



# Configuration Manager: Describing an Emerging Professional Figure

Enrico Sandrin  
Dep. of Management  
and Engineering  
University of Padova  
Vicenza, Italy  
enrico.sandrin@unipd.it

Cipriano Forza  
Dep. of Management  
and Engineering  
University of Padova  
Vicenza, Italy  
cipriano.forza@unipd.it

Gerhard Leitner  
Dep. for Informatics-  
Systems  
University of Klagenfurt  
Klagenfurt, Austria  
gerhard.leitner@aau.at

Alessio Trentin  
Dep. of Management  
and Engineering  
University of Padova  
Vicenza, Italy  
alessio.trentin@unipd.it

## ABSTRACT

The implementation and management of product configurators in enterprises are accompanied by several challenges and it is widely recognized that the organizational ones are among the biggest. In order to overcome such challenges, companies need people with adequate competencies. What are the required individual competencies to successfully implement and use product configurators (both sales and technical ones)? Which are the characteristics of an ideal professional figure that can have all these competencies? How could the needed competencies be developed through training? This paper brings these questions to the scientific discussion on product and sales configurators. However, these questions have a wider scope since they also relate to the enquiry on mass customization and on product variety management: they deepen the perspective on organizational design related to these issues.

## CCS CONCEPTS

• Social and professional topics → Professional topics → Computing and business, Management of computing and information systems.

## KEYWORDS

Mass customization, Configuration, Organization design, Configuration manager, Professional profile, Individual competencies

## ACM Reference format:

Enrico Sandrin, Cipriano Forza, Gerhard Leitner and Alessio Trentin. 2022. Configuration Manager: Describing an Emerging Professional Figure. In

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [Permissions@acm.org](mailto:Permissions@acm.org).

SPLC '22, September 12–16, 2022, Graz, Austria

© 2022 Association for Computing Machinery.

ACM ISBN 978-1-4503-9206-8/22/09...\$15.00

<https://doi.org/10.1145/3503229.3547049>

*Proceedings of the 26th ACM International Systems and Software Product Line Conference - Volume B (SPLC '22), September 12-16, 2022, Graz, Austria. ACM, New York, NY, USA, 8 pages.*  
<https://doi.org/10.1145/3503229.3547049>

## 1 Introduction

The use of a configurational approach allows to offer customized products in an efficient way [1]. A company that follows this approach predefines the allowed variations in product customizations and also defines the way these customizations can be realized [1]. These predefinitions reduce uncertainties and complexity in order definition as well as order fulfilment. However, a number of customization activities have to be performed to answer the customer enquiries and these activities altogether constitute the so-called configuration process. The product configuration process is a business process that starts from the choice of the product features that best meet the functional and budget requirements of the customer, and arrives at the generation of the documents used for the production and installation of the product. This process can involve products, services or combinations of them. The set of technical and human resources involved in the product configuration process constitutes the product configuration system.

The Configuration Manager is a professional who is responsible for the product configuration process. In particular, the Configuration Manager carries out the activities of analysis and design of the configurational approach and the configuration system, analysis of the configuration process and re-engineering of this process. In performing these activities, he/she may have an impact on the offer choices of products and services. In addition, the Configuration Manager evaluates the digitalization opportunities of the configuration process using IT solutions (such as product configurators); manages the implementation, maintenance and update of the configuration system; contributes to the training and development of those who work in the configuration system.

The Configuration Manager is a cross-functional figure who must be able to work and coordinate with employees assuming different functions in a company. Depending on the organizational

context, those who cover this role can assume a purely managerial role or, especially in small companies, also cover executive tasks related to the configuration process and the development of the configuration system. Whoever holds this role must have an excellent technical-commercial view, as well as IT and organizational competencies.

In the context of the product configuration community, the present paper aims to a scientific discussion on the profile of a Configuration Manager by providing a description of activities and individual competencies that refer to this professional figure. This discussion will help companies to identify appropriate personnel for product configuration projects and will help them to identify which individual capabilities to cultivate in order to improve the chance of success of a product configurator implementation.

The present paper is structured in eight sections. The first one recalls the theoretical background and the second one presents the objective and method. The following sections present the Configuration Manager activities (Section 4), the individual competencies of a Configuration Manager (Section 5), the standard-descriptors-based description of the Configuration Manager profile and reference areas (Section 6), and training activities to develop the individual competence of a Configuration Manager (Section 7). Final considerations follow in the Conclusion Section.

## 2 Theoretical Background

Configurators can be considered crucial components of mass customization systems so they are also called mass customization toolkits [e.g., 2, 3]. Consequently, they have to be aligned with the other components and foundations of mass customization systems, thus leading to considering their implementation in relation to the level of parts standardization, product modularization, and group technology, to mention just a few of the common mass customization enablers [4].

The effectiveness of configurators is well known, they, for example support the overcoming of the trade-off between customization and quality [5] as well as the trade-off between customization and time performance [6, 7]. However, we also know that in order to be effective the product space should be aligned with the customer requests [5]. Therefore, the design of configuration systems is interrelated with product design and organizational design [1]. This is not surprising being configuration systems socio-technical systems and consequently, their optimization depends on the fit between technology, people and organizations [1].

Exactly this socio-technical nature explains some of the main challenges in implementing and using configuration systems. In fact, organizational challenges are well recognized as the main challenges in their implementation [8]. However, there are many other challenges such as those related to knowledge elicitation and modelling that may be addressed in particular by appropriately scoping configuration projects [9]. These challenges can be partly reduced also by appropriately choosing the implementation process since we know, for example, that adopting a RUP or an agile (e.g.

Scrum) approach does have an effect on the overcoming of these challenges [10].

The requirements that can be derived from the discussion above are that suitable persons have to possess organizational insights, company product-process insights, and configuration technology insights in order to successfully implement, use and further develop configuration systems. This consideration is an immediate consequence of the results of several studies that investigated the implementation of configuration systems [e.g., 8, 11].

It is surprising to note that the study of the activities and competencies required of people who superintend (conceive, design, implement, develop, manage, maintain) this kind of system is extremely limited if not completely lacking. This gap is relevant both for companies that have to adopt a configuration system as well as for trainers who have to develop individual competencies in individuals who have to superintend the configuration process and its supporting systems.

## 3 Objective and Method

### 3.1 Objective

The objective of the present paper is to start a scientific discussion on the professional profile of a Configuration Manager by providing a description of activities and individual competencies that refer to this professional figure.

### 3.2 Method

Given the paucity of previous research on this issue, the primary goal of this paper is to rapidly collect and share knowledge. The theoretical basis of this effort is based on academic literature; the empirical knowledge, instead, is based on the personal experience of the authors of the present paper.

The authors' experience in the field ranges from 14 to 23 years in the following areas: studying and/or guiding configuration system implementation, training people to design and implement configuration systems, and assessing and guiding companies in implementing mass customization eventually using configuration systems. Given this experience of executors, managers, consultants, trainers, and researchers on these topics, the authors collectively gained deep insights into all of the relevant issues in this field. Furthermore, they have also performed research on organizational design and individual competencies for mass customization, thus enhancing the ability to identify the Configuration Manager activities and the related individual competencies. Two authors developed together the first proposal of Configuration Manager activities, individual competencies, and training activities. Subsequently, this proposal went through a number of refinements where each author proposed integration or modifications. We made three separate cycles of improvements, after a considerable amount of time from each other, to be able to see the proposal with new eyes. A final check has subsequently performed by two experts working respectively for a transfer and training center and for an association of SMEs.

The activities of the Configuration Manager are grouped based on the main processes in which this professional figure is involved. These processes (as can be seen also in the literature cited in the theoretical background) are the development of a mass customization strategy and the design of the most suitable configurational approach for this strategy (see Subsection 4.1), the analysis of the configuration process and system, and definition of its related digitization (see Subsection 4.2) and the implementation and management of a partially or totally digitalized product configuration system (see Subsection 4.3).

Considering the various processes and related activities and going back to the experiences of managing and transforming them we identified the required individual competencies. We grouped them in the way they are recognized by the training centers, i.e. attitudes and soft skills; knowledge; and skills. We made this choice because we would like to start a discussion that involves not only academics but also training centers.

The first group of competencies (attitudes and soft skills) comprises attitudes that describe the disposition and mind-sets to act or react to ideas, persons or situations [12] and the persons' underlying characteristics [13, 14]. This group was derived from well-recognized related research on individual competencies such as the works of Spencer and Spencer [14] and Boyatzis et al. [13]. As regards the second group, "knowledge is composed of the facts and figures, concepts, ideas and theories which are already established and support the understanding of a certain area or subject" [12]. As regards the third group, "skills are defined as the ability and capacity to carry out processes and use the existing knowledge to achieve results" [12].

The reasons for choosing this form of categorization has been, on one hand, to keep a language highly diffused among the companies where we are working and, on the other hand, to be comparable with previous research and with international and European classifications. Finally, we added standard descriptors to describe the figure of the Configuration Manager. The use of standard descriptors has the aim to facilitate the recognition of competencies across different region and systems. However, because these systems are not yet harmonized in practice, we decided to keep the correspondence with the Italian and Austrian system (we choose these two systems since authors are from these two countries).

To increase the validity of our results, we evaluated the derived features of the profile with some SMEs' top managers and entrepreneurs. Five of these evaluations have been guided by non-academics working for an association of SMEs and two evaluations have been guided by one of the authors. Therefore, this validity check allowed external control by knowledgeable people who are independent of the authors. The evaluations aimed to check whether the description of the professional figure was understandable and meaningful, whether this figure is useful in a company with high product variety/customization (including those that could benefit from the use of a configurational approach), whether the proposed training paths are relevant and flexible enough to be adaptable to different contexts.

## 4 Configuration Manager Activities

The main activity of the Configuration Manager consists of the design and development of the configurational approach and the configuration system for products/services a company offers. This activity is a consequence of a company's strategic decision to offer mass customization, which means being able to offer a higher variety and customization of products and services with costs, delivery times, and quality comparable to those of companies that offer standard products and services [e.g., 15, 16, 17]. A mass customization strategy can be deployed in different ways [18, 19]. For example, the company can decide which activities of the operational process (that go from product design to end-product delivery) can be influenced by customer requests (thus offering different degrees of product customization). Moreover, this decision can vary between different product families. Another decision in this context is the definition of which offered products are standardized, configurable or ad hoc designed and how these three categories are characterized in a specific company. On a practical level, a mass customization strategy involves (i) the development of a product offer aligned with the customers' individual requests the company wants to satisfy and, at the same time, aligned with (ii) the company's need to have processes that manage customized orders with the same ease with which they manage standard orders, and (iii) effective customer support in choosing the product characteristics that are optimal for the customer, limiting the allocation of company resources. The configurational approach allows companies to offer customized products and services efficiently through configurable products and services. It should be noted that in companies where product configurability has not yet been foreseen, for example in companies coming from craft production, it is common to find low standardization of components and processes. It is, therefore, necessary that the Configuration Manager, in this initial situation and subsequently in the management phases of the configuration system, collaborates in the standardization of components and processes.

The Configuration Manager, therefore, contributes both to the development of the specific customization strategy and to its operational implementation (supporting and coordinating with the various company functions involved). In particular, the development and implementation of a mass customization strategy imply the analysis of the current configurability of the products, the analysis of the interactions and the impacts of product configurability on company functions' decisions, the setting of the configuration system according to the strategic objective to compete through customization of configurable products. Additionally, the Configuration Manager is responsible for digitalizing the configuration process. With this in mind, the tasks of the Configuration Manager are not limited only to the analysis of the current configuration process and implementing digital systems to support this process, but he also contributes proactively to the definition of the configurational approach at a company level, also helping to coordinate the decisions of the multiple company functions involved (in particular Research and Development,

Marketing and Sales, Operations, Management Control, and Top Management) in adopting this approach. In the following subsections, the main activities in which the Configuration Manager is involved are only listed to avoid redundancies with what presented in this first part of Section 4.

#### **4.1 Development of a Mass Customization Strategy and Design of the Most Suitable Configurational Approach for This Strategy**

The main activities of this manager as regards the development of a mass customization strategy and design of the most suitable configurational approach for this strategy are to: (1) analyze the variety and customization management strategy and the degree of configurability of the products currently present in the company; (2) analyze the organizational context and the interdependencies of the configurational approach with technological and organizational choices; (3) development of a mass customization strategy; (4) design ways to align customer's individual requests with the company's need to (a) have processes that handle custom orders as easily as they handle standard orders, (b) effectively support the customer in the choice of optimal product for him/her by limiting the consumption of company resources.

In particular, as regards the fourth activity, the Configuration Manager contributes to the definition of the: distinction between ad hoc designed, standardized and configurable products; product space offered by the company to customers, choice and recognition of customer types; interaction methods with customers for the commercial configuration; definition of the product architecture and the characteristics of the production and logistics systems according to configurational logic; solutions to increase the configurability of the products; redesign solutions to change special products into configurable products; standardization of components and processes; connections between the configuration system and the management control system; connections between the configuration system and the production planning and control system; connections between the configuration system and the quality system; connections between the configuration system and other company's systems.

#### **4.2 Analysis of Configuration Processes and Systems, and Definition of Related Digitization**

The main activities of this manager as regards the analysis of the configuration process and system, and definition of its related digitization are to: (1) analyze the product configuration process currently present in the company; (2) analyze the context, the technological and organizational constraints in which the product configuration process is inserted; (3) identify and define proposals for improvement and re-engineering of the configuration process; (4) define the objectives to be achieved by digitalizing the product configuration process; (5) identify the suitable support activities and IT solutions for the digitalization of the configuration process (such as the product configurator) and how they integrate with other company information systems; (6) establish the optimal level of automation of the configuration process; (7) identify the product families to be included in the configurator.

#### **4.3 Implementation and Management of a Partially or Totally Digitalized Product Configuration System**

The main activities of this manager as regards the implementation and management of a partially or totally digitalized product configuration system are to: (1) collect and make explicit the product knowledge to be included in the product configurator; (2) model and represent the product knowledge to be included in the product configurator; (3) model product knowledge in the product configurator; (4) define the configurator implementation plan; (5) manage and overcome resistance to change; (6) manage the implementation and testing of the product configurator; (7) analyze the operation of the configuration system and its use by users to propose improvement projects; (8) manage configuration system improvement projects; (9) manage the maintenance and update of the knowledge included in the configurator; (10) manage the maintenance and technological updating of the IT solutions used in the product configuration system; (11) develop and update the competencies of those who work in the configuration system; (12) manage the human resources assigned to an organizational unit responsible for developing and updating the configuration system.

### **5 Configuration Manager Individual Competencies**

#### **5.1 Attitudes and Soft Skills**

The Configuration Manager is a figure that has to deal with multiple departments, which tend to be characterized by different orientations and by different cultural backgrounds. Furthermore, the Configuration Manager has to design and superintend systems that aim multiple objectives (e.g., efficiency, flexibility, customer satisfaction) and operate in an uncertain environment. In such conditions, (1) negotiation, (2) efficiency orientation, (3) flexibility, (4) information seeking, (5) analytical thinking, (6) pattern recognition, (7) group management, (8) teamwork, (9) planning, (10) initiative, and (11) customer orientation are important attitudes and soft skills to perform well in this professional role.

#### **5.2 Knowledge**

In order to effectively participate in the development of a mass customization strategy and design the most suitable configurational approach for this strategy a Configuration Manager should possess specific knowledge regarding: (1) variety/customization management strategies and configurational approach; (2) practices and methods for the implementation of mass customization; (3) characteristics of standard, configurable and special products; (4) methods of standardization of components and processes; (5) characteristics of the product configuration process.

In order to be able to analyse the configuration process and system, define their appropriate level of digitalization, implement and manage a partially or totally digitalized product configuration system, a Configuration Manager should possess knowledge

regarding: (6) IT solutions for the configuration process; (7) characteristics of product configuration systems; (8) characteristics of the company information systems connected to the configuration system (CRM, PDM / PLM, PIM, MPCS, social software, etc.); (9) internal and external users' need for a configuration system; (10) characteristics and representation of the product from a commercial point of view; (11) characteristics and representation of the product from a technical point of view; (12) characteristics and representation of the product from the production point of view; (13) characteristics and representation of the product from the point of view of management control; (14) characteristics and representation of the production process; (15) methods for evaluating costs and benefits; (16) basics of project management; (17) agile (e.g. Scrum) and RUP methods for managing digitalization projects.

### 5.3 Skills

In order to effectively participate in the development of a mass customization strategy and design the most suitable configurational approach for this strategy a Configuration Manager should be able to: (1) develop a mass customization strategy; (2) analyze the configurational approach from multiple perspectives; (3) design a configurational approach; (4) analyze special products in order to propose solutions to change them into configurable products; (5) apply methods for the standardization of components and processes.

In order to be able to analyse the configuration process and system, define their appropriate level of digitalization, implement and manage a partially or totally digitalized product configuration system, a Configuration Manager should be able to: (6) analyze the configuration process and its interdependencies with other business processes and systems; (7) choose IT systems suitable for the digitization of the configuration process; (8) use IT systems adopted for the digitization of the configuration process; (9) collect and make explicit product and process knowledge; (10) model and represent product and process knowledge; (11) define training courses to develop and update the skills required for the management and use of a configuration system; (12) use project management techniques; (13) use planning and monitoring techniques for activities; (14) use group management techniques; (15) use techniques to get collaboration; (16) use techniques to manage and overcome resistance to change.

## 6 Description of Configuration Manager Profile and Reference Areas with Standard Descriptors

Below are the standard descriptions that come closest to this new profile. The search revealed that there is not a codified profile that exactly matches the Configuration Manager profile. Various profiles and areas of activity have been identified which incorporate some characteristics but which, however, have a different orientation and purpose than the Configuration Manager. An ad hoc profile should therefore be developed and introduced. In any case, difficulties of functional placement would be encountered

given the inter-functionality of this profile. In order to clarify in which aspect a certain profile reported is relevant, each identified profile is accompanied by a brief specification of relevance.

This profile can take on more of a managerial role (in case he/she is responsible for an organizational unit dedicated to product configuration) or a specialist role (in case he/she has no direct responsibility for resources dedicated to the product configuration system), depending on the organizational context.

To present the correspondences in a concise and understandable way, the profile is, in the first step, described with respect to the European Skills, Competences, Qualifications and Occupations (ESCO) profiles. The next step, represented in Table 1 in the Appendix, is to report the correspondence between the ESCO profiles, the NUP ISTAT profiles, and the areas of activities (ADA) of the “Atlante del Lavoro” associated with these ISTAT profiles, emphasizing the relation to the Configuration Manager. For the sake of completeness and precision, Table 1 includes hyperlinks, associated with the standard terms used, which refer to the web pages where these terms are defined.

### 6.1 Description Using ESCO Profiles

The closest management profiles in ESCO are those located in the area sales, marketing and development managers (“122 - Führungskräfte in Vertrieb, Marketing und Entwicklung”, “122 - Dirigenti nei servizi di vendita, commercializzazione e sviluppo”), in particular the profiles research and development managers (1223), and sales and marketing managers (1221). In regards to group 1223, the Configuration Manager is closer to the product manager than to the research and development manager because (a) he/she does not preside over the new product development process (although he/she is involved in this process) as he/she manages the generation of new product variants within a product space that has been predefined in the new product development processes, and (b) defines the user experience during the shopping process through commercial configuration systems. Even if he/she is the owner of the commercial configuration system (which supports the presentation of the configured products to the customer, the help to the customer in choosing the configured product, and possibly the online sale of this product as well), the Configuration Manager cannot be considered a commercial director. The Configuration Manager presides over the configuration system that supports and possibly automates parts of the activities of the staff employed by the sales manager and the research and development manager, and uses, for this automation, the product knowledge on the sales and technical-production domains: this explains the location of this manager within this area.

As the Configuration Manager has to define, implement and maintain an IT system to support product configuration activities, this figure has strong similarities with the profiles of the Information and communications technology service managers (1330) group, but limited to a specific set of information technologies (those used for product configuration). Being the owner of the configuration information system, he/she has similarities with the profiles chief information officer and chief

technology officer. Having to manage the implementation of IT supports for the configuration system, he/she has similarities with the ICT project manager and, as regards the management of data and knowledge of the configuration system, he/she has similarities with the chief data officer.

In addition, as the introduction of a configuration system is an activity that can profoundly change business processes and that can also change the way products are designed over time, this profile shares many similarities with management and organisation analysts (2421) and industrial and production engineers (2141). Finally, the introduction of IT solutions to support the configuration system brings this profile closer to the characteristics of the system analyst (2511), in particular to the profiles of the ICT business analyst, enterprise architect, and user experience analyst.

## 7 Training Activities

Immediately after the proposal of a new professional figure, training activities have to be designed, which are partially or completely associated with the individual competencies associated to the figure. This issue is of practical relevance for academia and training centers on one side and for companies on the other. Individuals that undergo such pieces of training can be people already employed in a company or students who will be employed in the future.

Hereafter, we provide some preliminary considerations on training to improve the competencies of Configuration Managers. We report the synthesis of our experience in industry and in academia training. However, what is reported hereafter has been evaluated by an association of SMEs and a manager of a training center with long and specific experience.

### 7.1 The Main Contents

For the figure of the Configuration Manager, a training course is proposed based on the following contents:

1. *Mass customization and configurational approach* (Variety, customization, and mass customization strategies. Degree of product customization. Practices for the implementation of mass customization. Configurational approach and efficient customization. Standard, configurable and special products).
2. *Product configuration and its digitalization* (Product configuration process activities. Relations between organizational context and configuration activities. Digitalize / automate the configuration process).
3. *Product configuration systems* (Configuration systems architecture. Degree of automation of the configuration process. IT solutions for the configuration process. Commercial product modeling. Technical product modeling. Other product models. Configurators and connection / integration with other company information systems (CRM, PDM/PLM, PIM, MPCS, social software, etc.) Characteristics of sales configurators, needs and benefits perceived by the customer in the use of these systems. Implementation and management of digital configuration systems. Preliminary analysis for the execution of an IT solution implementation project for product configuration. How to manage a project for

the implementation of IT solutions for product configuration. Implementation, testing and launch of IT solutions for product configuration. Success and failure factors of the implementation project. How to overcome resistance to change. Management, maintenance and updating of a partially or totally digitalized configuration system.).

### 7.2 Course Customization

A training course must be customized according to whether only one company or more companies are involved, whether only process owners are involved or even participants in the process who are not process owners, whether the knowledge of the principles of mass customization is limited or advanced, whether the configurability of the products is absent or developed, whether or not a professional configurator is available, whether it is considered the entire process or only some specific aspects, etc.

The training path should ideally have parts in which the learner has an active role, possibly both in the evaluation and in the building of specific supports for the digitalization of the configuration process. Obviously, this can greatly increase the time required for the training course. Therefore, especially for small companies, it could be useful to analyze configuration websites, or to build simple configurators on Excel, or to break the training path into pills that allow learners to take a gradual path.

Especially in the case of individual companies, it should be considered the possibility of using training methods based on coaching and, in general, on learning through evaluation of concepts in a specific business context. In this case, the use in teams of tools developed for MC 4.0 implementation guidelines may also be useful. These tools are diagnostic tools but can also be used as teaching tools.

From what has been said above, a reference training course varies from 24 to 80 hours. Note that the minimum duration of the training course may be sufficient in companies that are already able to offer configurable products but it is not sufficient for companies that do not offer configurable products and therefore have never applied a configurational approach. In addition, if the company is going to make a consistent digitalization of a configuration process, the duration of the accompanying training path can also be significantly higher than the maximum reference duration.

## 8 Conclusion

Research on individual competencies for people working in mass customization environments is quite rare. Two exceptions are the works of Forza and Salvador [20] and Trentin et al. [17]. Even though these works are a source of reference for examples and considerations to better understand the issue of individual competencies in a customization environment, they do not consider a professional figure who superintends the management of variety and customization offered through a configurational approach. This paper contributes in this direction by proposing the professional figure of the Configuration Manager. More specifically, we illustrated the processes in which this manager is involved and the activities he or she has to perform. Subsequently, we provided

indications on soft and technical skills as well as the knowledge that this manager should have. We compared the figure with existing skill classification systems on the European as well as the national level and we described the Configuration Manager figure by using standard descriptors used in these systems.

The evaluation of this figure with managers, SMEs association, and training center managers showed that all companies engaged in customization recognized a company's need for the listed individual competencies. Some companies recognized the presence of this figure in their organizational chart, even though addressed by different names for the respective role or position. Other companies, less advanced in mass customization, thought that this professional figure includes so many competencies that it becomes very difficult to find adequate personnel willing to work for an SME. Other companies said that due to their small size it was difficult for them to get the required competencies from outside and that they have to develop them internally. Other companies said that they have two persons that together have the competencies covered by this figure. So the situation in the practical world is highly differentiated. The message that emerges very strongly is that the listed competencies are needed but how they are developed and located is a highly complex issue. Consequently, this opens a very wide opportunity and field for future research.

We think we have thrown a stone, we have opened a discussion regarding the Configuration Manager figure in companies having different sizes. We believe it is scientifically and practically relevant. However, this is only the first step. Starting from this point, a future research opportunity could be to see whether different training programs do have different effects to train specific capability of this professional figure. Another opportunity could be to see how specific capabilities reduce the configurator implementation challenges or enhance a company's mass customization capability.

## ACKNOWLEDGMENTS

We acknowledge financial support from the MC 4.0 Interreg V-A Italia–Austria project, Project ID: ITAT 1057. We would like to thank our MC 4.0 project partners and in particular Elena Fassa and Enrico Bressan for their help in assessing the professional figure and comments and which helped improve this research work considerably.

## REFERENCES

- [1] Cipriano Forza and Fabrizio Salvador. 2006. Product information management for mass customization: connecting customer, front-office and back-office for fast and efficient customization. Palgrave Macmillan, London, UK.
- [2] Nikolaus Franke, Peter Keinz and Martin Schreier. 2008. Complementing mass customization toolkits with user communities: how peer input improves customer self-design. *Journal of Product Innovation Management*, 25, 6, 546-559. DOI: <https://doi.org/10.1111/j.1540-5885.2008.00321.x>.
- [3] Frances Turner, Aurélie Merle and David Gotteland. 2020. Enhancing consumer value of the co-design experience in mass customization. *Journal of Business Research*, 117, September, 473-483. DOI: <https://doi.org/10.1016/j.jbusres.2020.05.052>.
- [4] Nikola Suzić, Enrico Sandrin, Svetlana Suzić, Cipriano Forza, Alessio Trentin and Zoran Anišić. 2018. Implementation guidelines for mass customization: a researcher-oriented view. *International Journal of Industrial Engineering and Management*, 9, 4, 229-243. DOI: <http://doi.org/10.24867/IJEM-2018-4-229>.
- [5] Alessio Trentin, Elisa Perin and Cipriano Forza. 2012. Product configurator impact on product quality. *International Journal of Production Economics*, 135, 2, 850-859. DOI: <https://doi.org/10.1016/j.ijpe.2011.10.023>.
- [6] Fabrizio Salvador and Cipriano Forza. 2004. Configuring products to address the customization-responsiveness squeeze: a survey of management issues and opportunities. *International Journal of Production Economics*, 91, 3, 273-291. DOI: <https://doi.org/10.1016/j.ijpe.2003.09.003>.
- [7] Alessio Trentin, Elisa Perin and Cipriano Forza. 2011. Overcoming the customization-responsiveness squeeze by using product configurators: beyond anecdotal evidence. *Computers in Industry*, 62, 3, 260-268. DOI: <http://dx.doi.org/10.1016/j.compind.2010.09.002>.
- [8] Katrin Kristjansdottir, Sara Shafiee, Lars Hvam, Cipriano Forza and Niels Henrik Mortensen. 2018. The main challenges for manufacturing companies in implementing and utilizing configurators. *Computers in Industry*, 100, 196-211. DOI: <https://doi.org/10.1016/j.compind.2018.05.001>.
- [9] Sara Shafiee, Katrin Kristjansdottir, Lars Hvam and Cipriano Forza. 2018. How to scope configuration projects and manage the knowledge they require. *Journal of Knowledge Management*, 22, 5, 982-1014. DOI: <https://doi.org/10.1108/JKM-01-2017-0017>.
- [10] Sara Shafiee, Yves Wautelet, Lars Hvam, Enrico Sandrin and Cipriano Forza. 2020. Scrum versus Rational Unified Process in facing the main challenges of product configuration systems development. *Journal of Systems and Software*, 170, December, 1-23. DOI: <https://doi.org/10.1016/j.jss.2020.110732>.
- [11] Lars Hvam, Simon Pape and Michael K. Nielsen. 2006. Improving the quotation process with product configuration. *Computers in Industry*, 57, 7, 607-621. DOI: <http://dx.doi.org/10.1016/j.compind.2005.10.001>.
- [12] European Union. 2018. Key competences for lifelong learning: a European reference framework. *Official Journal of the European Union*, 61, C189, 7-13. DOI: <doi/10.2766/569540>.
- [13] Richard E. Boyatzis, Scott S. Cowen and David A. Kolb. 1995. *Innovation in Professional Education: Steps on a Journey from Teaching to Learning*. Jossey-Bass, San Francisco, CA.
- [14] Lyle M Spencer and Signe M Spencer. 1993. *Competence at Work: Models for Superior Performance*. John Wiley & Sons, Inc., New York, NY.
- [15] B. Joseph Pine. 1993. *Mass Customization: The New Frontier in Business Competition*. Harvard Business School Press, Cambridge, MA.
- [16] Brian Squire, Steve Brown, Jeff Readman and John Bessant. 2006. The impact of mass customisation on manufacturing trade-offs. *Production and Operations Management*, 15, 1, 10-21. DOI: <https://doi.org/10.1111/j.1937-5956.2006.tb00032.x>.
- [17] Alessio Trentin, Tatiana Somià, Enrico Sandrin and Cipriano Forza. 2019. Operations managers' individual competencies for mass customization. *International Journal of Operations & Production Management*, 39, 9/10, 1025-1052. DOI: <https://doi.org/10.1108/IJOPM-10-2018-0592>.
- [18] Enrico Sandrin, Alessio Trentin and Cipriano Forza. 2014. Organizing for mass customization: literature review and research agenda. *International Journal of Industrial Engineering and Management*, 5, 4, 159-167. DOI: [https://www.iim.ftn.uns.ac.rs/images/journal/volume5/ijiem\\_vol5\\_no4\\_1.pdf](https://www.iim.ftn.uns.ac.rs/images/journal/volume5/ijiem_vol5_no4_1.pdf).
- [19] Giovanni Da Silveira, Denis Borenstein and Flávio S. Fogliatto. 2001. Mass customization: literature review and research directions. *International Journal of Production Economics*, 72, 1, 1-13. DOI: [https://doi.org/10.1016/S0925-5273\(00\)00079-7](https://doi.org/10.1016/S0925-5273(00)00079-7).
- [20] Cipriano Forza and Fabrizio Salvador. 2006. HRM policies for mass customization: understanding individual competence requirements and training needs for the mass customizing industrial company. In T. Blecker and G. Friedrich (eds.) *Mass Customization: Challenges and Solutions*. Springer, New York, NY. DOI: [10.1007/0-387-32224-8\\_12](https://doi.org/10.1007/0-387-32224-8_12).

## APPENDIX

**Table 1: Placement of the Configuration Manager among the ESCO profiles, the NUP ISTAT profiles, and areas of activities of the “Atlante del Lavoro”**

ESCO profiles			NUP ISTAT (ISTAT CP2011) profiles	“Aree di Attività” (ADA) from “Atlante del Lavoro”*
English	German	Italian		
<a href="#">1223 - Research and development managers</a> <ul style="list-style-type: none"> <li>• <a href="#">product manager</a></li> <li>• <a href="#">research and development manager</a></li> </ul>	<a href="#">1223 - Führungskräfte in Forschung und Entwicklung</a> <ul style="list-style-type: none"> <li>• <a href="#">Produktleiter/Produktleiterin</a></li> <li>• <a href="#">Forschungs- und Entwicklungsleiter/Forschungs- und Entwicklungsleiterin</a></li> </ul>	<a href="#">1223 - Dirigenti nel settore ricerca e sviluppo</a> <ul style="list-style-type: none"> <li>• <a href="#">responsabile di prodotto</a></li> <li>• <a href="#">responsabile di ricerca e sviluppo</a></li> </ul>	<a href="#">1.2.3.7.0 - Direttori e dirigenti del dipartimento ricerca e sviluppo</a>	
<a href="#">1221 - Sales and marketing managers</a> <ul style="list-style-type: none"> <li>• <a href="#">commercial director</a></li> </ul>	<a href="#">1221 - Führungskräfte in Vertrieb und Marketing</a> <ul style="list-style-type: none"> <li>• <a href="#">Kaufmännischer Leiter/Kaufmännische Leiterin</a></li> </ul>	<a href="#">1221 - Dirigenti nei servizi di vendita e commercializzazione</a> <ul style="list-style-type: none"> <li>• <a href="#">direttore commerciale/direttrice commerciale</a></li> </ul>	<a href="#">1.2.3.3.0 - Direttori e dirigenti del dipartimento vendite e commercializzazione</a>	<a href="#">24.04.06 - Pianificazione strategica della rete di vendita diretta e online</a>
<a href="#">1330 - Information and communications technology service managers</a> <ul style="list-style-type: none"> <li>• <a href="#">chief information officer</a></li> <li>• <a href="#">chief technology officer</a></li> <li>• <a href="#">ICT project manager</a></li> <li>• <a href="#">chief data officer</a></li> </ul>	<a href="#">1330 - Führungskräfte in der Erbringung von Dienstleistungen im Bereich Informations- und Kommunikationstechnologie</a> <ul style="list-style-type: none"> <li>• <a href="#">IT-Leiter/IT-Leiterin</a></li> <li>• <a href="#">Technischer Leiter/Technische Leiterin</a></li> <li>• <a href="#">IT-Projektmanager/IT-Projektmanagerin</a></li> <li>• <a href="#">Leiter der Datenverarbeitung/Leiterin der Datenverarbeitung</a></li> </ul>	<a href="#">1330 - Dirigenti nei servizi delle tecnologie dell’informazione e della comunicazione</a> <ul style="list-style-type: none"> <li>• <a href="#">direttore dei sistemi informatici/direttrice dei sistemi informatici</a></li> <li>• <a href="#">direttore dei servizi tecnologici/direttrice dei servizi tecnologici</a></li> <li>• <a href="#">project manager TIC</a></li> <li>• <a href="#">responsabile della gestione dati</a></li> </ul>	<a href="#">1.2.3.6.0 - Direttori e dirigenti del dipartimento servizi informatici</a>	
<a href="#">2421 - Management and organisation analysts</a> <ul style="list-style-type: none"> <li>• <a href="#">business analyst</a></li> <li>• <a href="#">business consultant</a></li> <li>• <a href="#">business intelligence manager</a></li> </ul>	<a href="#">2421 - Akademische und vergleichbare Fachkräfte im Bereich Management- und Organisationsanalyse</a> <ul style="list-style-type: none"> <li>• <a href="#">Unternehmensanalyst/Unternehmensanalytistin</a></li> <li>• <a href="#">Unternehmensberater/Unternehmensberaterin</a></li> <li>• <a href="#">Business-Intelligence-Manager/Business-Intelligence-Managerin</a></li> </ul>	<a href="#">2421 - Analisti della gestione e organizzazione</a> <ul style="list-style-type: none"> <li>• <a href="#">analista di business</a></li> <li>• <a href="#">consulente di gestione aziendale</a></li> <li>• <a href="#">responsabile business intelligence</a></li> </ul>	<a href="#">2.5.1.3.2 - Specialisti dell’organizzazione del lavoro</a> <a href="#">2.5.3.1.2 - Specialisti dell’economia aziendale</a> <a href="#">2.5.1.2.0 - Specialisti della gestione e del controllo nelle imprese private</a>	<a href="#">14.01.01 - Definizione della strategia IT (Information Technology) e suo allineamento al business</a> <a href="#">24.03.02 - Organizzazione e sviluppo organizzativo</a> <a href="#">24.05.03 - Gestione dei progetti (Project management)</a>
<a href="#">2141 - Industrial and production engineers</a> <ul style="list-style-type: none"> <li>• <a href="#">industrial engineer</a></li> </ul>	<a href="#">2141 - Wirtschafts- und Produktionsingenieure</a> <ul style="list-style-type: none"> <li>• <a href="#">Wirtschaftsingenieur/Wirtschaftsingenieurin</a></li> </ul>	<a href="#">2141 - Ingegneri industriali e gestionali</a> <ul style="list-style-type: none"> <li>• <a href="#">ingegnere industriale</a></li> </ul>	<a href="#">2.2.1.7.0 - Ingegneri industriali e gestionali</a>	<a href="#">24.05.04 - Programmazione della produzione</a>
<a href="#">2511 - Systems analysts</a> <ul style="list-style-type: none"> <li>• <a href="#">ICT business analyst</a></li> <li>• <a href="#">enterprise architect</a></li> <li>• <a href="#">user experience analyst</a></li> </ul>	<a href="#">2511 - Systemanalytiker</a> <ul style="list-style-type: none"> <li>• <a href="#">IT-Business-Analyst</a></li> <li>• <a href="#">Enterprise Architecture Manager/Enterprise Architecture Managerin</a></li> <li>• <a href="#">User Experience Analyst</a></li> </ul>	<a href="#">2511 - Analisti di sistema</a> <ul style="list-style-type: none"> <li>• <a href="#">analista business dei sistemi TIC</a></li> <li>• <a href="#">responsabile dell’organizzazione aziendale</a></li> <li>• <a href="#">analista della user experience</a></li> </ul>	<a href="#">2.1.1.4.1 - Analisti e progettisti di software</a> <a href="#">2.1.1.4.2 - Analisti di sistema</a>	<a href="#">14.01.01 - Definizione della strategia IT e suo allineamento al business</a> <a href="#">14.01.02 - Monitoraggio dei Trend tecnologici</a> <a href="#">14.01.03 - Innovazione nell’ambito ICT</a> <a href="#">14.01.14 - Ingegnerizzazione di sistemi ICT</a>

\* Areas of activities of the “Atlante del Lavoro” that are relevant to the Configuration Manager and which are associated with ISTAT CP2011 profiles