Democratizing Innovation in the Digital Era: Empowering Innovation Agents for Driving the Change

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Abstract. In the digital era, innovation power and speed have become the lifeblood of every successful industrial organization. While driving forward and managing innovation has been a subject mainly related to top-level decision makers and innovation managers for a long time, increasingly many organizations realize that this is inappropriate for keeping pace with the rapid changes in today's societal, economic and ecologic context. Instead, leveraging and pushing innovation from bottom-up by mobilizing the creativity and diversity of the entire workforce has become the lingua franca of innovation in the digital era. An essential part of an organization culture fostering the democratization of innovation is the appropriate empowerment of the workforce through the understanding of essential drivers of change as well as the key innovation megatrends that are about to transform society. This position paper attempts to compile a comprehensive set of skills qualification programs ought to cover, which are aimed at empowering a workforce to act as innovation agents on all levels and organizational positions.

Keywords: Innovation training · Innovation culture · Innovation management · Business model innovation · Change management · Digitalization

1 Introduction

Against the background of the highly networked, interconnected, and therefore complex and technology-intensive ecosystems that we have been building up over the last decade, continuous innovation power has become the lifeblood of every successful industrial organization. More than ever before, short innovation cycles and rapid change driven by complexly interlinked change drivers are challenging and transforming not only every single industry sector, but the entire social, economic, and ecologic ecosystem. As several key decision makers of European automotive manufacturers and suppliers put it, "The next ten years will see more changes than the last

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one hundred years have ever seen". In such a context, innovation can no longer be driven and managed by a few decision makers and innovation managers only. Instead, innovation must become an integral part of company's DNAs and with that, their organizational cultures. This is only possible by empowering a huge quantity of employees from several organizational units and hierarchy levels for taking an active, entrepreneurial part in the company's innovation initiatives.

While this is a fact largely confirmed by several studies and analyses of global innovation leaders, decision makers in Europe are lacking ways of implementing this requirement at a large scale in their organizations. One decisive reason for this is the lack of specialized training programs that teach concrete facts, challenges and good methods and practices of addressing them in their workforce's daily working practice.

In order to point this out, this paper is organized as follows. Section 2 explains the motivation of this paper, and the methodology applied to come up with the position statements and proposals it contains. Sections 3 to 8 propose the units and elements of competence we propose for Innovation Agents in Europe. Section 9 relates this work to the SPI Manifesto. Finally, Sect. 10 concludes and gives an outlook to related future activities.

2 Motivation and Methodology

The motivation for this position paper comes from the authors' close collaboration with major European industry, as well as their active participation in strategic European initiatives such as the EU Blueprint projects ALBATTS [1] and DRIVES [2]. We observed the need for an Innovation Agent qualification program that helps empower a broad range of workforce at all hierarchy levels and all industry sectors to actively inspire and push forward innovation in industrial organizations within the context of digital transformation and Circular Economy.

While innovation management has recently initiated its own body of knowledge [3], has become an internationally recognized job role with associated qualification programs over the last decade [4], the role of innovation agents has received much less attention so far. Professional training programs are still rare, e.g. [5, 6], and are mostly still focused on traditional innovation concepts and skills. Considering the fundamental transformation key industry sectors are undergoing, however, it quickly becomes evident that these traditional concepts and skills—although still relevant and valid—are not sufficient anymore to understand the full picture and to actively contribute to the key drivers of change. We motivate this statement by very briefly characterizing major changes that are ongoing in three primary industry sectors in Europe.

2.1 Automotive Industry Moving into Mobility Services

Astonishingly, one of the currently largest IT organizations in Germany is VW Group IT. This is due to the fact that they manage data and services across the entire vehicle fleet, as well as related tools and analysis results on several levels. The difference between data and knowledge is that knowledge can connect data by a context. This knowledge creation by a context can create new business scenarios. Furthermore,

the cloud is not only used in large companies but rather in the open network and can therefore help connect multiple businesses and sectors to form unprecedented alliances.

In the future, vehicles will be a part of the data cloud and make decisions depending on a huge multitude of data coming from various distributed sources. This unlimited amount of data shared among cars, the environment and personal data in mobile phones and profiles of drivers can be combined to new services, such as e-mobility services, personalized services, workplace services etc. [7, 8]. In order to be deployed successfully at a European scale, all these new services need promising sales scenarios and innovative business models fitting into the societal, economic and ecological megatrends of a Sharing Economy and a Circular Economy.

2.2 Medical Industry Engaging into Healthcare Services

Medical data almost on a global scale are private, highly confidential, and therefore need to be protected. Patients giving their consent, connected medical data will open completely new models of healthcare service models. E.g. in times of pandemic, mobile devices could measure patients' characteristic health indicators such as body temperature and heart rate and feed these data to the (health) cloud. Once in there, these data could be combined with data provided by mobile devices of people in the close neighborhood, allowing to quantify the risk of exposure to already infected people. This kind of service would give a significant contribution to better controlling pandemic situations particularly in highly populated (typically urban) spaces. Such services could also largely facilitate healthcare operations of aged and handicapped patients needing a caretaker's help particularly in emergencies.

2.3 Battery Industry Moving into Energy Services

In the European strategic sector skills alliance Blue Print project ALBATTS [1], the EU currently supports the specification of competences, skills and job profiles required for the creation of energy systems and a battery production chain in Europe. This requires building up new business scenarios and finding new business models that allow Europe to compete with the Asian manufacturers. The sophisticated collection of data across all energy clusters in Europe can facilitate services and business models leveraging the creation and sustainable operation of the alternative energy value chain in Europe. In such a value chain, green energies obtained in Europe would feed green batteries produced in Europe and driving forward the new mobility paradigm across the European territory. Big data containing valuable information about stocks, supply chains, user profiles, etc. could be shared by context among all European cleantech energy clusters to form joint strategies to harvest and provide green energies all the way to the last mile to end users and incite the latter to follow the urgent megatrend of sustainability.

All three innovation domains cited above have in common that a profound transformation of the involved sectors is required and already ongoing. These transformations need the particularly strong active engagement of a huge number of employees engaged in industrial organizations, both in their professional (as creators of innovation) and private environments (as providers and consumers of data and energy).

Making them understand the key drivers of the paradigms they are supposed to push forward, as well as the main modern facilitators should precisely be the principal objective of the Innovation Agent's qualification that we propose here.

3 Qualification Curriculum Strategy

The topics that the proposed Innovation Agent qualification needs to cover are numerous, diverse, interdisciplinary and interconnected. Therefore, we consider it essential to adopt a strategy for clustering the desired competences, and to define skill profiles expected from job roles that are representative for the targeted industrial organizations. We decided to adopt specification schemes that have evolved from key European initiatives, ECQA [9] and DRIVES [7]. Both also have strong roots in the three industry domains that are in our focus as of Sect. 2.

In DRIVES [2, 7], the European ESCO [10] format for describing job roles is applied. This requires a structure of competencies and skills, and the assignment of a level to a competence. The levels of competence used are

- Awareness: People can repeat the knowledge and are aware of it in their daily work.
- Practitioner: People can apply the knowledge in their daily work.
- Expert: People can extend and transfer the knowledge to solve complex problems in their daily work.

ESCO can easily be mapped to the ECQA format that foresees a structuring of competences in units and elements. An element (e.g. U1.E1 Identifying and Understanding Drivers of Change, see Table 1 and Table 2) signifies a competence containing skills (ESCO terminology) or performance criteria (ECQA terminology) denoting an individual's capabilities, see Table 1 below.

Table 1. Performance criteria example for the innovation agent competence element U1.E1.

Performance criterion	Evidence check: the student can demonstrate
INNOAGENT.U1.E1.PC1	The student knows drivers of change and can enumerate related smart technologies
INNOAGENT.U1.E1.PC2	The student knows key initiatives identifying change drivers and can explain the drivers promoted them

Table 2 shows the set of skill units and elements we propose that Innovation Agent qualification programs should cover, as well as their desired competence levels per job roles related to one of the three key activity areas in the value creation process chain: design/development, production/supply/service provision, organization/management. Each of these skill elements will be described in Sect. 4 with respect to their essential motivations and objectives.

Table 2. The proposed innovation agent skills set.

Units (U) and Elements (E) of the skill card	Innovation agent development	Innovation agent organisation & management	Innovation agent production
Unit 1 Understanding Change Drivers and Building Scenarios			
U1.E1 Identifying and Understanding Drivers of Change	Awareness	Awareness	Awareness
U1.E2 Building an Innovation Vision and Future Scenarios	Awareness	Awareness	Awareness
Unit 2 Continuous Idea Generation and Realisation			
U2.E1 Identification and Deep Understanding of Innovation Needs and Opportunities	Expert	Practitioner	Practitioner
U2.E2 Idea Generation, Shaping and Evaluation	Expert	Practitioner	Practitioner
U2.E3 Idea Realisation in Complex Industrial Ecosystems	Expert	Practitioner	Practitioner
U2.E4 Idea Market Deployment in Data- and Service-driven Ecosystems	Practitioner	Expert	Practitioner
Unit 3 Agile Learning Organisations and Open Innovation			
U3.E1 Core Competence Identification and Evolution	Awareness	Expert	Awareness
U3.E2 Dynamic Learning Cycles in Open Innovation Ecosystems	Awareness	Expert	Awareness
U3.E3 Open Innovation Organisation and Process Design	Awareness	Expert	Awareness
U3.E4 Agile Transformation and Networked Agility	Practitioner	Expert	Practitioner
U3.E5 Risk Management and Resilience	Practitioner	Expert	Practitioner
Unit 4 Modern Innovation Principles, Paradigms, and Strategies			
U4.E1 Open Networking, Sharing Economy and Circular Economy	Practitioner	Expert	Practitioner
U4.E2 Cyber-Physical Product-Service Systems, Servitisation, and Service Innovation	Expert	Practitioner	Expert
U4.E3 Big Data and Cloud-Enabled Business Models	Practitioner	Expert	Practitioner
U4.E4 Smart Systems-of-Systems and Enabling Business Models	Practitioner	Expert	Practitioner
U4.E5 Value-added Smart Manufacturing and Enabling Business Models	Awareness	Practitioner	Expert
Unit 5 Case Studies			
U5.E1 Mobility	Practitioner	Practitioner	Practitioner

(*continued*)

Table 2. (*continued*)

Units (U) and Elements (E) of the skill card	Innovation agent development	Innovation agent organisation & management	Innovation agent production
U5.E2 CleanTech/Energy	Practitioner	Practitioner	Practitioner
U5.E3 Healthcare	Practitioner	Practitioner	Practitioner

4 Understanding Change Drivers and Building Scenarios

4.1 Identifying and Understanding Drivers of Change

Knowing, understanding and interpreting drivers of change in the context of a particular industrial organization has become the key success factor for innovation leaders in the long run. The reason is again rooted in the complexity of modern ecosystems. Nobody is able to predict even the near future anymore, because mutual interdependencies of influencing factors are overly complex. Who predicted the hilarious speed of transformation in the automotive sector? Who predicted the Covid-19 crisis? Who can predict movements at the stock exchange? Therefore, decision makers need to align their strategies and decisions with key drivers of change, since they are sure to last for at least the decade to come. It is not sufficient, however, that only decision makers at the top hierarchy levels develop this insight. In the end, their workforce needs to understand and follow. For this to happen, they need to be made aware to understand the key concept of drivers of change, as well as their significance and impact. An Innovation Agent training program shall teach those key drivers from the economical, ecological, social, as well as technological perspectives. Political and legislative trends on national and international levels shall also be discussed in the particular context of selected target domains.

4.2 Building an Innovation Vision and Future Scenarios

The decade 2020–2030 will be characterized by a fundamental transformation of society in both economic and ecological aspects that keeps going on at a tremendous speed and affects every industrial sector. In today's highly interconnected world, we have created technical, economical and societal ecosystems whose complexities have become extremely difficult to manage. Consequently, it is practically impossible for anybody to predict how even their near future is going to look like. The current Covid-19 pandemic is a tragic, however, outstanding manifestation of our modern ecosystems' vulnerabilities and volatilities. When it comes to developing and continuously adapting innovation strategies in such complex contexts, the development of scenarios has proven successful at a large scale. Teaching those, shall cover concrete innovation scenarios for selected key industries in Europe such as mobility, energy and healthcare. These scenarios shall be based on insights and results collected from recent European and international studies addressing in particular the main drivers of change, megatrends, politics, as well as technology and legislation push and market pull.

5 Continuous Idea Generation and Realization

5.1 Identification and Deep Understanding of Innovation Opportunities

Every problem, shortcoming and inconvenience represents an opportunity for innovation. Well analyzing and deeply understanding such opportunities is the fundamental prerequisite for any fruitful downstream innovation process. This element shall teach methods and tools for deep problem understanding and continuous opportunity identification, with a particular focus on Design Thinking and special scenario techniques [11].

5.2 Idea Generation, Shaping and Prioritization

Being able to exploit every employee's and partner's creativity potential on an everyday basis is one of the crucial success factors that help breed an organizational culture of permanent innovation that is essential to stay at the forefront of competition. Generating and shaping ideas should no longer be reserved to a small number of "privileged" innovation managers and think tankers, but rather a daily natural element of a workforce (or on a daily basis). The evaluation and prioritization of the collected ideas has to be transparent and according to clearly defined criteria that have to be known to the contributors at every time. Contributors need time and creative freedom to shape their ideas against these criteria in order to maximize their contributions' relevance to their organization's strategic priorities [12]. Methods, models, techniques, organizations and process elements leveraging this idea generation, shaping and evaluation process shall be at the heart of this element.

5.3 Idea Realization in Complex Industrial Ecosystems

One of the biggest challenges traditional organizations are facing, is increasing the throughput of ideas to successful market deployment. Corporate entrepreneurship (sometimes also called "intrapreneurship") signifies the need of employees to adopt and continuously develop an entrepreneurial spirit in order to push their idea forward and let them grow in an organizational context that is increasingly complex [13]. Developing and permanently updating an entrepreneurial strategy taking into account the specific organizational, political, legal, and market context is crucial in such modern environments. Without the appropriate skills for mastering related methods and tools, intrapreneurs will quickly lose motivation and drive, negatively influencing the company's organizational culture and innovation power. Creating awareness for this and teaching inter- and intra-organizational innovation methods and strategies shall be the core subject of this element.

5.4 Idea Market Deployment in Data- and Service-Driven Ecosystems

While traditional economies relied primarily on the selling of products and consumer product ownership, modern and future business scenarios need to emphasize the creation of consumer experience by a complex interplay of high-tech products with the data cloud, and related service providers. Hence, deployment strategies and processes

in such modern economic and social environments differ significantly from what has been known so far. Not only new strategies, ecosystems, and business models must be created, but also the concerned enabling product and data chain needs to be designed for the provision of value-adding services creating unique customer experiences while still being provably compliant with relevant legislation and politics. While creating numerous new opportunities for higher-margin businesses, these new strategies will even become a necessity in the very near future, latest at the moment when high-tech smart products will become too expensive for mass users to afford. This will imply the slow but certain total replacement of the traditional product ownership paradigm by service models and ecosystems of a sharing economy (cf. BlaBlaCar, AirBnB, etc.).

This element shall teach essential concepts and success factors driving the integrated co-design of high-tech products and smart services in ways that services at various quality and experience levels can be sold to consumers all along the (closed) service lifecycle. The key role of harvesting and capitalizing on "Small Data" (i.e., the subset in the Big Data cloud that is of essential relevance for the provided services) shall be explained, both for enabling services and for providing (data) resources to other service providers (e.g., real-time environmental data captured by the diverse sensor network in current and future cars can be used not only for letting cars drive autonomously with the best possible driving experience, but they can also be sold to service providers outside the automotive sector, such as weather forecast centers, road network supervision and maintenance centers, etc.).

6 Agile Learning Organizations and Open Innovation

6.1 Core Competence Identification and Evolution

Core competence analysis is a traditional company strategy tool helping decision makers identify the actual core domains of knowledge, skills, and experiences which they have gained real competitive advantage in. These core competences therefore, represent the strategic pillars of the organization, which they shall build their innovation roadmap upon. Nowadays and in future, however, these core competences evolve and are linked with other competences much more rapidly than in the past. In particular, the IoT megatrend leads to electronic hardware, software, and internet connectivity integrated in almost every product, even in the most traditionally mechanical ones. In combination with the fact these products increasingly take over safety-critical and vital functions our everyday lives depend on, almost every sector will have to decide where to position related competences in hardware development, software development, as well as functional safety and cybersecurity. Innovation leaders master the continuous evolution, extension and adaptation of their core competence strategies and deployments better and in a more flexible and agile way than their less successful competitors. One of the key success factors we can derive from them is that they involve employees of several organizational units and hierarchy levels in the core competence analysis and evolution strategy rather than only high-level decision makers. Therefore, this element shall teach core competence analysis and

evolution principles in a way that a larger part of the employee basis can actively take part in the related activities and processes.

6.2 Dynamic Learning Cycles in Open Innovation Ecosystems

The dynamic learning organization is a fundamental innovation principle enabling corporate organizations to dynamically adapt to the continuously evolving context in terms of market demands, consumer behavior, politics, legislation, etc. in a way like a living organism. While implementing dynamic learning cycles in a particular organization has always been a challenge, doing so nowadays is even more difficult. The reason for this is the need for creating Open Innovation ecosystems [14], which means that a multitude of external and internal partners (distributed across the entire extended, connected enterprise) must be integrated in a company's innovation strategy, models, processes and operations. In general, industries in Europe needed more than 15 years to adopt Open Innovation principles, and some are still struggling to fully capitalize on the power of innovating in networks rather than within company walls only. Open Innovation requires an open, collaborative mind-set across the entire organization. This element shall teach the main characteristics of organization cultures that successfully implemented dynamic learning cycles in an Open Innovation spirit. It shall elaborate on the principles of Open Innovation, and how these can be made an engine for the realization of disruptive ideas, as well as for boosting the organization's responsiveness to change.

6.3 Open Innovation Organization and Process Design

Innovating in an Open Innovation environment needs to be reflected both within the enterprise organization and within their processes. The workforce needs to understand where and how a close collaboration with innovation partners and suppliers is expected and how it shall happen. Process definitions shall be explicit about critical interfaces in this co-innovation ecosystem, and about where each party's responsibilities are. Related process definitions shall, however, still leave enough freedom for the networked workforce to organize themselves best according to instant needs and get empowered for using their collective creativity to respond to innovation challenges. This element shall elaborate on this aspect from the perspectives of both process owners and process agents.

6.4 Agile Transformation and Networked Agility

The agile transformation of traditional organizations has received a lot of attention in the recent few years. Companies have been facing the need of developing the capability of responding to change much more quickly than they used to do. This trend is not only going to continue but it will even get considerably stronger given the highly interconnected and complex ecosystems that we have been creating in the digital age. Despite the asset of collected experiences from the recent past, creating agile organizations remains a challenge, especially when it comes to size and legacy. Highly networked organizations practicing Open Innovation add another level of complexity to

this, since agility needs to be replicated across enterprise boundaries with limited influence of a central controlling instance. In such an ecosystem, only the workforce itself can achieve connected, collective agility, driven by change agents replicating the agile mindset via their internal social networks. Established agile frameworks like Scrum and SAFe include some of these aspects. However, they lack guidance and do not scale in innovation networks [15]. This element shall elaborate on this subject and teach pragmatic solutions derived from best practice in industry.

6.5 Risk Management and Resilience

Just as in finance, sports and many other domains, moving fast and changing quickly and permanently implies a lot of risks and volatility. Managing risk and building up a solid level of resilience to permanent uncertainty, triggers of change, and potential crisis has become one of the most vital capabilities of industrial innovation leaders. While Open Innovation networks contribute to resilience, they make risk management more complex. Finding the right balance between the two has become an art and life insurance at the same time. This element shall teach core principles of modern risk management across the entire innovation life cycle and ecosystem, emphasizing the role of employees as innovation agents in this process.

7 Modern Innovation Principles, Paradigms, and Strategies

7.1 Open Networking, Sharing Economy and Circular Economy

The "Always On" society that is permanently connected through the ubiquitous internet has a huge impact on our economic ecosystems. Open, global networking principles have become a vital trait of successful organizations, as well as of consumer behavior. Platform companies such as BlaBlaCar, AirBnB, FlixBus and many others have made ubiquitous internet access the backbone of capitalizing on existing resources by making them available to everybody in the world at a fingertip. In this way, the new concept of Sharing Economy is developing rapidly and reshaping traditional consumer behavior and values. Furthermore, as climate change and resource scarcity have become tangible in people's everyday lives everywhere on this planet, consumers' awareness for the urgent need of changing behavior is gaining more and more influence in the way industry is supposed to create value. Closing the product lifecycle by various "Re-strategies" (re-using, re-remanufacturing, re-purposing, re-cycling) has become a top-priority even in traditional resource-intensive industrial organizations. Far beyond a legislative "must" only, the Circular Economy is about to become a major strategic workhorse for the fourth industrial revolution. Circular economy supported by data economy and an IoT infrastructure enables the extension of the traditional manufacturing operation to the entire product life cycle.

7.2 Cyber-Physical Product-Service Systems and Service Innovation

The key enabler of service-oriented economy and innovation is connectivity and smart technologies leveraging continuous adaptation and learning capabilities in service-enabling. The design of such connected, intelligent, adaptive product-service-systems requires the research and deployment of new design principles, methods and tools. Not only data-driven machine learning algorithms confront traditional development organizations with unprecedented challenges, but there is also the need for designing and re-designing such cyber-physical systems all throughout their service lives. Currently, this becomes most evident in Over-the-Air-Update functionality (OTA) that increasingly many product designers must integrate into their products in order to assure their capability of continuously upgrading and adapting their behavior throughout the entire use phase, even including the end-of-life. While apparently simple and easy to specify, just this single add-on functionality confronts development organizations with design challenges that are new for them, in particular functional safety and cybersecurity [16]. How to avoid that an OTA introduces unexpected, safety-relevant misbehavior of the product? How to avoid any kind of malicious attacks before, during, and after the OTA operation? How to assure the compatibility of the updated products with the other connected products? How to re-certify and re-homologate the product after the update? These and many other design-related questions need to be solved before any design problems and weaknesses can lead to collateral damages via the IoT and the cloud. This element shall teach the essential concepts of successfully designing cyber-physical product-service-systems, and create awareness for the particular challenges and partly yet unsolved problems. Since the keyword at the center of these challenges is multi-disciplinary, multi-competent design teams, the Innovation Agent training shall empower a large basis of designers from different disciplines (technical, legal, environmental, medical, etc.) to give their active contributions to modern product-service-systems innovation.

7.3 Big Data and Cloud-Enabled Business Models

A natural consequence of Service Economy gradually replacing Product Economy through networked Open Innovation ecosystems is that traditional business models will no longer be adequate to be successful on the market. Traditional automakers must move from selling individual cars towards mobility experience. Traditional centralized electrical power station and network operators have to transform themselves into green energy providers. Traditional medical device manufacturers must learn using patients' health data in the medical cloud to provide optimal and distanced healthcare services. Apart from the challenges to the design processes and organization outlined earlier, the design and deployment of innovative service and cloud-oriented business models brings along huge difficulties and risks as well. A new business model, once designed, can hardly be prototyped for experimentation like a product. It rather requires the establishment of a lot of legal contracts, the deployment of new organizations and IT infrastructures, and the like. Either it works, or the company (and with it, probably the entire network of suppliers and service partners) will fail. This element shall elaborate on these subjects that are absolutely crucial for Europe's economic future. Every

employee needs to understand that their organizations do not even have the choice. It is imperative for them to follow this trend if Europe does not want to be left behind and lose its position at the forefront of innovation. Practical trainings on modern business model innovation still being rare, in Europe, it shall be the Innovation Agent qualification's key mission to fill this particular gap.

7.4 Smart Systems-of-Systems and Enabling Business Models

This element shall extend the previous one by taking a focus on Business Model Innovation for deploying intelligent system-of-systems on the European markets. The trend that is addressed here is the fact that numerous sectors are becoming more and more dependent on each other. An outstanding example is the introduction of E-Mobility on the European market, which is still hampered to a large extent by the missing charging infrastructure. Likewise, autonomous driving relies on a ubiquitous, safe and secure real-time cloud infrastructure linking vehicles with road infrastructure (e.g. traffic lights), but also people. How to co-develop these systems of systems? How to cope with the differences in innovation cycles? How to manage the risks?

Even if most of related challenges are of political and legal nature and therefore need to be solved on higher, strategic levels, it is a proven fact that in the highly complex interconnected world we created, top-level decision makers increasingly depend on advice coming from a large multi-disciplinary group of domain-experts: Trained Innovation Agents will be able to fulfill exactly this crucial role.

7.5 Value-Added Smart Manufacturing and Enabling Business Models

Finally, Europe must not miss the big, unique chance to re-establish their formally leading manufacturing industry thanks to technological trends such as cyber-physical, interconnected manufacturing systems, additive manufacturing, as well as smart, flexible manufacturing systems [17]. Being pushed ahead by global mega-trends such as sustainability, customization, and Circular Economy, the Fourth Industrial Revolution (Industry 4.0) is going on at a tremendous speed from a technology-push perspective. Political, organizational and business model related aspects, however, are still lagging and endanger Europe's competitiveness with respect to countries like China and the USA in particular. Unless a large basis of highly capable, competent and still motivated employees gets trained in thinking and actively pushing in this direction, companies in Europe will face more and more difficulties in becoming and staying a key player in this industrial revolution that is about to transform society on a global level.

Apart from creating awareness for all these subjects, this element shall make Innovation Agents understand the core technical, social, economic, and ecologic aspects of Industry 4.0 in very concrete down-to-the-earth terms using case studies from real industry practice. It shall help them elaborate the basis of an Industry 4.0 strategy roadmap for their particular organizations and thereby move from generic buzzwords to concrete value-adding strategies.

8 Role-Based Training Design and Delivery

As pointed out in numerous groundbreaking innovation and creativity management publications, in particular [18], an effective and successful innovation culture requires different roles to be actively represented in any innovative organization. Democratizing innovation by scaling innovation training and other enablers to a large organization scale therefore also implies carefully taking into account innovation roles and related profiles in both content and approach to empowerment and teaching. To design and deliver the proposed Innovation Agent qualification, we propose the following four building blocks:

1) *Emotional - The behavioral innovator*. Human factors driving innovative behavior: typologies, learning and strategies.
2) *Educational - The innovation toolbox.* Principles, concepts, strategies, methods and tools: existing knowledge on innovation skills.
3) *Empirical - The innovation experience*. Use cases where the innovation toolbox has been applied with success or failure.
4) *Experimentation - The innovation journey (or endeavor)*. A hands-on, coached module to experiment a selected innovation use case.

The idea is to let training participants discover their own interests and characteristic traits in order for them to be able to select the role(s) they will feel most comfortable and enthusiastic in. This is fundamental, since innovation, creativity and entrepreneurial spirit come from motivation, passion, and conviction.

9 Relevance to the SPI Manifesto

According to the SPI Manifesto [19], people are at the center of every process, every organization, as well as every change process. The digital era affects each and every sector in terms of innovation and change processes are going on much more rapidly than ever before. Moreover, the digital transformation is highly complex in terms of the numerous interdependencies among stakeholders and business processes it requires. Such speed and complexity can only be driven by a pro-active support and contribution of an industrial organization's workforce. Concentrating change power and strategy to just a few top-level managers is a model that has turned out to be inappropriate in such digital, networked ecosystems, and therefore bears a lot of risk.

In this sense this contribution also tries to strengthen the existing SPI Manifesto in a way that it highlights the increasing lively importance of giving power and motivation to the workforce in order for the change to happen in a continuous and sustainable manner. In addition to that, the proposed qualification is aligned with the need for cradle to crate lifelong learning concept that is increasingly vital for empowering workforce to understand and drive the change.

10 Summary, Conclusion and Outlook

This position paper elaborates on the urgent need for the establishment and large-scale deployment of an Innovation Agent qualification program that aims at empowering a large part of the workforce of companies in Europe to actively push forward innovation in the digital era while also controlling the direction it takes with respect to sustainability. Apart from the digital megatrend, concepts such as Circular Economy, Sharing Economy, as well as Product-Service Systems have to be well known and understood by the workforce in order for them to be able to take them into account in their daily activities. To this aim, the paper suggests a curriculum structure in terms of competence units composed of focused elements. The suggested content of these units and elements has been derived from the authors' exhaustive experiences in consulting, coaching and teaching major industry in Europe, as well as from EU Blueprint project studies.

Based on the EQF, it provides the essential design basis that facilitates its integration in diverse curricula in Europe, as well as Europe-wide certification. While large-scale enterprises are the main target group for the Innovation Agent qualification, we expect that SME's will also profit from cultural leverage effect that a broad and timely innovation facilitation training will have in every organization. We also pointed out the importance of a role-specific adaptation of the Innovation Agent curriculum in terms of depth of knowledge elements, as well as the emphasis on learner's personal characteristic traits and objectives. Only motivated learners will also be innovative!

Since, to the best of our knowledge, there is currently no comparable program available on European level, we are currently launching an initiative uniting representatives from European industry clusters, VET organizations, and universities in order to set up such a program. Our objective is to launch pilot trainings in one year to come into play and subsequently, to improve and extend the program continuously through teaching practice both on-site and on-line. Additionally, the pupils of today will be the employees, employers, and entrepreneurs of tomorrow. Teaching the young will feed the knowledge workforce we need in the not so distant future.

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