson, crew leader or store manager. "Middle-level managers" include positions as general manager, plant manager, production manager, regional manager or divisional manager. The category "top-level manager/owner" covers senior managers, executives and owners. The category "others" subsumes jobs such as HR specialist, coordinator, consultant, ICT responsible, R&D coordinator or student/intern. Overall, the findings show a relatively balanced dispersion across different job positions (see Figure 7).

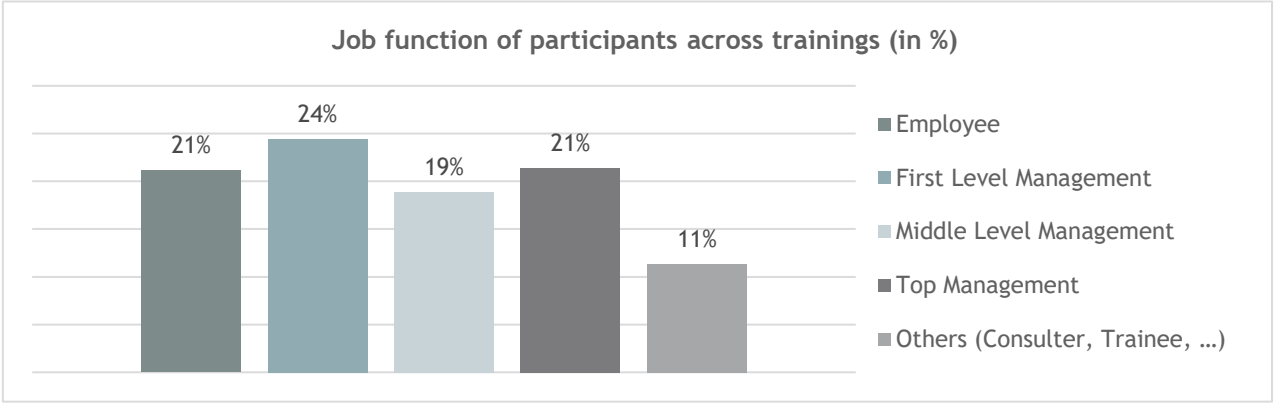


Figure 7 Job functions of participants

2.2. Firm Characteristics

Training participants were asked about their firm's industry sector, the annual turnover and the number of employees. In this report, we use the criteria defined by the Upper Austrian Federal Economic Chamber[4] to classify the firms according to size: microenterprise (up to 9 employees, turnover ≤ 2 million euros), small-scale enterprise (up to 49 employees, turnover ≤ 10 million euros), medium-scale enterprise (up to 249 employees, turnover ≤ 50 million euros) and large-scale enterprise (above 250 employees, turnover > 50 million euros). The results are described below.

Figure 8 reveals that 58% of all participating companies are smaller than 250 employees. Consequently, more than half of the participants' companies can be classified as small- or medium-scaled enterprises which are the target group of the InnoPeer AVM project. Still, nearly one quarter (24%) of the participants work in large-scale enterprises. This implies that interest for the InnoPeer AVM training programme is not limited to SMEs.

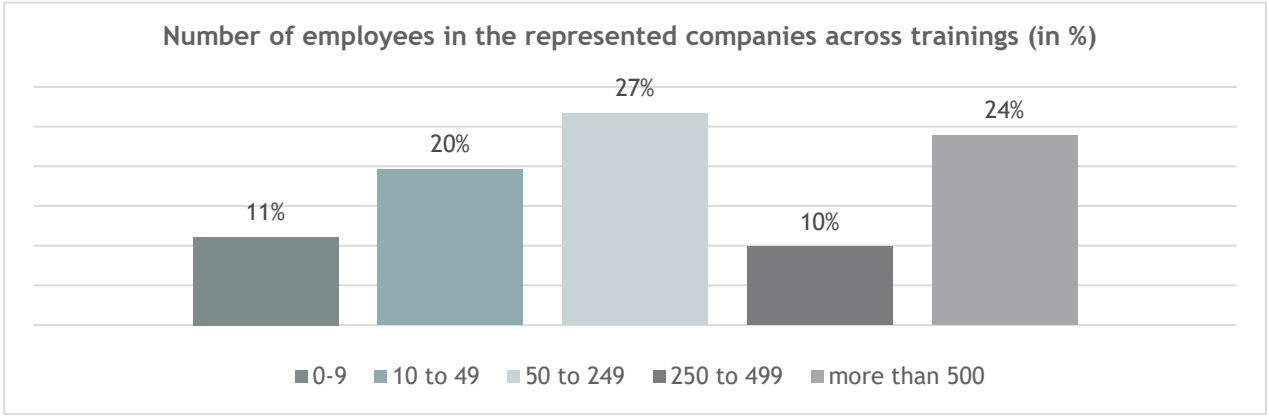


Figure 8 Number of employees of participating companies

Figure 9 shows the annual turnover of the represented companies. While 40% of them had a yearly turnover of less than 10 million euros, a third of all companies had at a turnover of more than 50 million euros per year. These findings go hand in hand with the results above and reveal that although the initial target group was the SME sector, many larger organisations or companies could be reached too.

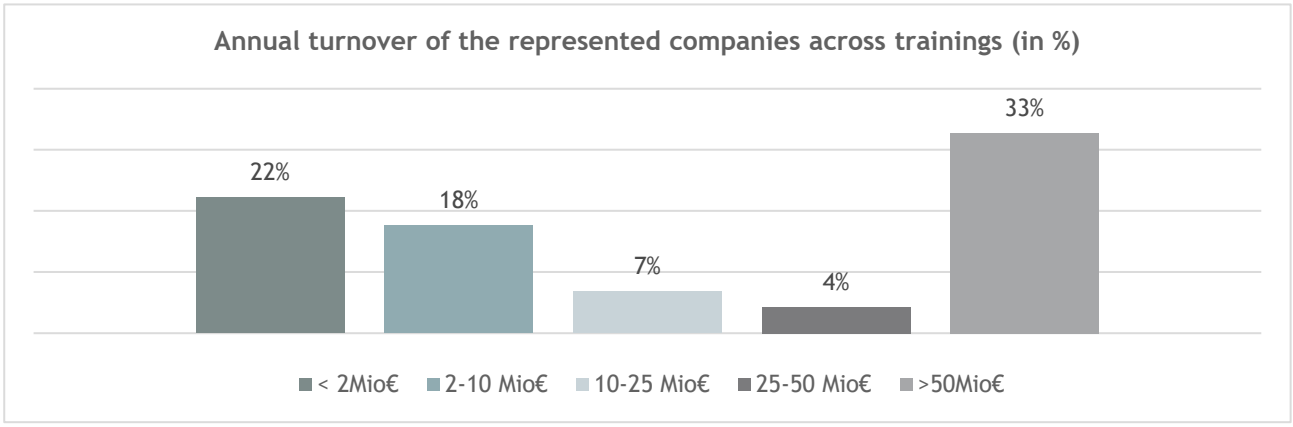


Figure 9 Annual turnover of participating companies

[4] See website of the Upper Austrian Federal Economic Chamber https://www.wko.at/service/zahlen-daten-fakten/KMU-definition.html

Because the main target group of the InnoPeer AVM qualification programme are SMEs in the manufacturing sector, the NACE classification was applied in the evaluation survey. Participants were asked to which of the following categories their company belongs:

- 25. Manufacture of fabricated metal products, except machinery and equipment,
- 26. Manufacture of computer, electronic and optical products,
- 27. Manufacture of electrical equipment,
- 28. Manufacture of machinery and equipment n.e.c.,
- 29. Manufacture of motor vehicles, trailers and semi-trailers, or
- 30. Manufacture of other transport equipment.

As already revealed in the mid-term reports D.T3.3.5. and D.T3.3.6, many participants were not able to choose an industry sector in this list because the training attracted participants from a broad range of branches and industries. Accordingly, the category “others” is quite high (40%) and most prominently covers consulting, IT & ICT and complementary products for machines (incl. hydraulic, oils, chemicals & finishing). Figure 10 shows that almost a fourth (23%) of participating companies is operating in machinery and equipment sector while 12% fabricate metal products, except machinery and equipment.

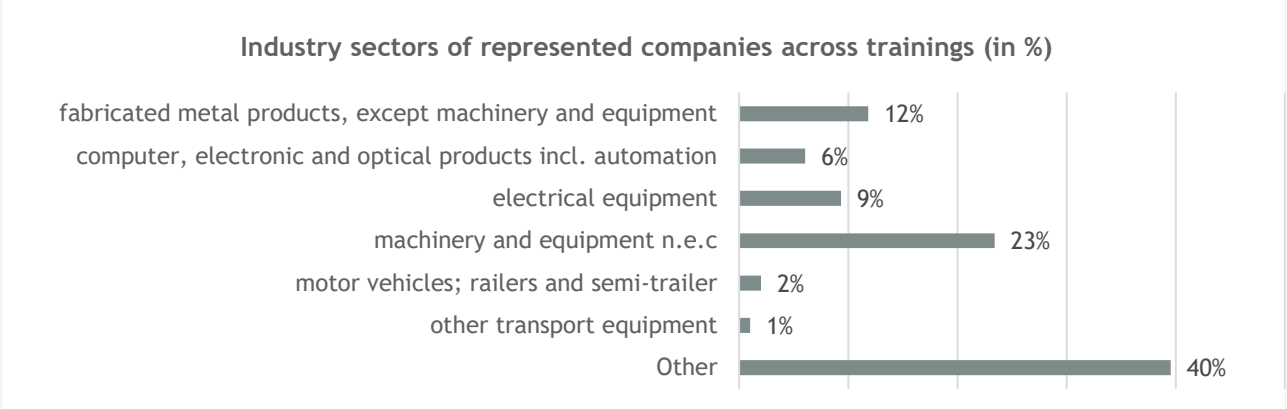


Figure 10 Industry sector of participating companies

3. t1 Evaluation Results

In this section, the results of the t1 analysis are presented. Precisely, the evaluation of the participants regarding the content in general, the organisation and progress of the training, the extent of new knowledge, the usability and transferability of the knowledge, the differences between the training and the expansion of the previous knowledge about AVM will be shown. In addition, we will present topics that were found most useful and interesting as well as subjects that should have been addressed in more detail. Finally, the results give an overview of prominent contributions/challenges of participants from practice, the typical development paths and key success factors of SMEs and lessons learnt from the pilot training.

The results are broadly consistent und nearly congruent throughout the different trainings (basic training, advanced training, strategy camp, model factory). Because of the neglectable differences between the means across trainings in relation to the total mean, we here refrain from showing idiosyncratic differences across trainings. Rather, the aggregated results depicted in

Figure 11 show that overall the participants gave very positive feedback - all means being above 7.5. Most positive feedback was received on the dimension of organisation and method of the training as well as on the general impression that the participants will keep the training in good memory and that the training added value to the whole InnoPeer AVM training curriculum. Furthermore, training participants are satisfied

with the amount of newly gained knowledge, the usability of provided knowledge for work, the better understanding regarding AVM-related strategies after the training and working with the teaching cases and the CE Mega Case respectively. In general, the analysed means in the basic and advanced trainings were lower than in the practical trainings (i.e. strategy camps and model factories). Moreover, while the means of the basic and advanced trainings are mostly below the total mean, the ones of the practical trainings – especially of the strategy camps – are above the total mean.

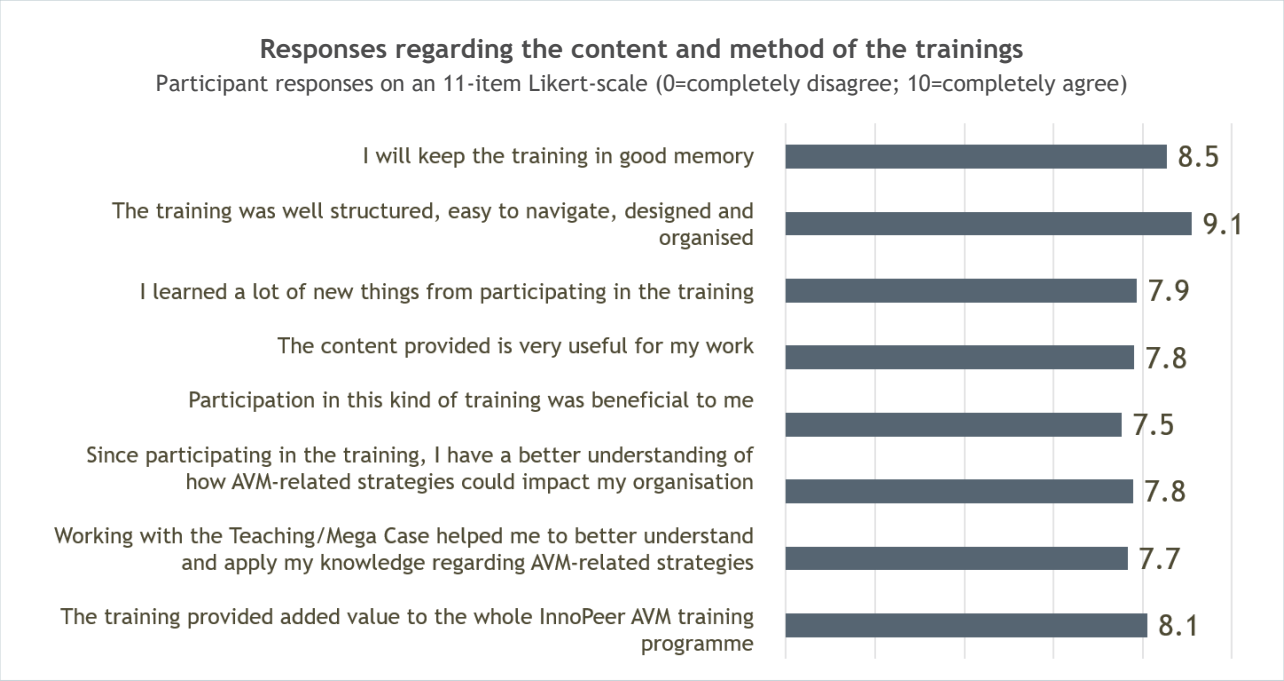


Figure 11 Responses regarding the content and method of the trainings

The question *"Participation in this kind of training was beneficial to me"* also shows a similar picture – basic training and advanced training are below the total average mean, while the mean of the practical trainings remain above (see Figure 12). However, in contrast to the other dimensions, the mean of the different training types here distinctly deviates from the total mean. Advanced training participants appraise this dimension the worst in comparison to other training participants. In contrast, model factory and strategy camp participants gave higher responses to this statement. A possible explanation for this deviation is that the direct interaction with people input and knowledge can be better transferred and understood as this is the case in an online training.

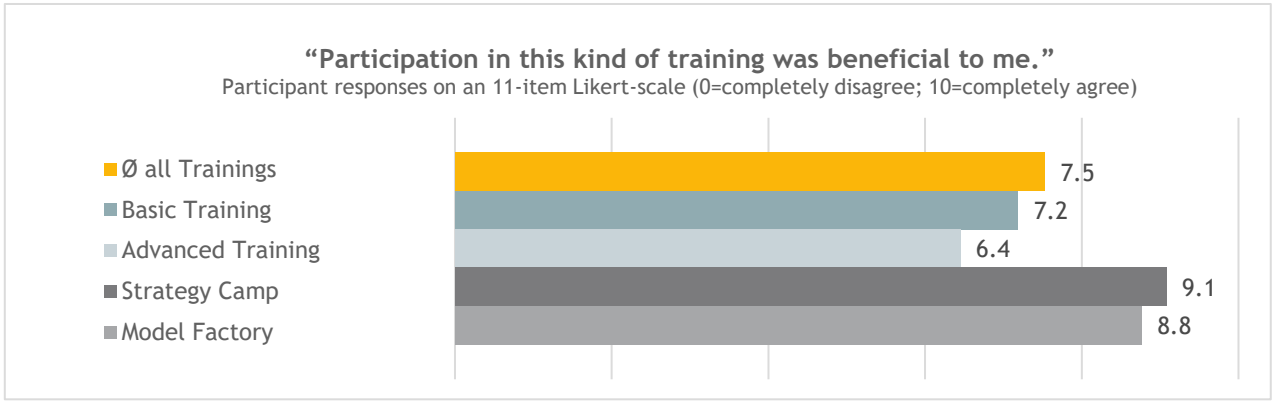


Figure 12 Perceived utility of the trainings

Finally, we want to point out some regional specificities of the t1 evaluation. Regarding the results of the basic trainings, participants of Lower Silesia have reported by far the highest values, whereas Veneto and Western Transdanubia generally exhibit the lowest means. A similar tendency became obvious in the analysis of the strategy camps. While Lower Silesia is again the region with the highest means, participants of Emilia Romagna and Western Transdanubia estimated the asked dimension significantly lower. The means of the model factories reveal that there are hardly any regional differences. The question *"I learned a lot of new things from participating in the training"* constitutes the only exception. In line with the results obtained in the basic trainings and strategy camps, participants from Lower Silesia reported a significantly higher mean than Emilia Romagna.

Most useful, interesting and neglected subjects

The answers of the participants to the open questions of the t1 evaluation have been qualitatively analysed and categorised and are presented in this section. The participants were asked, which topics they found most useful[5], which ones interested them most[6] and which could have been addressed in more detail[7]. While we briefly summarise the findings of the mid-term reports D.T3.3.5 and D.T3.3.6, additionally mentioned topics according the three presented open questions that were not reported there were categorised into the three knowledge dimensions of the InnoPeer AVM training programme: (1) Strategy and Business Model Development (BMD), (2) Human Resource Management (HRM) and Organisation (ORGA) and (3) Technology (TECH). Table 6 summarises these findings.

	Subjects useful to tackle challenges	Most interesting subjects	Subjects to be addressed in more depth
Strategy BMD	▪ strategic planning ▪ value chains ▪ BMD ▪ ERP	▪ ERP ▪ agile structures ▪ design thinking	▪ strategy implementation ▪ marketing and AI ▪ best practice examples for innovation and production
HRM ORGA	▪ recruiting ▪ HR planning ▪ organisational structure ▪ AVM process planning ▪ paradoxical leadership	▪ resistance to change ▪ change management ▪ leadership ▪ knowledge development	▪ talent development ▪ communication ▪ project management ▪ process optimisation ▪ leadership related to AI
TECH	▪ machine connectivity ▪ dynamic manufacturing processes ▪ mass customisation	▪ cloud computing ▪ connectivity ▪ big data	▪ AI ▪ blockchain ▪ big data ▪ human-machine interfaces ▪ 3D-printing ▪ simulation

Table 6 Most useful, interesting and neglected training subjects

Subjects useful to tackle challenges. With regard to the usefulness of the topics, participants were asked to name training subjects that helped them to tackle the identified challenges. As already stated in D.T3.3.6, participants of the strategy camps saw value in the theoretical inputs and knowledge they gained during the strategy camps. Participants named similar subjects as participants of the other training types. Especially the Business Model Canvas, the change management roadmap and the competency map helped them to get a better understanding of the challenges they face within their companies. Additionally, inputs

[5] Asked question: Which training subjects could you use to tackle the challenges you identified above?

[6] Asked question: Which subjects did you find particularly interesting in the online training course?

[7] Asked question: Which subjects would you have liked to be addressed additionally, more in depth or differently?

on how to implement, manage and develop an organisation when facing challenges caused by new technologies are seen as important learnings derived from the strategy camps. A range of topics that were covered in all trainings received positive feedback by participants as to how useful they are for application in practice. For Strategy and BMD, the subjects useful to tackle challenges were especially issues on strategic planning, value chains (e.g. in the context of internationalisation, globalisation), BMD and business models in general, enterprise resource planning and value stream mapping. The inputs on business models, specifically digital business models and the business model canvas are inputs tools regarded as valuable to ongoing business operations. In the HRM and ORGA dimension, topics such as recruiting, HR planning (e.g. with regard to lack of skilled labour), organisational structure, collaboration, production planning tools, AVM process planning but also paradoxical leadership (i.e. leadership to enable strategic agility, practices for creative solutions and fast decision making) were mentioned. As most useful topics in the dimension of TECH, machine connectivity, dynamic manufacturing processes and mass customisation were reported. In the t2 evaluation, participants referred to the technology module and emphasised valuable insights on 3D printing, sensors, cloud computing, UPC UA and cybersecurity. Moreover, participants reported that the topics covered in the case study identify problems, inputs and learnings that are applicable to their own company. Furthermore, one participant highlighted the opportunity to see the production process with its own eyes.

Most interesting subjects. Regarding the most interesting topics, participants of the basic trainings were asked to name their interests and state the most interesting topics which were dealt with in the training. The results of D.T3.3.5 have already revealed that all dimensions and subjects that were covered in the basic trainings received positive feedback. Subjects that were specifically found to be interesting by several basic training participants were Internet of Things (IoT), 3D Technology, Additive Manufacturing, Business Cases and the Business Model Canvas. The analysis of the other trainings has shown that these topics were also interesting for participants of the other training types. What was found to be most interesting in the dimension of strategy and BMD were again enterprise resource planning system, agile structures and the design thinking approach which could actually be used by the companies as concrete methods to tackle certain challenges. For HRM and ORGA, the topics of managing resistance to change, change management in general (i.e. to manage the transition towards digitalisation), leadership during change (e.g. paradoxical leadership) and knowledge development (not only on an individual level, but also on an organisational level to get from the individual to the organisational knowledge) were found to be most interesting. In the TECH dimension, cloud computing, connectivity, big data, technology and data security were depicted as most interesting subjects.

Subjects to be addressed in more depth. Lastly, participants were asked for subjects that they missed or topics that should have been addressed more in depth. In D.T3.3.5, the wish for more than one teaching case per dimension as well as for more practical examples during the lectures was already revealed. This finding was confirmed for the other trainings. According to the feedback from the participants of the basic training, the topic of Industry 4.0 as a whole should be evaluated from different points of view and integrated as such in the training programme. For instance, participants of the basic training are additionally interested in gaining knowledge about employees in 4.0, the risks of Industry 4.0 or different scenarios or consequences of Industry 4.0 (e.g. where and why Industry 4.0 could lead to employment or unemployment in the future). These subjects were partly reviewed in the other trainings. For strategy and BMD, the topic of strategy implementation (i.e. not the formulation of a strategy, but how to actually implement a formulated strategy) was especially missed. Additionally, the topic of marketing and the role of AI would have been interesting in this regard and also more best practice examples for triggering innovation and production as well as cost reduction. In the HRM and ORGA dimension, talent development and communication (i.e. transparent communication especially in change processes) are topics that should have been more addressed. Moreover, in the t2 evaluation, participants stated that the topic of change management should have been covered in more depth, especially with regard to how to point out advantages of AVM to employees, get them on board with digitalisation and handle their concerns. Furthermore, project management in general (e.g. usefulness of setting up smaller project teams that are specifically dedicated to AVM related projects), process optimisation, leadership related to AI (here was the question if leadership

becomes actually obsolete with AI or not), dynamic adaption to changing environments were suggested as topics to deal with more intensively. For the TECH dimension, again topics such as artificial intelligence, blockchain, big data, human-machine interfaces, 3D-printing, simulation, algorithms for managing production data, industrial clouds, remote control of machines, Internet of Things and TRIZ are requested to be addressed in more depth.

Apart from these findings, the legal aspect concerning new technologies and the concrete integration of technologies in SMEs would have required more attention. Some participants additionally wished for more real-life examples in the courses (e.g. experiences from practice as to how AVM has successfully been implemented, learnings regarding the change process and success stories from hidden champions). All in all, participants seemed to demand a stronger focus on technology in the trainings.

Experiences from the practical trainings

For the strategy camps and model factories, project partners additionally summarised prominent contributions and challenges of participants from practice, the typical development paths and key success factors of SMEs and lessons learnt from the pilot training in "written assignments". The contributions of participants focused on AVM-related challenges and how their practical experience relates to the issues addressed during the trainings while, at the same time, participants were asked to think about certain areas within their company that are most concerned with AVM.

Challenges and contributions from practice

Participants of the strategy camps were encouraged to discuss AVM-related challenges and how they are encountered in practice. First of all, technological developments require novel knowhow which participants acknowledge will change the organisation, their products and eventually impact their business models and strategic direction leading to different work procedures and new challenges for HRM. Many SMEs do not have the necessary knowhow yet. Therefore, feelings of uncertainty among employees are increasingly triggered, requiring companies to develop new tools and motivation systems for employee development in the frame of revised HR-systems. Participants further express their uncertainty about how to successfully integrate their production-centred business models with software solutions without losing current customers, keeping costs low and creating a change process that builds on integration and cooperation. Consequently, also the integration of lead user into development processes can be regarded as a major challenge faced by companies. Lastly, participants of the strategy camps describe that a changing environment with regard to technological standards and resources will become an increasingly dominant challenge in the future.

The focus of the model factories was on the implementation of Industry 4.0 solutions. The participants of the model factory in Emilia Romagna had the possibility to study the solutions adopted by Bosch VHIT and to see them in operation along with the production line. Such solutions are powered by Internet of Things (IoT) and generate a complex array of data that are exploited to manage production and logistics. As a result, participants got familiar to how Industry 4.0 solutions are put into practice and how they can affect efficiency and effectiveness of the production. In their day-to-day work, the challenge of digital transformation especially means problems in understanding the technical aspects of the new solutions, identifying the proper suppliers and partners and designing and managing the transition towards a new organisational model and new working processes. The participants of the model factory in Lower Silesia shared their biggest challenges in a discussion, worked on a case study and visited 'Materialise' to view new product development and implementation of additive manufacturing on a production scale. Two technologies from the powder bed fusion group – SLS (Selective Laser Sintering) and MJF (Multi Jest Fusion) – were subject of this model factory. Furthermore, participants constructed phone holders which were conceptualised in the living labs. The results of the two methods were thereby analysed and compared – making differences between key AVM technologies visible.

Key Success Factors

For SMEs to successfully implement AVM solutions, strategy camp participants listed a variety of factors that are needed. First and foremost, a change in mind set has to take place. This includes the awareness of the need for change as a fundamental baseline for survival in the long run as well as foresight and understanding of technological changes and their impact on future business models and operations. The change in mind set thereby is inevitably linked to adapting strategies and visions in order to effectuate the necessary changes. Furthermore, flexibility, a supporting culture that allows mistakes as well as the active involvement of employees in change processes through participation and skill training were identified as further key success factors in the transition towards AVM.

In the model factories, similar key success factors were identified. Participants learnt how to organise a small internal team dedicated to design and implement Industry 4.0 solutions at production level by exploiting expertise in ICTs and by integrating such expertise with the core production know-how of the company. They also learnt strategies to interact with external experts (e.g. research centres, start-ups, technology integrators), as it is impossible to internalise all the competences necessary to implement Industry 4.0 solutions. Furthermore, the awareness of a change was fostered and advantages of additive manufacturing were shown. Additionally, they learnt a standardised roadmap to follow to implement digital transformation within their companies. A proactive approach can be achieved by showing examples how other companies operate with AVM. This is the biggest impulse to act. Finally, model factories were a good opportunity to get to know how other companies deal with AVM topics and implementation.

Lessons Learnt

In light of the ongoing technological developments, strategy camp participants acknowledged that there is an undeniable necessity for change (“change is a must”). Therefore, participants see a major learning in having received a toolbox of theoretical inputs on certain methods that can be used to trigger certain practical changes within their organisations. One example mentioned was the mapping of competences in order to analyse which areas or skills within an organisation need to be improved. Another explicit theoretical tool participants took away from the strategy camps is the change management roadmap.

In the model factory, participants had the possibility to see IoT-based solutions as well as additive manufacturing processes in action and received an important insight regarding the role of data. Moreover, advantages of the digital model were highlighted. One of the major learnings in the model factory of Lower Silesia was “co-creation”. To reach “co-creation” a cooperation in many dimensions is necessary. The customer, engineer, designer, manufacturer, IT specialist and many others should work together not only to create a new product but to find the best solution.

4. t2 Evaluation Results

This chapter shows the results of the t2 evaluation. For each training, the organising project partners conducted semi-structured interviews based on a predefined interview guideline focusing on which actions for change have been inspired and were actually implemented. At the beginning, the extent of AMV activities within the participating organisations was queried and with whom the information obtained was shared. Additionally, it was analysed in how far the course had a positive impact on the organisations. In particular, what concrete changes are being striven for, how much the extent of innovations has increased or which activities have been initiated based on the knowledge gained in the trainings. Furthermore, it was analysed which additional support would be needed to further advance in AVM and again a general feedback on the trainings.

Since the basic training was the first contact for many participants with the InnoPeer AVM training programme, we specifically asked those participants on selected issues in the t2 analysis. First of all, participants were asked *“who in the organisation endorsed the basic trainings and decided upon your*

participation?". More than 60% of the participants stated to join the training due to their own interest. Around 15% were sent by their superiors and just under 10% due to request of technical management or business develop enterprise. Second, basic training participants were asked *"with whom have you shared the knowledge gained in the basic trainings?"*. The findings show that the knowledge gained during the basic trainings was later shared with different levels of management as well as relevant colleagues (e.g. technical departments or R&D), HR and in some cases even with external project partners. The main reason why information was shared was due to its relevance in ongoing projects or new inputs that were in-cooperated with regard to customer service and product development. Overall, participants were satisfied that a successful knowledge transfer of the inputs they received in the basic trainings took place. More than half (56%) considered the basic training as a comprehensive informative event on AVM. Almost a third (32%) said it was an upskilling event for the following AVM application in the organisation and 12% used the training as a networking opportunity with others from the same line of business. Finally, the results to the question *"on a scale of 0 to 10, what is your own estimation of the level of implemented AVM activities within your organisation before the start of the basic trainings?"* revealed only an average mean of 4.19. Looking at the respective regions (see Figure 13), Veneto (2.5), Emilia Romagna (3.0) and Lower Silesia (3.0) report lower values than Bavaria (7.0), Upper Austria (6.3) and Western Transdanubia (6.0).

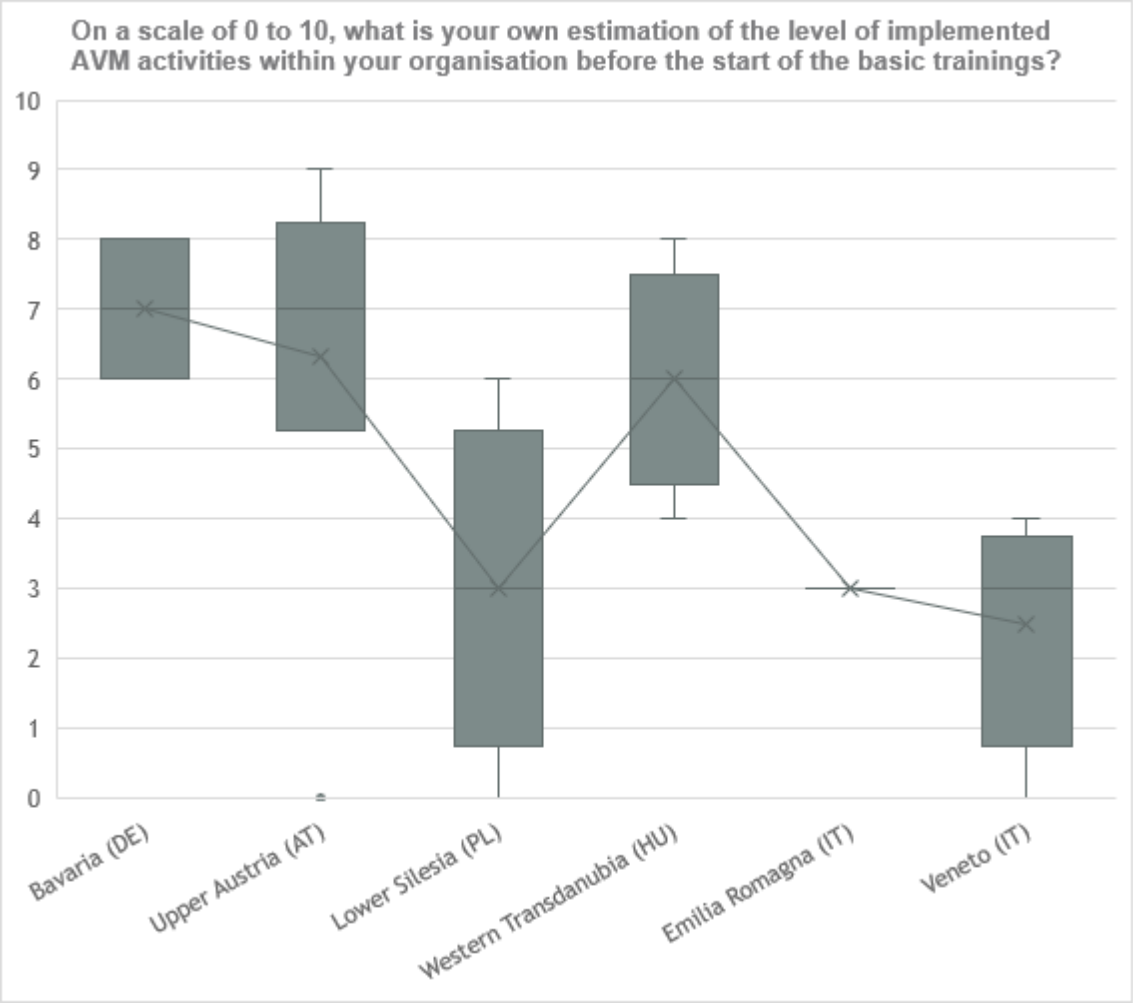


Figure 13 Implemented AVM activities prior to training

Regarding the question of how much participants have already been dealing with AVM-related topics prior to the training, Figure 14 shows an average value of 5.9. This number is mainly influenced by the answers of the basic training participants as they represent almost half of the total sample. The means of strategy camps (7.0) and model factories (7.0) were found to be above the average values.

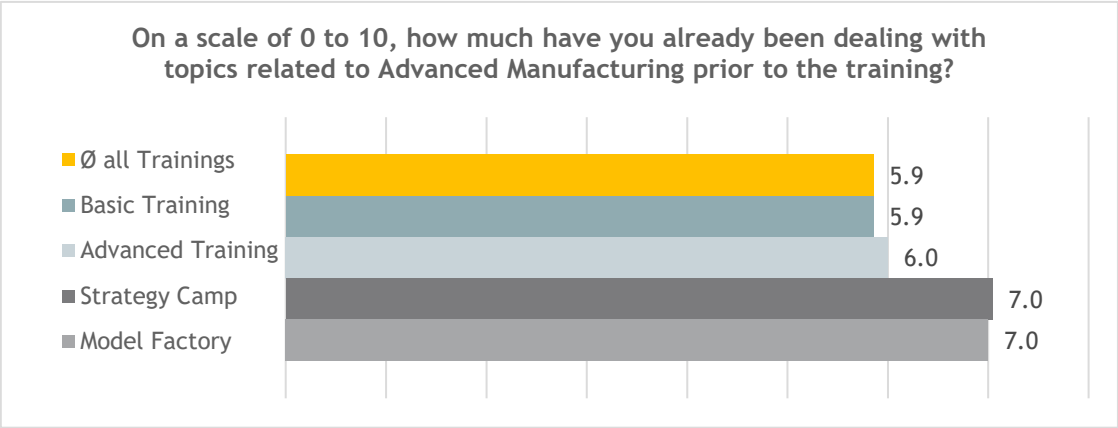


Figure 14 Experience with AVM-related topics

Subsequently, the respondents of all training courses were asked how well they could apply the knowledge gained in the trainings at their workplace. Figure 15 shows that the overall mean is at a level slightly above the average mean (6.4). The respective mean values of the basic (5.2) and advanced trainings (8.5) represent the end points of the entire range. But why is that difference so high? Why could the participants of the basic training apply the knowledge obtained at the training only to such a small extent and the evaluated participants from the advanced training much better? A relation of any collected variable shows no relation to each other. This raises the assumption that this results from another not evaluated predictor. Even if there is little social effect in online surveys, the number of positive answers increases, since satisfied participants are more willing to give something back - thus more likely to take part in the surveys - than dissatisfied participants. Therefore, for the online survey in the advanced courses we generally observed that the answers tend to be shifted in a positive direction. With regard to the lowest mean displayed in the basic training, the assumption could be obvious: The more people repeat a specific knowledge – amount of visited different InnoPeer AVM trainings – the more they are able to learn and integrate this new knowledge. Therefore, participants of the basic training were not able to apply their gained knowledge in that amount as participants of e.g. strategy camp could, as they have not yet visited several consecutive trainings as defined the InnoPeer AVM curriculum.

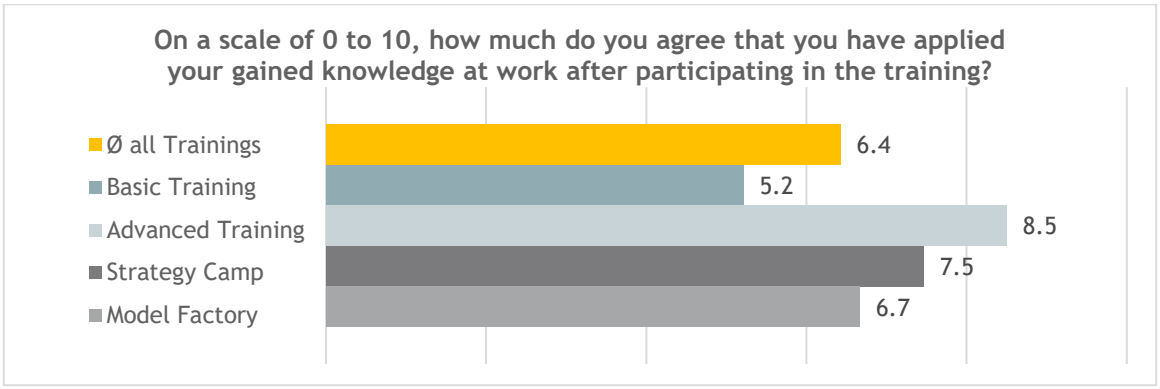


Figure 15 Application of gained knowledge at work

In total, the trainings have a positive effect on the companies with a reported average mean of 7.4 (see Figure 16), although it needs to be considered that not all participants are authorised to tackle changes in their organisations. To assume this number a little better, the participants of the basic trainings were asked whether their job function authorises them to develop and/or implement AVM strategies in their organisation. The results show that only 60% are authorised, although more than 85% hold a position, which at least is attributable to first level management. These not clearly consistent numbers are influenced by the fact that respondents make decisions in teams (> 80% report at least a team decision is made by more than three people). Again, the reported mean values vary from relatively low (6.3) in the model factory to high (8.0) in the advanced trainings. However, also here is not entirely clear which variables relate together. Again, all data collected were correlated and possible covariances were calculated. Only work experience relates positively to the impact on the organisations. This number reaches a level of R^2= 0.11 for the basic trainings and R^2= 0.26 for the strategy camps. This implies that the higher the work experience of the participant, the higher the positive impact on the organisation after the training.

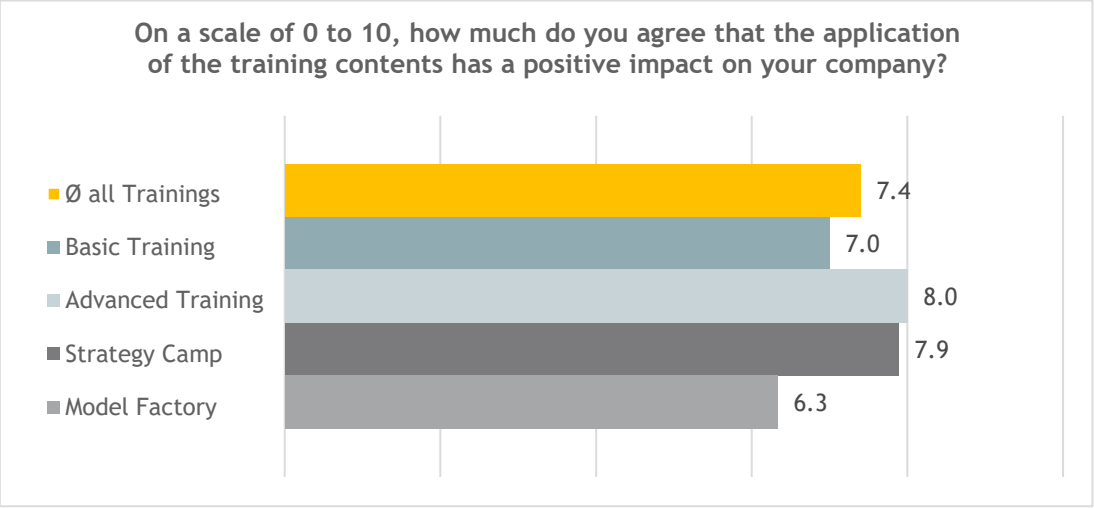


Figure 16 Positive impact on participants' organisation

As shown in Figure 17, with regard to concrete changes in the organisational structure encouraged after the trainings, participants report an average mean of 6.1. The included variables of the basic trainings and strategy camps were viewed in detail, as only these reach a certain number of usable responses. Also, for that item, significant relations could be found. For the sample of basic training, work experience is a strong (R^2= 0.41) positive influencing predictor for encouraged changes of organisational structure. This means that the higher the work experience, the higher the amount of initiated changes. Additionally, the size of the company, which we deduce on the annual sales and the number of employees, has a negative influence to concrete changes in an organisation. The turnover at the sample basic training have a medium (R^2= 0.17) negative influence and for the strategy camp even a strong (R^2= 0.51) negative influence. The variable "number of employees" influences the amount of initiated concrete changes on the organisation structure on a low level (R^2= 0.17) negatively. Therefore, the bigger a company is (in terms of number of employees and turnover), the smaller the level of encouragement of concrete changes after the training.

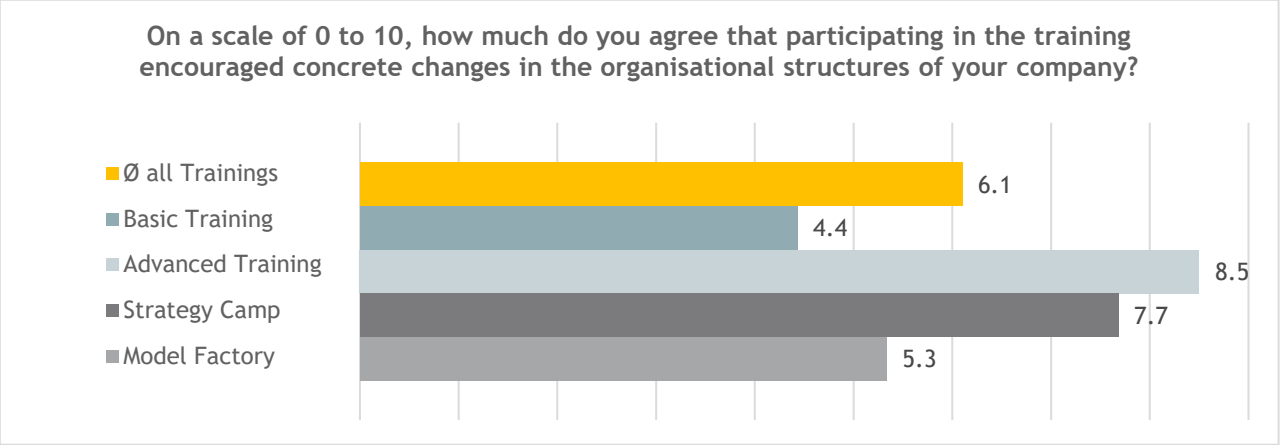


Figure 17 Initiation of concrete changes

Figure 18 shows that with an average mean of 6.2, the training inputs have led to innovative activities in participants' firms. Again, the basic trainings are on the lowest level (5.2) and the advanced training on the highest (7.5). Concentrating only on the basic trainings, the found relation with work experience has a positive medium (R^2= 0.25) influence to innovative activities. In the case of the strategy camps, there are no interrelations found. This means that the higher the work experience, the more likely innovative activities are triggered.

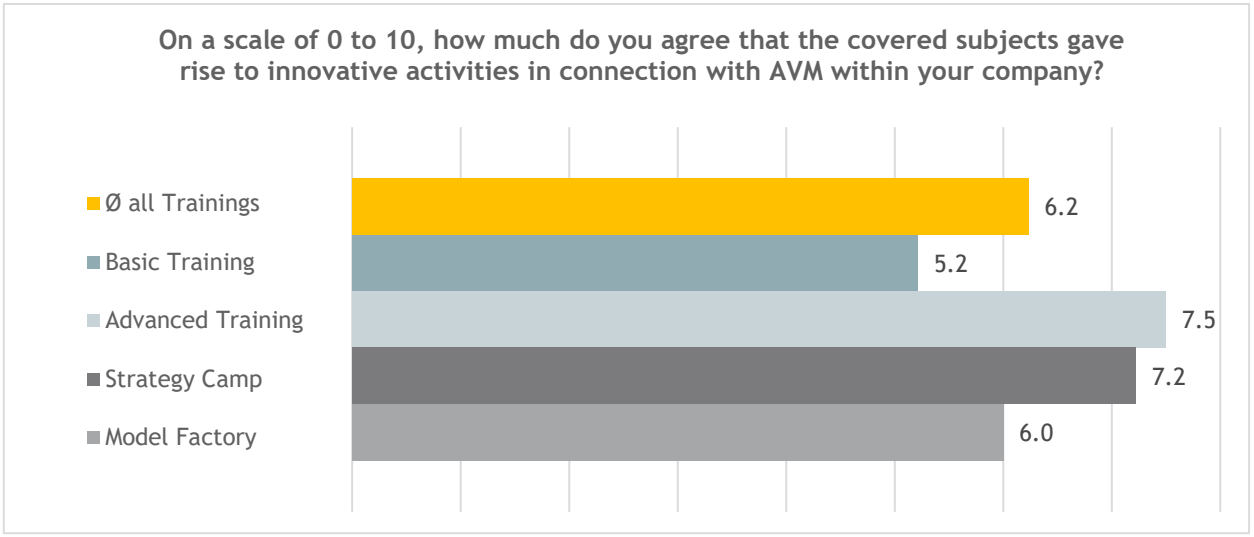


Figure 18 Encouragement of innovative activities

After the trainings, several firms have taken concrete actions. For example, for one basic training participant, the training inputs with regard to the knowledge dimension "technology" gave the necessary input that was needed to start a project to digitalise all construction sites. In another case, participation in the basic trainings led to the digitalisation of all logistics recordings in the company. The trainings provided the tools to understand how to use relevant data, how to handle it for later operations and how to elaborate on it. Overall, it was reported that organisational activities, such as providing AVM trainings for employees were implemented after the trainings. Participants furthermore claimed that the inputs they received from the trainings made them rethink their business model and adapt it in areas where they now see room for improvement.

Figure 19 shows the areas in which actions have been taken. Most of the participants implemented changes in the company strategy (23%), technology (21%) or organisation (21%) after the trainings. Changes in the area of human resources and business model display lower values, especially with regard to the strategy camps. This is surprising, since many of them indicated the business model canvas/roadmap as the most useful tool in implementing innovative AVM practices in these areas. In total, HRM and BMD also reach a medium level as they seem to be important for advanced training participants.

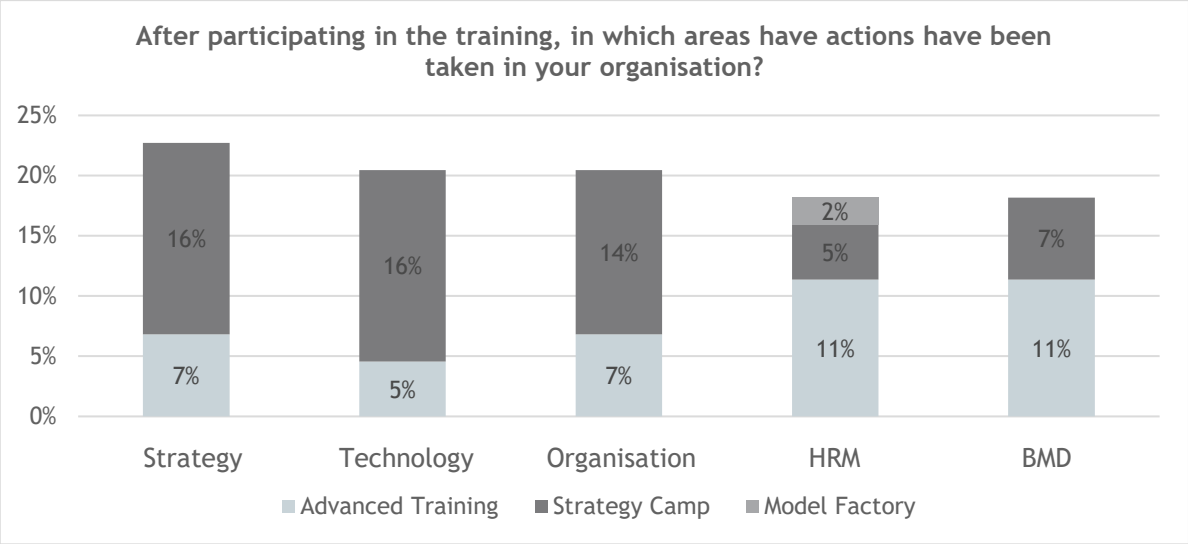


Figure 19 Areas of implemented actions

Figure 20 shows that compared to the areas of TECH (23%), strategy (25%) and BMD (20%), participants plan less changes in the fields of ORG (16%) and HRM (16%). Precisely, they see room for improvement in their companies with topics related to big data, interconnecting equipment to digitalise entire processes and 3D visualisation. The wish to first participate in the advanced trainings before deciding on which new technologies to integrate, which organisational changes to make and how to better support HRM with regard to changes caused by AVM technologies was mentioned in the received feedback.

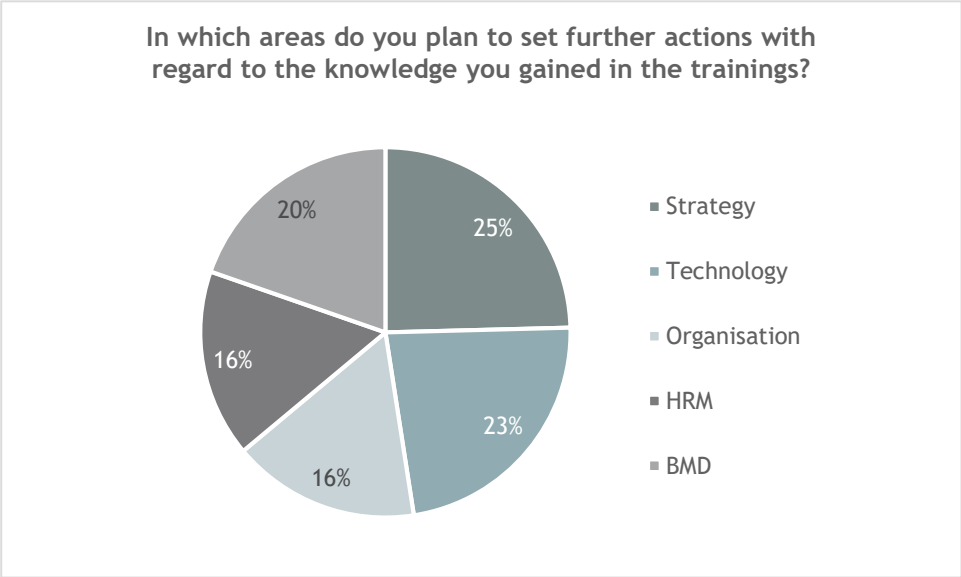


Figure 20 Areas of planned further action

As can be seen in Figure 21, participants' responses were categorised according the dimensions Strategy/BMD, HRM, ORG and TECH. In the dimension strategy and BMD, the major reasons why training participants plan to implement changes are increasing revenue and productivity. In this context, productivity is related to the whole company as well as to the employees. Furthermore, reaching new goals and strategies for the company's brand development according to modern challenges within the industry and handling the challenges of digitalisation by developing a new strategy or adapting the business model are also driving forces in the change initiating process. Some participants mentioned that changes and innovative developments are necessary to avoid falling behind the competition and getting outdated. In this regard finding a new position on the market is necessary. Moreover, it is a good opportunity to define a new value proposition that includes digital innovation and reconsidering the exploitation of existing solutions. Other rationales include achieving improved efficiency and decreasing costs. A specific reason is to achieve a better position from a customer's point of view by concentrating on core competencies and giving customers solutions and not only a product. Finally, an expansion of possible application fields concerning AVM manufacturing will enrich the business model and enable change.

In the dimension of HRM, factors such as reducing operational stress, enhancing employees' well-being, increasing satisfaction at the workplace and reinforcing the potential of employees play an important role. Another reason for change is trying to increase employees' motivation by communicating the necessity of change and educating them on the benefits of the changes (e.g. new software). If employees understand the benefits, they show a higher willingness to adopt. Regarding the dimension of ORG, widening the perspective, extending existing development paths, building a cooperation network within the company by using a cloud solution and gaining professional as well as digital improvement were taken into consideration by participants when they thought about changes in their business. In the area of TECH, the increased usage of AVM technologies and the development of advanced technologies were arguments for implementing change in their company. Furthermore, the training generated awareness that SMEs need support in accomplishing digital transformation.

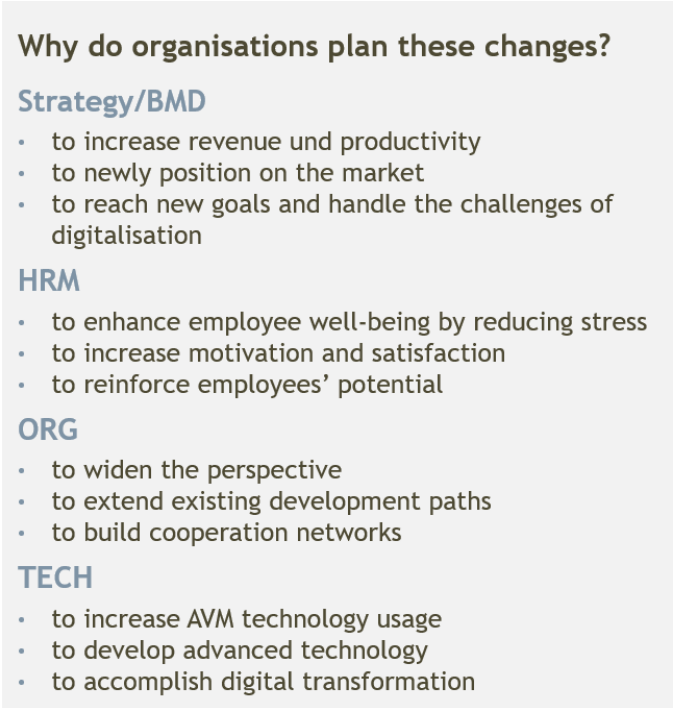


Figure 21 Reasons for planned changes

For many participants the basic training was the first or only visited training. We therefore asked them where they would need additional support. Answers to this question are illustrated in Figure 22. Three thirds of the interviewees would be interested in additional support when it comes to making progress in launching further AVM activities in their organisations. The majority is looking to further exchange and/or collaborate with other companies (14%) and research centres (21%). Further support would also be needed in the area of staff qualification (25%) and in technical in-house support (23%).

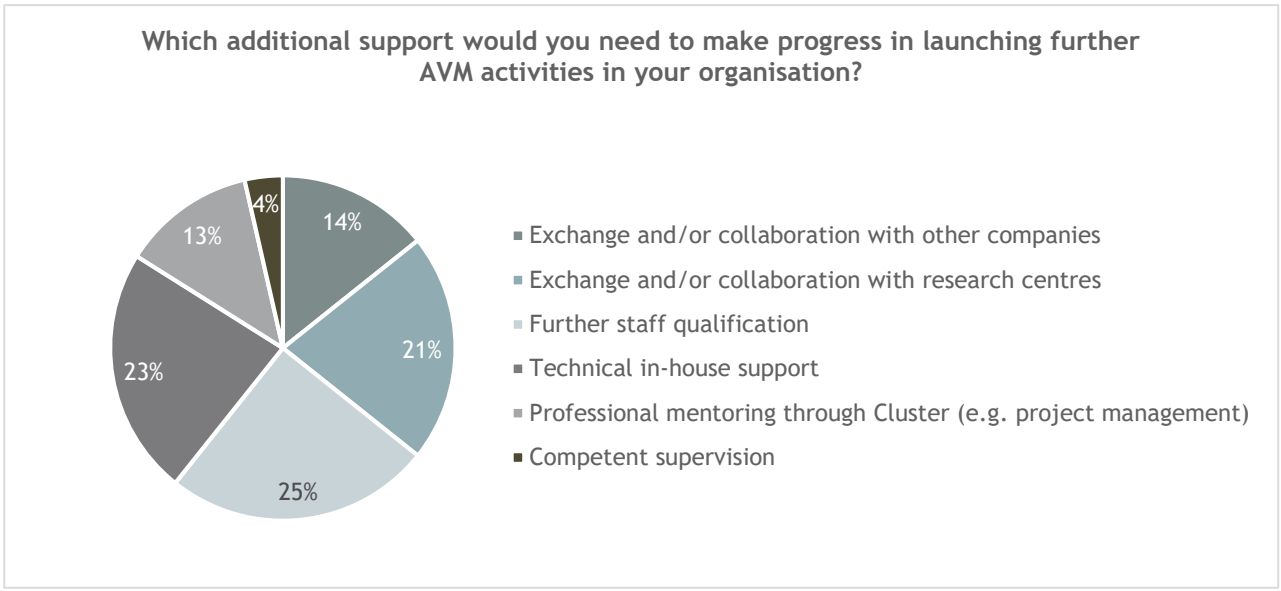


Figure 22 Required support to launch further AVM activities

5. Conclusion

Along with the ongoing pilot trainings of the InnoPeer AVM project, an accessory assessment programme for analysing the impact of AVM capacity building on participating SMEs has been implemented. To assess reaction and learning in the short-term as well as behaviour and results in the long-term, quantitative (i.e. questionnaires) and qualitative tools (i.e. semi-structured interviews) were used within a longitudinal study design carried out at two points in time, at t1 (directly after the trainings) and at t2 (3-6 month after the trainings). In total, 397 questionnaires from the t1 evaluation and 61 responses from the t2 evaluation have been assessed and analysed for this final report. The InnoPeer AVM pilot trainings took place in the five project regions Upper Austria, Bavaria, Veneto, Emilia Romagna, Lower Silesia and Western Transdanubia. Additionally, transnational online trainings in 5 different modules (HRM, ORGA, BMD, TECH 1, TECH2) were organised. In total, the pilot actions have reached a participant number of 1084 (effective May 14, 2020). This number splits up in basic trainings (281 participants), advanced trainings (713 participants), strategy camps (64 participants) and model factories (25 participants). The average participant can be characterised as male (80%), 40 years old, holds 9.5 years of work experience, has been dealing with AVM topics for 6.2 years, has a university degree (80%) and acts as a manager (first-level, middle-level or top-level). The average participant firm has less than 250 employees (48%), a yearly turnover of less than 10 million euros (40%) and operates in the field of machinery and equipment or fabricated metal products (35%).

The most positive feedback in t1 was received with regard to the organisation and method of the trainings (9.1) and that participants will keep the training in good memory (8.5) as well as to the value added to the training curriculum (8.1). High satisfaction was also achieved in terms of newly gained knowledge (7.9), the usability of knowledge (7.8) and a better understanding regarding AVM-related strategies (7.8). Participants

highly appreciated working with teaching cases and the CE Mega Case in order to work on real-life problems in an applied fashion (7.7). In general, the analysed means in the basic and advanced trainings were lower than in the practical trainings (i.e. strategy camps and model factories). Moreover, while the means of the basic and advanced trainings are mostly below the total mean, the ones of the practical trainings – especially of the strategy camps – are above the total mean. This trend is the same for the dimension of utility of training but the exception is here that the means of the different trainings differ distinctly from the total mean in contrast to the slight differences across the other dimensions. Regarding regional differences, it was observed that Lower Silesia exhibits the highest values across all trainings. According to the participants, the most useful topics included strategic planning, BMD, HR planning, AVM process planning and machine connectivity. The most interesting topics included ERP, resistance to change, leadership, cloud computing and big data. Subjects to be addressed in more depth included strategy implementation, best practice examples for innovation and production, talent development, project management, artificial intelligence and human-machine interfaces. All in all, participants seemed to demand a stronger focus on technology in the trainings.

The findings of t2 show that the knowledge gained during the basic trainings was later shared with different levels of management as well as relevant colleagues (e.g. technical departments or R&D), HR and in some cases with external project partners. Overall, participants were satisfied with the knowledge transfer of the inputs they received in the basic trainings. More than a half (56%) considered the basic training as a comprehensive informative event on AVM. Almost a third (32%) said it was an upskilling event for the following AVM application in the organisation and 12% used the meeting as a networking opportunity with others from the same line of business. As for many participants, the basic training was the first or only visited training, we asked them where they would need additional support. Three thirds of the interviewees would be interested in additional support when it comes to making progress in launching further AVM activities in their organisations. The majority is looking to further exchange and/or collaborate with other companies (14%) and research centres (21%). Further support would also be needed in the area of staff qualification (25%) and technical in-house support (23%).

Moreover, the t2 analysis revealed only an average mean of 4.19 according to implemented AVM activities before the basic trainings. Looking at the respective regions, Veneto (2.5), Emilia Romagna (3.0) and Lower Silesia (3.0) report lower values than Bavaria (7.0), Western Transdanubia (6.0) and Upper Austria (6.3). An investigation of the application of gained knowledge at the workplace showed the wide deviation of respective mean values from the basic (5.2) and advanced training (8.5), while the average mean was 6.4. In total, the trainings have a positive effect on the companies with a reported average mean of 7.4. The reported mean values vary from lowest in the model factory (6.3) to highest in the advanced trainings (8.0). Most of the participants implemented changes in the company according to strategy (23%), technology (21%) or organisation (21%) after the trainings. Furthermore, 45% of respondents plan AVM-related changes in the field of strategy and BMD, followed by changes in HRM and ORG (32%) and TECH (23%). The reasons for planning these changes are diverse and include, for example, increasing revenue and productivity, enhancing employee's well-being by reducing stress, widening the perspective and increasing AVM technology usage.

Outstanding relations and interactions

Several indicators were compared to find possible trends and interactions that may help to better understand the results of the impact analysis. There was no clear relationship between the age, education or job function. However, some tendencies regarding company size, work experience and the level of implemented AVM activities prior to the trainings have emerged.

Company size. We found that the number of employees (R^2= 0.17) as well as the annual turnover in the samples basic training (R^2= 0.17) and strategy camp (R^2= 0.51) have a negative influence on concrete changes in organisational structure. This implies that the bigger a company is (in terms of number of employees and annual turnover), the smaller the level of encouragement of concrete changes after the training. Smaller companies typically reacted better to the ideas presented during the training. There is in

spots even a medium to strong noticeable negative trend between company size on implemented changes within the organisations, both in terms of the number of employees and the turnover. This is not surprising, since smaller companies tend to be more flexible and a few employees have a better chance of effecting change than in the case of large companies. This is also indicative of the success of our project, since it is specifically targeted towards SMEs.

Work experience. Most of the participants had rather high work experience. Over 42% report an experience for more than ten years. Work experience was found to have a positive relation to the general positive impact on a company concerning the training input, led to innovative activities within an organisation and initiate concrete changes at the organisational structure. A positive relation between work experience and impact on the organisation was found (R^2= 0.11 for basic trainings and R^2= 0.26 for strategy camp). This implies that the higher the work experience of the participant, the higher the positive impact on the organisation after the training. With regard to concrete changes in the organisational structure encouraged after the training participants report an average mean of 6.1. In this regard, relations with regard to work experience (middle positive R^2= 0.41) were found - the higher the work experience, the higher the amount of initiated changes. Additionally, with an average mean of 6.2, the training inputs have led to innovative activities in participant's firms. For basic trainings again, a positive relation with work experience was found (medium positive R^2= 0.25). This means that the higher the work experience, the more likely innovative activities are triggered.

Level of implemented AVM activities prior to the trainings. The results to the question *"on a scale of 0 to 10, what is your own estimation of the level of implemented AVM activities within your organisation before the start of the basic trainings?"* revealed only an average mean of 4.19 – implying that participant firms generally assess their level of implemented activities as rather low. Looking at the respective regions, Veneto (2.5), Emilia Romagna (3.0) and Lower Silesia (3.0) report lower values than Bavaria (7.0), Upper Austria (6.3) and Western Transdanubia (6.0). We found that the lower the level of implemented AVM activities prior to the training, the better the assessment of the t2 evaluation. This implies that especially those with a lower rate respond positively to the ideas introduced in the trainings and display higher levels of initiated changes and innovative activities.

To conclude, the satisfaction with the InnoPeer AVM pilot trainings was very high and we could observe concrete examples of how the pilot actions have encouraged and initiated changes and innovative activities in participating companies. Given the points elucidated above, the diversity regarding company size (i.e. SMEs *and* large-sized enterprises) and operating industries should be given special consideration in the establishment of a standard qualification programme, especially with regard to the development of criteria of sustainability and the creation of standards (cf. A.T2.4 – Development of a standard qualification programme up to "InnoPeer-certified AVM managers" according to the needs of SMEs in CE). Public authorities, business support organisations and sectoral agencies can take the results as a starting point for designing and granting more tailor-made programmes that support resident companies in overcoming respective AVM-related challenges.