8th International Conference on Mass Customization and Personalization – Community of Europe (MCP-CE 2018)
Digital Customer Experience
September 19-21, 2018, Novi Sad, Serbia

# A REVIEW OF MASS CUSTOMIZATION IMPLEMENTATION GUIDELINES TO SUPPORT RESEARCHERS

**Nikola Suzić[1], Enrico Sandrin[1], Svetlana Suzić[1], Cipriano Forza[1], Alessio Trentin[1], Zoran Anišić[2]**
[1]Department of Management and Engineering, University of Padova, Vicenza, Italy
[2]Department of Industrial Engineering and Management, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Republic of Serbia

**Abstract:** *Mass customization (MC) is a concept that is gaining constant attention in both industry and academia. Recently MC implementation guidelines have been identified as an emerging sub-stream of MC research. A review of this sub-stream has been performed taking the perspective of the practitioners. In the present paper we focus on the researchers' need to frame and develop the future MC implementation guidelines. By providing data generated from the systematic literature review on MC implementation guidelines we inform the researchers on how much and in which way a certain aspect of MC implementation guidelines has been considered in the available guidelines. In result, with systematic and detailed description of the previous works, the present paper supports researchers to clearly communicate (to other researchers) similarities and differences of their research and to frame and write their works.*

**Key Words:** ***mass customization, implementation guidelines, literature review, product platform, modularity, group technology, part standardization, form postponement, concurrent product-process-supply chain engineering, product configuration***

## 1. INTRODUCTION

In order to enhance the readability and communication of the present article, a couple of definitions will be provided straight on at the beginning of the paper. These definitions are based on the previous part of the research that was conducted in [1]:

- *Mass customization (MC)* 'is defined as an organization's ability to provide customized products and services that fulfil each customer's idiosyncratic needs without considerable trade-offs in cost, delivery, and quality' ([1] based on [2]–[5]
- *MC implementation guidelines (MC-IGs)* 'are intended to guide company transformation towards MC. They do so by providing:
  - o An overview of MC
  - o The applicability context of the IGs
  - o As-is analysis tools to assess the company's current situation
  - o Exemplified implementation instructions of MC enablers
  - o Required resources for implementation of MC enablers
  - o Factors that may hinder implementation of MC enablers' [1]
- *MC enablers* 'are technology- and organization-based factors that support the development of MC capabilities' ([1] based on [6], [7])

In order to help researchers in framing and developing the future MC implementation guidelines, the present work reports the detailed data generated from the systematic literature review of the available MC implementation guidelines. These data inform the researchers about how much a certain aspect of MC implementation guidelines has been considered, and the way in which it has been presented. Therefore, the researcher can have specific hints on how to homogenize his work with previous works or how he can differentiate his work from the previous works. Thus, while in [1] the focus was on what is needed to research to better satisfy the needs of practitioners in terms of MC implementation guidelines, in the present research the focus is on how the research is done and communicated in order to facilitate the researcher in valuing the results of his research. The issue of communication is of high importance for researchers since once the appropriate content (i.e. the one that most satisfies the need of practitioners) has been addressed [1], the researcher has subsequently the need to communicate to other researchers his findings. Therefore, the similarities or the differences of the one's research with the previous ones should be consider in the framing, but even more in the writing of the research outputs.

Therefore, the present work is continuation of the research done in [1] which focused on identification of characteristics of available MC implementation guidelines and generating suggestions for their improvement from mainly practitioners' point of view.

During the research we decided to split the output in two articles, with the first article focusing on practitioners' point of view [1] and the second one (i.e. the present article) providing additional information focused on the information needs of the MC-IG researchers. The reason for publishing two articles on the same data analysis comes from the fact that, while summarizing results of MC implementation guidelines classification through application of the inductive coding scheme ([1] and the present researach), it became obvious that amount of the generated data surpasses the scope of one publication. Moreover, it became evident that if all results would be presented in one article, the focus of the article would be lost and the contribution unclear. In the present article we provide, among others, the following additional information: the details of the inductive coding process and the exact coverage of each code in percentages.

The rest of this article is organized in three sections, namely: Literature review method, Results and opportunities for improvement of MC implementation guidelines, and Discussion and conclusions. The 'Literature review method' section provides information on the search and selection strategy, the coding process and the coding criteria. The 'Results and opportunities for improvement of MC implementation guidelines' section provides a detailed numerical description of the results as well as additional incremental opportunities for MC implementation guideline improvements. The 'Discussion and conclusions' section discussed contribution of the present research in comparison to the previously conducted MC literature reviews.

## 2. LITERATURE REVIEW METHOD

The literature review is a method usually used for summarizing the state of the art in the subject field and for identification of the future research opportunities [8]. In order to secure the replicability of the research we set to clearly define the research method [8]–[10]. Thus, in remainder of this section, we present the search strategy, article selection process, coding criteria and coding process applied.

### 2.1. Search strategy and article selection

We focused our literature review on IGs available in academic literature to introduce MC starting from current (as-is) situation of the company. Replicating the search strategy of Fogliatto, da Silveira and Borenstein [11], we used the terms 'mass customization'/'mass customisation' in order to concentrate on papers dealing with MC. In addition, in order to focus on notions of 'implementation guidelines' or 'implementation methodology', these two search terms were combined (by using the AND operator) with at least one of the following terms (i.e. by using any of the following terms connected with the OR operator): 'implementation', 'methodology', 'mov*' (moving towards, etc.), 'enabl*' (enabler, enabling, enable, etc.), 'adopt*' (adoption, adopt, etc.), 'obstacl*' (obstacle, obstacles, etc.) or 'guid*' (guide, guidelines, etc.). The use of these keywords to search for IGs is based on the synonymous way in which the terms 'implementation guidelines' and/or 'implementation methodology' are used in the management literature dealing with implementation (cf. [12], [13]).

The search was conducted on Article Title, Abstract and Keywords in the Scopus database. The search encompassed articles published up to March 2015. Conference papers, conference reviews, books and book chapters were excluded from the search. This choice follows the motivation provided by Fogliatto, da Silveira and Borenstein [11], who assert that the field of MC research is mature enough to allow searches for significant research contributions in articles only. Furthermore, only publications in the English language were taken into account. Using these search criteria, the initial search yielded 549 articles (Table 1).

These 549 articles were further selected based on the quality of the journal in which they were published. Scimago database rankings were used as a measure of journal quality. A journal and its publications were taken into account only if all subject categories in which the journal was classified in the Scimago database were ranked Q1 or Q2 in the Scimago rankings for the year 2013. This criterion led to a total of 387 publications published in 145 journals.

A number of these 387 articles are not really intended to guide MC implementation in practice (some of them being review articles, some dealing with MC enabler typologies, etc.). Thus, we developed a set of three criteria to further refine our article selection ([1] – Table 1).

After the criteria were established, we could further narrow the selection of the articles. We read the abstracts and applied criterion 1, in this way excluding articles that are not intended to guide MC implementation in practice. Conservative approach was applied in the selection process, bringing the articles for which a clear decision could not be made in this step to the next selection step. This meant that criterion 1 had to be applied also in the next step. In effect, 235 articles passed the abstract reading.

Among 235 articles some deal with several MC enablers, while others deal with only one MC enabler. MC implementation guidelines should consider multiple MC enablers [7], [11], [22], [23], [14]–[21] and use a holistic approach to MC implementation [20], [22], [24], [25]. Thus, in present research, we do not regard articles covering single MC enablers as MC-IGs. In result, we further selected articles based on the shared belief that, in order to achieve MC, two or more MC enablers should be implemented - criteria 2 and 3. We further full text read 235 articles using criteria 2 and 3 in combination with criterion 1, and finally ended up with 20 relevant articles. Table 1 shows the overview of the article search and selection process which is exactly the same adopted by [1].

This small but emerging MC research sub-stream (i.e. 20 articles published in 5 year period 2010-2015) is highly dispersed - 17 journals. There is also notable prevalence of engineering and industrial engineering journals among the sources.

Table 1. *Article search and selection steps*

| Step | Search/ selection step | Criteria used | Resulting number of articles |
|---|---|---|---|
| 1 | Initial search | -Search with keywords* in Title, Abstract and Keywords in Scopus database<br>-Excluded conference papers/reviews, books and book chapters (Fogliatto et al., 2012)<br>-Excluded non-English papers<br>*keywords used: 'mass customization'/'mass customisation' in combination with at least one of the following terms: 'implementation', 'methodology', 'mov*' (moving towards etc.), 'enabl*' (enabler, enabling, enable, etc.), 'adopt*' (adoption, adopt, etc.), 'obstacl*' (obstacle, obstacles, etc.) or 'guid*' (guide, guidelines, etc.) | 549 |
| 2 | Publication quality selection | -Selection based on the journal ranking (keeping articles from Q1 and Q2 journals in Scimago database) | 387 |
| 3 | Abstract reading | *Criterion 1* Article states the objective of developing MC-IGs or claims to contribute to guiding the implementation of MC | 235 |
| 4 | Full text reading | *Criterion 1*<br>AND<br>(*Criterion 2* Article provides information about the order in which two or more MC enablers should be implemented<br>OR<br>*Criterion 3* Article provides implementation instructions for each of two or more MC enablers, regardless of whether or not it fulfils Criterion 2) | 20 |

### 2.2. Coding process and coding criteria

We opted to build our classification scheme in an inductive manner [26] since our search of the MC literature did not reveal a research framework suitable for conducting deductive analysis of the relevant articles. Inductive analysis 'refers to approaches that primarily use detailed readings of raw data to derive concepts, themes, or a model through interpretations made from the raw data by an evaluator or researcher' with a primary purpose 'to allow research findings to emerge from the frequent, dominant, or significant themes inherent in raw data, without the restraints imposed by structured methodologies' [26: p.238]. This absence of preconception in the analysis of scientific contributions is one of the reasons why in recent years inductive analysis has been gaining significance as a data analysis strategy in systematic literature reviews [27]–[31].

The inductive coding process consisted of five phases (Table 2), during which, articles were read several times in order to identify themes and categories (coding dimensions and codes). After the initial identification of specific relevant text segments (phases 1 and 2, Table 2), text segments were labelled and a provisional classification scheme was created and applied to the articles (phase 3). Next, the tentative scheme was iteratively refined based on group discussions, and the articles were re-classified (phase 4, Table 2). This iterative process continued until complete agreement was reached among the researchers. After the final classification of the articles, the MC-IG building blocks were identified by marking out the subset of coding dimensions that directly address the content of MC-IGs (phase 5, Table 2).

Table 2. *The steps of the inductive analysis coding process (based on [26], [32])*

| Phase number | Phases of the inductive analysis coding process (based on [26], [32]) | Description of the coding phase | Resulting number of categories |
|---|---|---|---|
| 1 | Initial reading of text data | Initial reading of the relevant articles (done in the selection process) | Categories not yet defined |
| 2 | Identify specific text segments related to objectives | Initial identification of text segments dealing with MC-IGs | Multiple potential categories |
| 3 | Label the segments of text to create categories | Creation and application of a tentative classification scheme | 123 |
| 4 | Reduce overlap and redundancy among categories | Iterative refinement of the tentative classification scheme through discussion in research team | 57 (16 coding dimensions/sub-dimensions and 41 codes/sub-codes) |
| 5 | Create a model incorporating the most important categories | Deriving of MC-IG building blocks by marking out the subset of coding dimensions that directly address the content of MC-IGs | 7 (MC-IG building blocks) |

## 3. RESULTS AND OPPORTUNITIES FOR IMPROVEMENT OF MC IMPLEMENTATION GUIDELINES

The 20 selected articles were analysed carefully via full-text reading. They were classified based on (1) MC overview, (2) MC implementation instructions, (3) applicability context of the guidelines, (4) required resources, (5) as-is analysis tools, (6) hindrance factors, (7) instruction exemplification, (8) instruction format and (9) research method.

### 3.1. Mass customization overview

'MC overview presents the essentials of the MC concept. These essentials include a definition of MC, a list of MC enablers, definitions of MC enablers, a set of the basic MC enabler relationships, a list of the company departments involved in implementing MC, a set of the benefits derived from MC implementation and a set of the benefits derived from each MC enabler implementation. The MC definition and the list of MC

enablers together comprise a minimum MC overview' [1].

The analysis of available MC implementation guidelines shows that:

- only 20% of articles provide an overview of MC (Table 3)
- articles differ substantially regarding the provided MC overviews:
  - some articles cover a wide range of MC overview components (e.g. [20], [33])
  - while other articles address only a few MC overview components
- a definition of MC is provided in 65% of MC-IGs. Moreover, most of the MC-IGs (54%) refer to Pine's definition of MC [3]
- some MC enabler definitions are provided in 90% of the MC-IGs. Usually, these definitions are limited to the MC enablers that fall within the article's scope

Table 3. *Summary of the articles, classified according to MC overview*

| Coding dimension | Codes | Number of articles | Percent of articles |
|---|---|---|---|
| MC overview | MC overview provided | 4 | 20% |
| | MC overview not provided | 16 | 80% |
| Total number of articles | | 20 | 100% |

The MC overview should ideally include all MC overview essentials. This information enables the practitioner to understand the main characteristics of MC and the position of MC among other manufacturing strategies (e.g. mass production, craft production, etc.) and to make a first assessment of his/her own company's position regarding MC.

### 3.2. MC implementation instructions

'MC implementation instructions describe how to implement MC. They indicate which MC enablers to implement and the steps to implement them' [1]. MC implementation instructions can be classified into two types depending on their scope:

(1) 'Single enabler' implementation instructions – 'are presented as guidance to implement one specific MC enabler in practice' [1]

(2) 'Bundled enabler' implementation instructions – 'are implementation instructions that define relationships between two or more enablers. The relationship can be one of precedence, embeddedness or parallel implementation. While 'single enabler' implementation instructions aim to provide detailed implementation instructions for one specific enabler, 'bundled enabler' implementation instructions aim to define the relationships between two or more enablers' [1]

*The enablers considered in the implementation instructions*. Eight enablers are considered in the 'single enabler' implementation instructions and/or the 'bundled enabler' implementation instructions in the articles (Table 4), namely: group technology, part standardization, product modularization, process modularity, product platform development, information technology (IT)-based product configuration, form postponement, and concurrent product-process-supply chain engineering. For definitions of MC enablers please refer to [1].

The analysis of available MC implementation guidelines shows that:

- the number of enablers for which 'single enabler' implementation instructions are provided varies considerably across articles (Table 5)
- in most cases (75% of articles) these instructions are provided for two or three enablers per article – Table 5
- there are seven MC enablers for which at least one article provides 'single enabler' implementation instructions (Table 4)
- the enablers for which 'single enabler' implementation instructions are provided most frequently are product platform development and product modularization (14 articles – Table 4), part standardization and IT-based product configuration are present in six or seven articles, while least considered enablers are group technology (three articles), form postponement (two articles) and concurrent product-process-supply chain engineering for MC (one article)
- 'single enabler' implementation instructions may or may not include the sequence of activities. The sequence of activities is the constraint-driven order of the activities needed to implement one MC enabler. In order to be treated as a sequence, at least one constraint must be explicitly stated between the start and finish of the different MC implementation activities. An analysis of the articles that include 'single enabler' implementation instructions shows that 43% of the cases provided the sequence of activities to be done during the enabler implementation
- 'bundled enabler' implementation instructions are provided in all 20 articles (Table 6). Notably, the selection criteria allowed the retention of articles that do not explicitly provide 'bundled enabler' implementation instructions. However, a very careful reading of these articles revealed the presence of implicit 'bundled enabler' implementation instructions. For this reason, instructions were categorized not only according to the number of enablers participating in the relationship, but also according to the degree of explicitness (explicit, implicit, in part explicit and in part implicit) of the presentation of the relationships among the implementations of different enablers. The result is that most 'bundled enabler' implementation instructions are provided for three enablers (nine articles) or two enablers (eight articles) and are explicitly provided in 14 (70%) articles (Table 6)
- 'bundled enabler' implementation instructions can refer to different relationships between enablers [1]. Thus, alternative relationships could be one of the following:
  - Precedence relationship – 'when IGs state that one enabler should be implemented before the other enabler' [1]. For example, instructions can

state that part standardization must precede product modularization in the implementation process. According to a precedence relationship, one enabler should be sequenced before or after another enabler.

- o Embeddedness relationship – 'when IGs state that the implementation of one enabler is a part of another enabler's implementation' [1]. For example, implementation guidelines could indicate that product modularization is not an independent enabler but is a part of product platform development. In this case, the product modularization enabler is embedded in the product platform development enabler.
- o Parallel implementation – 'when IGs state that one enabler should be implemented at the same time as another enabler' [1]. For example, instructions can state that form postponement should be implemented at the same time as product platforms are developed.

A detailed analysis of enabler relationships available in the MC-IGs shows that precedence relationships, i.e. the sequential logic, dominates the resulting relationships model [1]. However, the detailed analysis of enabler relationships goes out of the scope of this paper. Thus, for detailed relationships analysis please refer to [1].

Table 4. *List of used enablers in the articles, with frequency of appearance (based on 'single enabler' implementation instructions provided)*

| Enabler name | Number of articles in which 'single enabler' implementation instructions are provided | Percent of articles in which 'single enabler' implementation instructions are provided |
|---|---|---|
| Product platform development | 14 | 70% |
| Product modularization | 14 | 70% |
| Part standardization | 7 | 35% |
| IT-based product configuration | 6 | 30% |
| Group technology | 3 | 15% |
| Form postponement | 2 | 10% |
| Concurrent product-process-supply chain engineering | 1 | 5% |
| Process modularity | 0 | 0% |

The number of enablers for which 'single enabler' implementation instructions are provided per article (usually two or three – Table 5) and the number of enablers which are related through 'bundled enabler' implementation instructions per article (usually two or three – Table 6) is relatively small, bearing in mind that, in total, eight different enablers were recorded in the articles in our study (Table 4). We suggest that this narrow research scope is usually a consequence of the researchers' previous experiences and opinions regarding the most important enablers for MC implementation. We conclude that widening the scope of the enablers addressed through MC implementation instructions in future developed MC-IGs should be set as a goal.

Table 5. *Summary of the articles classified according to 'single enabler' implementation instructions*

| Coding dimension | Codes | Count per article | Number of articles | Percent of articles |
|---|---|---|---|---|
| 'Single enabler' implementation instructions | 'Single enabler' implementation instructions provided for… | 6 or more enablers | 0 | 0% |
| | | 5 enablers | 1 | 5% |
| | | 4 enablers | 1 | 5% |
| | | 3 enablers | 6 | 30% |
| | | 2 enablers | 9 | 45% |
| | | 1 enabler | 2 | 10% |
| | 'Single enabler' implementation instructions not provided | …not provided | 1 | 5% |
| Total number of articles | | | 20 | 100% |

Table 6. *Summary of the articles classified according to inclusion of enablers in 'bundled enabler' implementation instructions*

| Coding sub-dimension | Codes | Count per article | Way of presenting the relationships in the article | | | No. of articles (percent) |
|---|---|---|---|---|---|---|
| | | | E* | I | E/I | |
| Inclusion of enablers in 'bundled enabler' implementation instructions | 'Bundled enabler' implementation instructions provided | 6 related enablers | 1 | 0 | 0 | 1 (5%) |
| | | 5 related enablers | 0 | 1 | 1 | 2 (10%) |
| | | 4 related enablers | 0 | 0 | 0 | 0 (0%) |
| | | 3 related enablers | 6 | 2 | 1 | 9 (45%) |
| | | 2 related enablers | 7 | 1 | 0 | 8 (40%) |
| | 'Bundled enabler' implementation instructions not provided | No related enablers | N ** | N | N | 0 (0%) |
| Total number of articles | | | 14 | 4 | 2 | 20 (100%) |

** E – explicit; I –implicit; E/I – in part explicit and in part implicit; ** N – not applicable*

### 3.3. Applicability context of the guidelines

'The applicability context of the guidelines concerns the generalisability of the MC-IGs. The applicability context provides the limits of validity for the proposed guidelines. For example, the industry, types of products and size of the company represent the applicability context of the guidelines' [1].

The analysis of available MC implementation guidelines shows that:

- only 35% of the articles explicitly cover applicability context dimension (first two codes in Table 7), which shows that generalizability tends not to be justified openly in the articles
- only two articles that address the generalizability issue were found Kudsk, Hvam et al. [34] indicated generalizability by stressing similarities between the building construction industry and the cement

factory design/construction sector, while Ismail et al. [35] based their applicability context on a widely recognized characteristic of SMEs: the lack of resources
- most of the articles deal with manufacturing (90%)
- only 5% of articles deal with services
- the articles that deal with manufacturing mostly address mechanical production, electronics and construction (e.g. complex products such as cars, industrial steam turbines, computers, etc.)
- country and market are not addressed as applicability contexts in the articles

Table 7. *Summary of the articles classified according to applicability context of the guidelines*

| Coding dimension | Codes | Number of articles | Percent of articles |
|---|---|---|---|
| Applicability context of the guidelines | Applicability context specified and justified | 2 | 10% |
| | Applicability context specified | 5 | 25% |
| | Applicability context not explicitly specified but self-evident | 12 | 60% |
| | Applicability context not explicitly specified and not self-evident | 1 | 5% |
| Total number of articles | | 20 | 100% |

Our research has shown that MC-IGs could be improved by stating their applicability context, but further development of implementation guidelines will probably require that they be developed with a specific context in mind (e.g. SMEs, furniture industry, etc.). This viewpoint is further supported by Sousa and Voss [36: p.711], who state that 'the failure to acknowledge the limits of applicability of OM practices may lead to their application in contexts to which they are not suitable'. Moreover, some of the questions to be considered related to the applicability context of the guidelines are: What are the characteristics of the context that are relevant for IG development and utilization (e.g. level of product customization, industry sector, service-manufacturing distinction, company size, etc.)? Which context variables are relevant for tailoring the IGs for each case of MC implementation? Which components of the IGs are context dependent and which are not? In addition, the maturity level of the MC implementation could be considered as a specific aspect of the applicability context that could influence the significance of specific MC enablers for a company with a different MC implementation maturity level.

### 3.4. Required resources

'Required resources are the resources needed to implement MC or one or more MC enablers. Some examples of required resources are financial resources, time, human resources and other resources required for MC implementation ' [1].

The analysis of available MC implementation guidelines shows that:
- only 20% of the articles address required resources (Table 8)
- resources required to implement MC are addressed in a relatively superficial way
- usually, when resources are addressed, only a single resource is addressed per article
- the types of resources addressed are:
  - financial resources (e.g. cost of a product configurator through an estimated 'cost of the software' based on prior experiences in MC implementation - [34: p.96]; and 'additional costs for developing a new platform' - [37: p.5])
  - human resources (e.g. '[c]ost of labour training to assemble a certain platform type' - [38: p.1003]; and human resources for developing a configuration system, i.e. 'it was deemed necessary to use four man years to develop the system' - [34: p.96])
  - generic resources (e.g. 'significant efforts' needed for optimizing a software product platform - [39: p.104])
- set of required resources is usually limited to the scope of the article, and includes, at the most, those resources required for implementing the one or two MC enablers considered in the article, usually not taking into account the overall implementation of MC

Table 8. *Summary of the articles classified according to required resources*

| Coding dimension | Codes | Number of articles | Percent of articles |
|---|---|---|---|
| Required resources | Required resources addressed | 4 | 20% |
| | Required resources not addressed | 16 | 80% |
| Total number of articles | | 20 | 100% |

In our research, we found that the language for describing the resources required for MC implementation is not developed. There is no taxonomy of resources that is used in the MC-IG research sub-stream. The MC-IG sub-stream could probably draw from existing taxonomies and adapt them to make them MC specific.

### 3.5. As-is analysis tools

'As-is analysis tools support assessments of the current company situation concerning future MC implementation challenges. They can be in the form of procedures, formulae, templates and so on' [1].

The analysis of available MC implementation guidelines shows that:
- 25% of the articles include as-is analysis tools (Table 9)
- as-is analysis tools do not go beyond the scope of the MC enablers addressed in the article, using as-is analysis tools:
  - as a part of methodology for the development of product family architecture for MC [33]
  - for enabling implementation of IT-based product configuration [34], [40]
  - for a company analysis based on the customization level and product modularity type [41]
  - for applying product similarity measures to existing product families [35]

Table 9. *Summary of the articles classified according to as-is analysis tools*

| Coding dimension | Codes | Number of articles | Percent of articles |
|---|---|---|---|
| As-is analysis tools | As-is analysis tools provided | 5 | 25% |
| | As-is analysis tools not provided | 15 | 75% |
| | Total number of articles | 20 | 100% |

Research has shown that as-is analysis tools can vary substantially in different MC-IGs. In future research, the MC-IG research sub-stream could benefit from a comprehensive classification of the as-is analysis tools that are used. For example, a distinction could be made between the as-is analysis tools that are applied very quickly, providing an overall view of the company with regard to MC, and tools that are very detailed and can help the company understand exactly which MC enablers to implement. These detailed as-is analysis tools could eventually help to scope and pace implementation of MC enablers.

### 3.6. Hindrance factors

'Hindrance factors are variables that negatively affect MC implementation. They can appear in the form of resistance to change as well as various other obstacles, challenges, barriers, and so on' [1].

The analysis of available MC implementation guidelines shows that:

- only 15% of the articles address hindrance factors (Table 10)
- hindrance factors identified in the MC-IGs are:
  - resistance to change from managers and company engineers [34]
  - lack of resources [35]
  - need for additional employee training for MC [38]

Table 10. *Summary of the articles classified according to hindrance factors*

| Coding dimension | Codes | Number of articles | Percent of articles |
|---|---|---|---|
| Hindrance factors | Hindrance factors provided | 3 | 15% |
| | Hindrance factors not provided | 17 | 85% |
| | Total number of articles | 20 | 100% |

Although hindrance factors have been considered in some articles, there are still a number of open questions; for example, what are the exact hindrance factors? Are some hindrance factors interdependent? Do hindrance factors change from one phase of MC implementation to another? Are hindrance factors context dependent? Are hindrance factors related to the available and required resources? Furthermore, these proposed questions could be followed by indications of how to mitigate the influence of the hindrance factors, how to identify company-specific hindrance factors and whether the hindrance factors are common across the different MC enablers or should have different weights.

### 3.7. Instruction exemplification

'Instruction exemplification refers to providing an example of an implementation instruction's application. The example aims to show how an application of the implementation instruction would look in practice' [1].

The analysis of available MC implementation guidelines shows that:

- almost all articles exemplify the implementation instructions they provide (Table 11)
- examples can be used to (Table 12):
  - explain how the enabler should be applied in practice or
  - present an application of the implementation instructions
- implementation guidelines can contain both of previously stated applications

Table 11. *Summary of the articles classified according to instruction exemplification*

| Coding dimension | Codes | Number of articles | Percent of articles |
|---|---|---|---|
| Instruction exemplifica-tion | Exemplified implementation instructions | 18 | 90% |
| | Non-exemplified implementation instructions | 2 | 10% |
| | Total number of articles | 20 | 100% |

Table 12. *Purpose of exemplification in MC implementation guidelines*

| Coding sub-dimension | Sub-codes | Number of articles | Percent of articles |
|---|---|---|---|
| Exemplified implementa-tion instructions purpose | Explaining how the enabler should work when applied in practice (a) | 1 | 5,6% |
| | Example of implementation instructions application in practice (b) | 2 | 11,1% |
| | Examples used for both purposes (a+b) | 15 | 83,3% |
| | Total number of articles | 18 | 100% |

Instruction exemplification has high coverage in the articles we analysed (Tables 11 and 12). Further, we infer that authors considered exemplification an important part of the implementation instructions. We argue that this is due to the nature of knowledge transfer, where conveying ideas is more effective if an example is provided. We conclude that the need for providing examples for implementation instructions has been recognized by researchers and is fulfilled in the articles.

### 3.8. Instruction format

'Instruction format refers to the way implementation instructions are organized and presented. Depending on the instruction format, implementation instructions can be more or less well organized and presented' [1].

Implementation instructions can be provided in the following formats (definitions are taken from [1]):

(1) Textual format:
  (a) Plain text only – 'a case when instructions are presented in textual format without any kind of structure'
  (b) Organized text – 'a case when instructions are organized using bullet points, paragraphs or

sections, where every bullet point/paragraph/section provides instructions for one single activity'

(2) Graphical format – 'a case when instructions are provided through a graphical presentation, for example, in the form of a flow chart, drawing, chart, diagram, etc.'

(3) Tabular format – 'a case when instructions are given in the form of a table'

The analysis of available MC implementation guidelines shows that:

- codes are not mutually exclusive. Thus, one implementation instruction can be provided in multiple formats, leading to a higher total than the recorded number of implementation instructions (Table 13)
- 'single enabler' implementation instructions tend to provide a larger amount of information per instruction because they tend to be more detailed and elaborate. In result, 'single enabler' implementation instructions use 2 or 3 formats per instruction (2,8 on average) – Table 13
- bundled enabler' implementation instructions are often provided in a very brief form with much less information. In result, 'bundled enabler' implementation instructions use 1 or 2 formats per instruction (1,4 on average) – Table 13
- for most of the 'single enabler' instructions, both plain text (present in 74% of 'single enabler' implementation instructions) and the graphical format (89%) are used, with the addition of either organized text (49%) or a tabular format (66%) – Table 13
- 'bundled enabler' implementation instructions use plain text (present in 46% of the 'bundled enabler' implementation instructions), organized text (46%) or a graphical format (47%), and the three couplings of these three formats are equally distributed (Table 13)
- the tabular format is not used for 'bundled enabler' implementation instructions (Table 13)
- use of plain text and organized text is similar in both implementation instruction types, while the use of the graphical format differs
- in 'single enabler' implementation instructions, the graphical format, along with the tabular format, is mainly used to provide sufficiently detailed examples of enabler implementation
- for 'bundled enabler' implementation instructions, the graphical format is most often used to convey exact relationships between enablers

Our experience has shown that plain text instruction format takes more time to process and generates more interpretation disagreements among the readers than for the other three instruction formats used in MC-IGs (i.e. organized text, graphical format and tabular format). These findings imply that communication effectiveness of the plain text format is lower than of the other three identified instruction formats. Thus, we conclude that future developed MC-IGs should limit the use of the plain text format where possible. In other words, the integrated use of organized text, graphical formats and tabular formats should be preferred over the use of the plain text format in future developed MC-IGs. Moreover, an interesting question for future research would be: To what extent does the instruction format influence the usability of MC-IGs?

Table 13. *Analysis of the articles according to instruction format*

| | | 'Single enabler' implementation instructions | | 'Bundled enabler' implementation instructions | | |
|---|---|---|---|---|---|---|
| Coding dimension | Codes | No. of 'single enabler' implementation instructions provided in a specific format | % from total of 47 'single enabler' impl. instr. | No. of 'bundled enabler' implementation instructions provided in a specific format | % from total of 59 'bundled enabler' impl. instr. | Total |
| Instruction format | Plain text (Textual format) | 35 | 74% | 27 | 46% | 62 |
| | Organized text (Textual format) | 23 | 49% | 27 | 46% | 50 |
| | Graphical format | 42 | 89% | 28 | 47% | 70 |
| | Tabular format | 31 | 66% | 0 | 0% | 31 |
| Total number of cases in which instructions have been provided | | 47 | 100% | 59 | 100% | 106 |
| Average number of instruction formats used per instruction | | 2,8 | - | 1,4 | - | N/A |

### 3.9. Research method of MC-IGs

'The research method is an important characteristic of a scientific contribution and is even more important in the case of an applied discipline where the research addresses both academics and practitioners' [1].

Relevant articles were analysed based on the research method they applied to: (1) build the implementation guidelines, and (2) to assess the validity of the implementation guidelines (Table 14). An established classification of research methods [42], [43] augmented with the action research method [44], was used to classify the articles into: conceptual modeling, case studies (including multiple case studies), surveys, mathematical modeling (or simulation), and action research (Table 14).

The analysis of available MC implementation guidelines shows that:

- conceptual modeling is the main research method for building MC implementation guidelines (18 articles, 90% - Table 14)
- case study is the main research method for assessing the validity of the MC implementation guidelines (14 articles, 70% - Table 14)
- only 3 (15%) articles do not perform tests of the developed MC-IGs
- deeper analysis of the 18 articles that build IGs through conceptual modeling shows that conceptual modeling can appear as pure conceptual modeling with eventual light use of mathematics (50% of

cases), or as conceptual modeling with the use of heavy mathematical reasoning (50% of cases). When applied, conceptual modeling with heavy mathematical reasoning is used either for developing optimization algorithms (78% of cases) or for developing genetic algorithms (22% of cases), both of which are always used for providing implementation instructions for product platform development and related MC enablers (e.g. product modularization, part standardization, etc.)

- the 14 articles that report using case studies to assess the validity of MC-IGs, use the term case study in a broader sense than it is used in the field of Operations Management (see [45]). While 8 articles (57% of articles) test the MC-IGs in actual contexts, 5 articles (36% of articles) simply use real company data to exemplify the application of IGs in a context similar to a real one, and 1 article (7% of articles) base their validity assessment on fake (abstract) data
- the assessment of MC-IGs through case studies can be characterized based on the number of cases used and on who performs the assessment. Most of the 14 articles that assess the validity of MC-IGs through case study use a single case study. However, three articles use multiple case studies [35], [38], [40]. The situation is more differentiated when we consider who performs the testing in a real organization (8 of 14 articles). In this case, 50% of the articles report that testing was done by the authors themselves, while the rest of the articles (50%) do not report who did the testing of the implementation guidelines. Interestingly, none of the articles reported that the MC-IGs were tested by the company personnel with researchers involved as no more than external observers.
- only two articles use a method different from conceptual modeling for developing MC-IGs (Table 14). Q. H. Yang et al. [20] used the case study method used for building and testing implementation guidelines at the same time, while Kudsk, Hvam et al. [34] used action research to build and to assess the implementation guidelines.

Table 14. *Summary of articles according to research method (RM)*

| RM to assess the IGs / RM to build the IGs | Conc. model. | Case study | Survey | Math (or simul.) | Action research | Not tested | Total (percent) |
|---|---|---|---|---|---|---|---|
| Concept. modeling | 0 | 13 | 0 | 2 | 0 | 3 | 18 (90%) |
| Case study | 0 | 1 | 0 | 0 | 0 | 0 | 1 (5%) |
| Survey | 0 | 0 | 0 | 0 | 0 | 0 | 0 (0%) |
| Math (or simul.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 (0%) |
| Action research | 0 | 0 | 0 | 0 | 1 | 0 | 1 (5%) |
| Total (percent) | 0 (0%) | 14 (70%) | 0 (0%) | 2 (10%) | 1 (5%) | 3 (15%) | 20 (100%) |

The MC-IG research sub-stream focuses on the transfer of academic knowledge into practice. The extensive use of conceptual modeling for building IGs (Table 14) shows that researchers ground their newly developed IGs within existing academia settings. The extensive use of the case study method to assess the validity of IGs (Table 14) shows an intention of researchers to guarantee that the proposed MC-IGs actually work in practice. The MC-IG analysis has therefore shown that MC-IGs in general strive to integrate academia and practice.

The research methods used to develop and assess the validity of MC-IGs plays an important role in obtaining acceptance and trust from practitioners. Thus, choosing different research methods could boost the development of MC-IGs that are deeply rooted in practice . Among others, interviews with practitioners (consultants, managers and entrepreneurs) could be used in order to better understand the impact of a specific industry context, company size, degree of MC implementation, and so on, that should be taken into account while developing MC-IGs. Focus groups with MC consultants could be a method to build on the failures and successes accumulated through years of implementation experiences in different contexts. Longitudinal case studies could be used to assess the long-term effect of MC-IG use and could generate specific refinements based on practical experiences of MC implementation, and so on.

Notably, the research presented did not take into account how managers learn to implement MC. This learning process could take place through various workshops, professional journals, informal encounters with other practitioners, and so on. Examining how managers learn to implement MC could be one of the research opportunities for future MC-IG development.

## 4. DISCUSSION AND CONCLUSIONS

This section discusses contribution of the present research in respect to the previous MC literature reviews. Firstly, we discuss the contribution of the present research relative to the literature review presented in [1]. Secondly, we discuss contribution of the present research in respect to the other MC literature reviews found [2], [7], [11], [46], [47].

Firstly, the present work, built upon the research presented in [1], contributes to the further development of MC implementation guidelines sub-stream by helping researchers in framing and developing their MC-IGs. This is achieved by providing detailed analysis of how the MC implementation guidelines research is done and communicated. In this way, the present research complements [1] that focused on practitioners by identification of characteristics of available MC implementation guidelines and generating suggestions for their improvement.

Secondly, our literature review complements the previous literature reviews on MC. Altogether, five literature review articles focused on MC were found [2], [7], [11], [46], [47]. Three of these five literature reviews cover overall MC [7], [11], [46], while two of these reviews focus on a specific part of the MC research [2], [47].

None of the five literature reviews focuses on MC implementation or MC implementation guidelines. The first article with overall coverage - [7] - classified the available MC frameworks, discussed MC success factors

and MC enablers as well as providing a general MC research agenda for the future. A decade later, the same group of authors [11] reviewed the MC literature with a similar focus. In their second literature review, they covered the years from 2000 to 2010, updating their previous research, and once more identified research gaps for the future. Kumar, Gattoufi and Reisman (2007) [46] provide a literature review with a historical perspective to understand the evolution of MC and MC research and stress the need to classify MC research.

Two literature reviews that cover a narrower MC scope [2], [47] differ regarding their focus. Sandrin, Trentin and Forza [2] focus their research on MC organizational antecedents. Ferguson, Olewnik and Cormier [47], instead, focus on the process of MC product development, which they analyse through the lenses of the marketing, engineering and distribution domains. Both [2] and [47] highlight future opportunities for research in their respective topics.

Even though available literature reviews do not focus on the MC implementation process, they stress the importance of conducting research on this subject. So, when providing future directions for MC research, Da Silveira, Borenstein and Fogliatto [7: p.8] call for research in MC implementation, stating that 'Future research on MC should focus on the formulation of methodologies that enable rapid reconfiguration of existing organizational structures and processes into a mass-customized production system'. Although in their latter review, Fogliatto, da Silveira and Borenstein [11: p.22] do not restate the need for developing MC methodologies, they mention the issue of developing 'more effective solutions' compared to existing MC approaches, tangentially touching on the point of MC implementation guidelines. Sandrin, Trentin and Forza [2: p.159] stress that 'The importance of transforming organisations to pursue an MC strategy has been acknowledged since the introduction of the MC concept'. This 'transforming organizations to pursue an MC strategy' is synonymous with the MC implementation process.

Finally, previous literature reviews also highlight that research on the MC implementation process is limited. Da Silveira, Borenstein and Fogliatto [7: p.11] conclude that 'there are several pending issues regarding its [mass customization's] practical implementation' and that 'literature on MC implementation is still incipient'. They base these conclusions on the fact that 'Most claims are drawn from limited case examples or based on educated guesses from authors rather than from hard evidence obtained through exhaustive research' [7]. Kumar, Gattoufi and Reisman [46: p.653] assert that 'there is a void of rigorous quantitative modeling and decision support in implementing mass customization strategy successfully and effectively', which supports the point that research on MC implementation is limited. Sandrin, Trentin and Forza [2: p.159] assert that in MC literature, 'relatively less attention has been paid to the organizational antecedents of MC … as compared with its technological enablers', stressing in this way the limited attention that has been focused on a specific part of the MC implementation endeavour. These conclusions are in line with our research findings that led to the relatively low number of articles retrieved from the MC literature that could be characterized as MC-IGs (20 articles).

## 5. REFERENCES

*NOTE: The 20 relevant articles identified after the selection process and deeply analysed are marked with symbol "*".*


[1] N. Suzić, F. Cipriano, A. Trentin, and Z. Anišić, "Implementation guidelines for mass customization: current characteristics and suggestions for improvement," *Production Planning & Control*, In Press, 2018.

[2] E. Sandrin, A. Trentin, and C. Forza, "Organizing for mass customization: Literature review and research agenda," *International Journal of Industrial Engineering and Management*, vol. 5, no. 4, pp. 159–167, 2014.

[3] J. B. Pine, *Mass Customization: The New Frontier in Business Competition*, Boston: Harvard Business School Press, 1993.

[4] G. Liu, R. Shah, and R. G. Schroeder, "Linking Work Design to Mass Customization: A Sociotechnical Systems Perspective," *Decision Sciences*, vol. 37, no. 4, pp. 519–545, 2006.

[5] B. Squire, S. Brown, J. Readman, and J. Bessant, "The impact of mass customisation on manufacturing trade-offs," *Production and Operations Management*, vol. 15, no. 1. pp. 10–21, 2006.

[6] C. W. L. Hart, "Mass customization: conceptual underpinnings, opportunities and limits," *International Journal of Service Industry Management*, vol. 6, no. 2, pp. 36–45, 1995.

[7] G. da Silveira, D. Borenstein, and F. S. Fogliatto, "Mass customization: Literature review and research directions," *International journal of Production Economics*, vol. 72, no. 1, pp. 1–13, 2001.

[8] J. Rowley, and F. Slack, "Conducting a literature review," *Management Research News*, vol. 27, no. 6, pp. 31–39, 2004.

[9] D. Tranfield, D. Denyer, and P. Smart, "Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review," *British Journal of Management*, vol. 14, no. 3, pp. 207–222, Sep. 2003.

[10] S. Seuring, and S. Gold, "Conducting content-analysis based literature reviews in supply chain management," *Supply Chain Management: An International Journal*, vol. 17, no. 5, pp. 544–555, 2012.

[11] F. S. Fogliatto, G. J. C. da Silveira, and D. Borenstein, "The mass customization decade: An updated review of the literature," *International Journal of Production Economics*, vol. 138, no. 1, pp. 14–25, Jul. 2012.

[12] A. Ortiz, F. Lario, and L. Ros, "Enterprise Integration—Business Processes Integrated Management: a proposal for a methodology to develop Enterprise Integration Programs," *Computers in Industry*, vol. 40, no. 2–3, pp. 155–171, Nov. 1999.

[13] B. D. Rouhani, M. N. Mahrin, F. Nikpay, R. B. Ahmad, and P. Nikfard, "A systematic literature review on enterprise architecture implementation methodologies," *Information and Software Technology*, vol. 62, no. 1, pp. 1–20, Feb. 2015.

[14] S. Ma, W. Wang, and L. Liu, "Commonality and postponement in multistage assembly systems," *European Journal of Operational Research*, vol. 142, no. 3, pp. 523–538, Nov. 2002.

[15] F. Salvador, C. Forza, and M. Rungtusanatham, "Modularity, product variety, production volume, and

component sourcing : theorizing beyond generic prescriptions," *Journal of Operations Management*, vol. 20, no. 5, pp. 549–575, 2002.
[16] *G. Hernandez, J. K. Allen, and F. Mistree, "Platform Design for Customizable Products as a Problem of Access in a Geometric Space," *Engineering Optimization*, vol. 35, no. 3, pp. 229–254, Jun. 2003.
[17] F. T. Piller, K. Moeslein, and C. M. Stotko, "Does mass customization pay? An economic approach to evaluate customer integration," *Production Planning & Control*, vol. 15, no. 4, pp. 435–444, Jun. 2004.
[18] *T. Blecker, and N. Abdelkafi, "Complexity and variety in mass customization systems: analysis and recommendations," *Management Decision*, vol. 44, no. 7, pp. 908–929, 2006.
[19] R. Krishnapillai, and A. Zeid, "Mapping Product Design Specification for Mass Customization," *Journal of Intelligent Manufacturing*, vol. 17, no. 1, pp. 29–43, Feb. 2006.
[20] *Q. H. Yang, G. N. Qi, Y. J. Lu, and X. J. Gu, "Applying mass customization to the production of industrial steam turbines," *International Journal of Computer Integrated Manufacturing*, vol. 20, no. 2–3, pp. 178–188, 2007.
[21] A. Shamsuzzoha, S. Kyllönen, and P. Helo, "Collaborative customized product development framework," *Industrial Management & Data Systems*, vol. 109, no. 5, pp. 718–735, May 2009.
[22] J. Daaboul, A. Bernard, and F. Laroche, "Extended value network modelling and simulation for mass customization implementation," *Journal of Intelligent Manufacturing*, vol. 23, no. 6, pp. 2427–2439, 2012.
[23] J. K. Purohit, M. L. Mittal, S. Mittal, and M. K. Sharma, "Interpretive structural modeling-based framework for mass customisation enablers: an Indian footwear case," *Production Planning & Control*, vol. 27, no. 9, pp. 774–786, 2016.
[24] E. Feitzinger, and H. Lee, "Mass customization at Hewlett-Packard: the power of postponement," *Harvard Business Review*, vol. 75, no. 1, pp. 116–121, 1997.
[25] J. Jiao, L. Zhang, and S. Pokharel, "Coordinating product and process variety for mass customized order fulfilment," *Production Planning & Control*, vol. 16, no. 6, pp. 608–620, 2005.
[26] D. R. Thomas, "A General Inductive Approach for Analyzing Qualitative Evaluation Data," *American Journal of Evaluation*, vol. 27, no. 2, pp. 237–246, 2006.
[27] N. G. Weiskopf, and C. Weng, "Methods and dimensions of electronic health record data quality assessment: enabling reuse for clinical research," *Journal of the American Medical Informatics Association : JAMIA*, vol. 20, no. 1, pp. 144–51, Jan. 2013.
[28] V. Couture, R. Drouin, S.-L. Tan, J.-M. Moutquin, and C. Bouffard, "Cross-border reprogenetic services," *Clinical genetics*, vol. 87, no. 1, pp. 1–10, Jan. 2015.
[29] J. Harvey, S. Dopson, R. J. McManus, and J. Powell, "Factors influencing the adoption of self-management solutions: an interpretive synthesis of the literature on stakeholder experiences," *Implementation science : IS*, vol. 10, no. 1, p. Article number 159, Jan. 2015.
[30] N. H. Thuan, P. Antunes, and D. Johnstone, "Factors influencing the decision to crowdsource: A systematic literature review," *Information Systems Frontiers*, vol. 18, no. 1, pp. 47–68, Jun. 2015.
[31] M. S. Wood, and A. Mckelvie, "Opportunity evaluation as future focused cognition: Identifying conceptual themes and empirical trends," *International Journal of Management Reviews*, vol. 17, no. 2, pp. 256–277, 2015.
[32] J. W. Creswell, *Educational research: Planning, conducting, and evaluating quantitative*. Saddle River, NJ: Prentice Hall, 2002.
[33] *J. Jiao, and M. Tseng, "A methodology of developing product family architecture for mass customization," Journal of Intelligent Manufacturing, vol. 10, no. 1, pp. 3–20, 1999.
[34] *A. Kudsk, L. Hvam, C. Thuesen, M. O. Grønvold, and M. H. Olsen, "Modularization in the Construction Industry Using a Top-Down Approach," *Open Construction and Building Technology Journal*, vol. 7, pp. 88–98, Sep. 2013.
[35] *H. Ismail, I. Reid, J. Mooney, J. Poolton, and I. Arokiam, "How Small and Medium Enterprises Effectively Participate in the Mass Customization Game," *IEEE Transactions on Engineering Management*, vol. 54, no. 1, pp. 86–97, Feb. 2007.
[36] R. Sousa, and C. Voss, "Contingency research in operations management practices," *Journal of Operations Management*, vol. 26, no. 6, pp. 697–713, Nov. 2008.
[37] *S. K. Moon, and D. A. McAdams, "A market-based design strategy for a universal product family," *Journal of Mechanical Design*, vol. 134, no. 11, paper 111007-1, 2012.
[38] *M. Hanafy, and H. ElMaraghy, "A modular product multi-platform configuration model," *International Journal of Computer Integrated Manufacturing*, vol. 28, no. 9, pp. 999–1014, Jul. 2015.
[39] * H. I. Alsawalqah, S. Kang, and J. Lee, "A method to optimize the scope of a software product platform based on end-user features," *Journal of Systems and Software*, vol. 98, pp. 79–106, Dec. 2014.
[40] *A. Kudsk, M. O. Grønvold, M. H. Olsen, L. Hvam, and C. Thuesen, "Stepwise Modularization in the Construction Industry Using a Bottom-Up Approach," The Open Construction and Building Technology Journal, vol. 7, pp. 99–107, Sep. 2013.
[41] *F. Salvador, C. Forza, and M. Rungtusanatham, "How to mass customize: Product architectures, sourcing configurations," *Business Horizons*, vol. 45, no. 4, pp. 61–69, Jul. 2002.
[42] L. Chen, J. Olhager, and O. Tang, "Manufacturing facility location and sustainability: A literature review and research agenda," *International Journal of Production Economics*, vol. 149, pp. 154–163, 2014.
[43] S. Pashaei, and J. Olhager, "Product architecture and supply chain design: a systematic review and research agenda," *Supply Chain Management: An International Journal*, vol. 20, no. 1, pp. 98–112, 2015.
[44] P. Coughlan, and D. Coghlan, "*Action Research*", in Researching Operations Management, pp. 236-264, New York/London, Routledge, 2008.
[45] C. Voss, N. Tsikriktsis, and M. Frohlich, "Case research in operations management," *International Journal of Operations & Production Management*, vol. 22, no. 2, pp. 195–219, 2002.
[46] A. Kumar, S. Gattoufi, and A. Reisman, "Mass customization research: trends, directions, diffusion intensity, and taxonomic frameworks," *International Journal of Flexible Manufacturing Systems*, vol. 19, no. 4, pp. 637–665, 2007.
[47] S. M. Ferguson, A. T. Olewnik, and P. Cormier, "A review of mass customization across marketing, engineering and distribution domains toward development of a process framework," *Research in Engineering Design*, vol. 25, no. 1, pp. 11–30, Aug. 2014.
[48]* Z. Anišić, and C. Krsmanović, "Assembly Initiated Production as a Prerequisite for Mass Customization and Effective Manufacturing," *Strojniski Vestnik/Journal of Mechanical Engineering*, vol. 54, no. 9, pp. 607–618, 2008.
[49]* M. Bajaras, and B. Agard, "A Methodology to Form Families of Products by Applying Fuzzy Logic,"

*International Journal on Interactive Design and Manufacturing*, vol. 9, no. 4, pp. 253–267, 2014.
[50]* F. Gao, G. Xiao, and T. W. Simpson, "Module-Scale-Based Product Platform Planning," *Research in Engineering Design*, vol. 20, no. 2, pp. 129–141, 2009.
[51]*F. Gao, Y. Zhang, and G. Xiao, "A Methodology to Support Platform Parameters Determination through Considering Main Factors in Product Life Cycle," *International Journal of Computer Integrated Manufacturing*, vol. 27, no. 5, pp. 470–478, 2013.
[52]* F. B. Kong, X. G. Ming, L. Wang, X. H. Wang, and P. P. Wang, "On Modular Products Development," *Concurrent Engineering: Research and Applications*, vol. 17, no. 4, pp. 291–300, 2009.
[53]* X. Meng, Z. Jiang, and G. Q. Huang, "On the Module Identification for Product Family Development," *The International Journal of Advanced Manufacturing Technology*, vol. 35, no. 1-2, pp. 26–40, 2007.
[54]* S. K. Moon, J. Shu, T. W. Simpson, and S. R. T. Kumara, "A Module-Based Service Model for Mass Customization: Service Family Design," *IIE Transactions (Institute of Industrial Engineers)*, vol. 43, no. 3, pp. 153–163, 2010.
[55]* T. Qu, S. Bin, G. Q. Huang, and H. D. Yang, "Two-Stage Product Platform Development for Mass Customisation," *International Journal of Production Research*, vol. 49, no. 8, pp. 2197–2219, 2011.
[56]*X. F. Zha, R. D. Sriram, and W. F. Lu, "Evaluation and Selection in Product Design for Mass Customization: A Knowledge Decision Support Approach." *AI EDAM: Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, vol. 18, no. 1, pp. 87–109, 2004.

## CORRESPONDENCE

PhD Nikola Suzić, Research Fellow
University of Padova
Department of Management and Engineering
Stradella S. Nicola, 3
36100 Vicenza, Italy
suzic@gest.unipd.it

PhD Enrico Sandrin, Research Fellow
University of Padova
Department of Management and Engineering,
Stradella S. Nicola, 3,
36100 Vicenza, Italy
enrico.sandrin@unipd.it

Svetlana Suzić, PhD Candidate
University of Padova
Department of Management and Engineering
Stradella S. Nicola, 3
36100 Vicenza, Italy
svetlana.suzic@phd.unipd.it

PhD Cipriano Forza, Full Prof.
University of Padova
Department of Management and Engineering
Stradella S. Nicola, 3
36100 Vicenza, Italy
cipriano.forza@unipd.it

PhD Alessio Trentin, Ass. Prof.
University of Padova
Department of Management and Engineering
Stradella S. Nicola, 3
36100 Vicenza, Italy
alessio.trentin@unipd.it

PhD Zoran Anišić, Full Prof.
University of Novi Sad
Faculty of Technical Sciences,
Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia
anisic@uns.ac.rs