Customization and Customer-Product Learning

Jørgensen, Kaj Asbjørn

Published in:
Bridging Mass Customization and Open Innovation

Publication date:
2011

Document Version
Early version, also known as pre-print

Customisation and Customer-Product Learning

Kaj A. Jørgensen, Thomas Ditlev Petersen, Kjeld Nielsen

Abstract

In order to support decision making in companies, who want to implement Mass Customisation (MC) and Product Configuration, a previously published model for customisation is developed. This model identifies customisation in four different levels, ranging from the structure level at the bottom, through the performance level and the experience level to the learning level at the top. This model has a dual view with customers/demand at one side and product/supplier at the other side. It is developed so that it can be generally applied and, typically, product designers must decide how far up in levels the customisation should aim.

This paper sets special focus on the upper levels of customisation, especially the learning level, and it is shown that products with a large range of user-oriented functionalities often require much training to use and that customers on the other hand are sometimes not prepared for such a learning effort. Means for overcoming this inequality must come in focus by the supplier and provided with the product.

1. Introduction

Since Mass Customisation (MC) was introduced by Davis (Davis, 1989) and Pine (Pine, 1993), (Pine et al., 1993), it has called for changes regarding the view of customer-product relationships and several companies have recognised the need for mass customisation. Much effort has been put into identifying which success factors are critical for an MC implementation and how different types of companies may benefit from it (Lampel and Mintzberg, 1996), (Gilmore and Pine, 1997), (Sabin, 1998), (Silveira et al., 2001), (Berman, 2002).

For obvious reasons, there are different strategies on how to implement MC most appropriately and it varies naturally also between different companies, markets and products. Because there is not a single generic strategy, it is important to look at the issue from different viewpoints. The fact that products must be easily customisable in order to achieve MC has been described comprehensively in the literature and, more general, (Berman, 2002) and (Pine, 1993) have discussed the issues related to readiness of the value chain. Newer research underlines that MC is a strategic non-reversible development and suggests that the change process is considered as a strategic mechanism. Consequently, in order to benefit fro MC, the mangers must tailor the development process to the existing business, rather than vice versa (Salvador, 2009).

Customisation is very often an important issue regarding design, marketing, sales and production. It is rather fundamental for customers to seek for individual demands and, consequently, suppliers must decide to what degree they want to fulfil these demands. Many manufacturers have learned that manufacturing of many product variants may increase the cost dramatically and non-profitably.

2. Product Configuration and MC

An often used approach for implementation of MC is product configuration, in which a series of products is defined by one single model – a product family model (Jørgensen, 2003). Hence, a product family can be viewed as the set end products, which can be formed by using a predefined product family model. The result of each configuration will be a model of the configured product, configured product model, and from this model, the physical product can be produced.

Most of the methods, which exist for product family modelling, focus on modelling of the solution space of a configuration process. This means that they describe the attributes of the products and the product structure. Hence they do typically not focus on additional information, which goes beyond what must be used to perform the configuration itself. This kind of information, which could include e.g.

customer, market, logistics and manufacturing information, is according to (Reichwald et al., 2000) similarly important, since a successful implementation of MC must integrate all information flows in the so called "Information Cycle of Mass Customisation".

Mass Customisation and product configuration is relevant for many enterprises and great benefits are normally found, where customisation is common and where the idea is introduced gradually. In general, however, the benefits depend very much on the product and the market. In the relationship between the manufacturer and the market or more precisely the product and the customer, the product configurator plays a major role.

A major distinction regarding markets/customers is between business-to-business (B2B) and business-to-consumers (B2C) and an important dimension here is the degree of personalisation. Personalisation is most relevant in relationship with B2C and a high degree of personalisation towards individual customers or small groups of customers generates special requirements to product configurators but, on the other hand, this also raises new opportunities for increased volume.

A product family model is often the basis for development of a product configurator. A product configurator can be defined as a tool, computer software, which can support users in the configuration process (Faltings, 1998), for instance by selecting modules to compose products. Hence, product configurators are important tools, which can provide a range of opportunities for adding new dimensions to the subject and configuration may also add more value to customers. Therefore, when a configurator is designed, a large number of design parameters must be considered and balanced decisions must be made. Many of the parameters are related to development of software systems, e.g. usability, reliability, flexibility and security.

The enormous development of electronics and particularly in computer based technologies has resulted in great change in product design and product development. For instance, a large range of products have shifted from mechanical products to mechatronic products with electro mechanic and electric parts (Bishop, 2002) and (Chen, 2009). This development is continuing and for many new generations of existing products, the percentage of traditional mechanical parts is decreasing. Particularly, customisation of mechatronic and electronic products raises new issues.

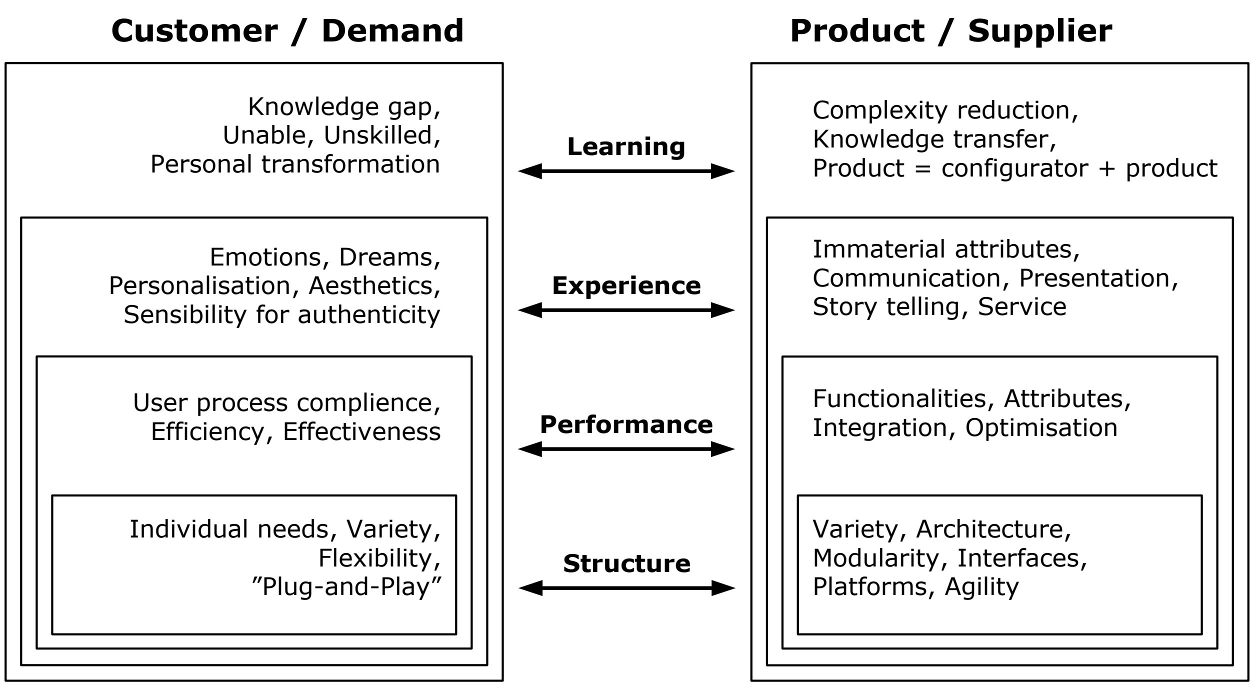

Figure 1: Customisation on four different levels

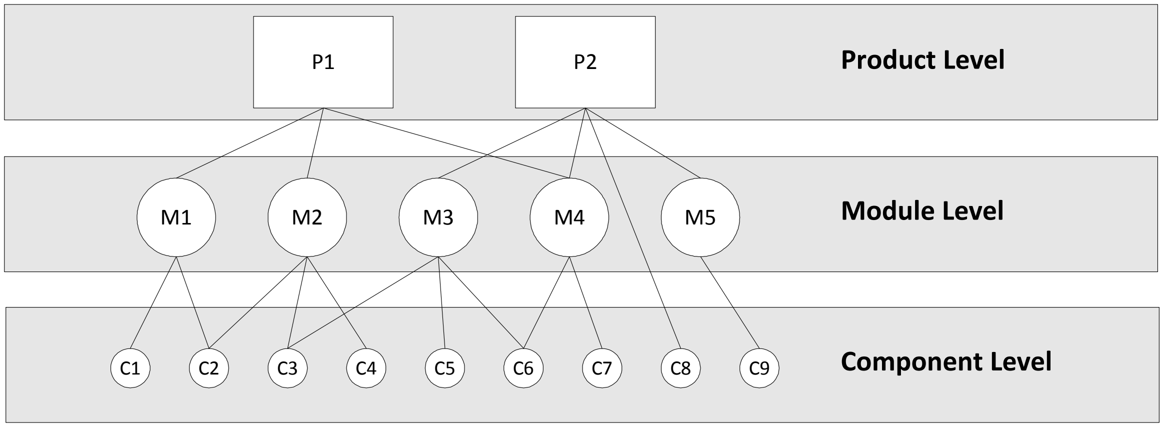

Figure 2: Model of the structure with the three levels.

3. Customisation Levels

In order to support the decision making regarding customisation of products, a model for customisation has previously been developed (Jørgensen, 2009) and (Jørgensen 2010). This model (see figure 1) arranges customisation in four different levels of customisation, ranging from the structure level at the bottom, through the performance level and the experience level to the learning level at to top. The model has a dual view with customers/demand at one side and product/supplier at the other side and it is developed so that it can be generally applied and, typically, it must be decided how far up in levels the development should aim. Further, it is important, that there is a good match between the two sides and on each level.

In the following, the four levels of the model is described in further detail and, subsequently, particular focus is set on the upper level, the learning level.

3.1. Customisation: Structure Level

It is very common to view customisation on the structure level because it is characterised as a matter of offering components, which can be used as building blocks, comparable with using the well known LEGO bricks. Typical commercial product examples are computers, automobiles and bicycles. Important issues are modularity, interfaces of modules and product platforms. Modules are defined as assemblies of components and end products are composed of modules (see figure 2). Very often, modularity is recommended as a precondition for implementation of product configuration and modules are most preferably identified with clear separation of functionalities, i.e. modularity is in contrast to integration. Further, different architectures of modularity are worth considering.

For mechatronic and electronic products like for many other types of products, modularity is a common characteristic in the traditional understanding. The development has shown that electronic modules have increasingly replaced mechanical modules and, in connection with this, basic modularisation principles may be considered because a clearer delineation between structure and function may be possible. Another result is that, more often, interface issues relate to the interactions between the computer hardware and the controllable modules and, hence, standard electronic interface solutions can be utilised.

Included in mechatronic and electronic products, however, is often one or more embedded computers and, thus, these computers are controlled by software. Seen from a structural view, software can be regarded as a component like the more traditional components and typically it is located in a memory unit. On the other hand, software has many other characteristics. Software regarded as a module adds new dimensions to modularity and platforms and decisions about the software architecture can also relate to various platform issues (Simpson, 2004) and thereby perhaps cover different product variants. In addition, software can be designed with a number of parameters, which can easily be assigned different values and thereby be used for customisation. In the following, primarily mechatronic and electronic products with embedded computers and software are taken into consideration.

3.2. Customisation: Performance Level

On the next level, the performance of products is essential. When products are installed in their user environment, they perform their functions – hopefully in the expected way. Therefore, considerations about the ability to perform the functions, which are required by the customer, are very important and should be a significant subject of configuration. Hence, the focus of product configuration is shifted to identification and definition of product attributes instead of modules and components. This is particularly important when the performance of the product is essential and a careful balance between integration and modularisation must be established. Extreme product examples are automobile engines and computer processors. The performance level is also important in companies, where order horizons are long and where many changes often have to be managed. Focus on requirements regarding the product functions in the early stages may reduce the need for making expensive changes in later phases.

Functional issues of mechatronic products are related to both hardware and software but it is rather characteristic for these products that an increased number of functions are provided via the software (Isermann, 2009). For instance, electronic controller components may enable a dynamic optimisation of the performance of the product and thereby, e.g. reduce the energy consumption. Furthermore, they may provide enhanced supervision of the product and collect and offer vital data for maintenance and repair. This implies that the design of hardware and software must be handled in an integrated way in order to achieve an optimal design. Mapping of functional requirements to specific modules is considered in (Jiao et al., 1998), (Du et al., 2000) and (Männistö, 2001). Jiao proposes to use a triple-view representation scheme. The three views are the functional, the technical and structural view. The functional view is used to describe, typically, the customer's functional requirements and the technical view is used to describe the design parameters in the physical domain. The structural view, which corresponds to the structural level described above, includes the mapping between the functional and technical view as well as the rules of how a product may be configured. The description of this modelling approach is however rather conceptual, and is not easily implemented in industrial applications.

Customisation can even be shifted to a new meaning because many mechatronic products can offer set-up customisation. Consequently, each customer can configure the product with a favourite set-up. However, many examples give indications that, if the number of functionalities provided to the customers is enormous, many of them will not be used in practice.

The two lower levels of customisation, the structure level and the performance level, are rather common and widely used with many products and on all types of markets. Further levels of customisation will primarily relate to customers and products with higher degree of personalisation.

3.3. Customisation: Experience Level

The next level, termed the experience level, focuses on special attributes of products and also on immaterial attributes, which are related to customer's emotions and dreams. Involvement in a configuration process will for many customers result in a higher degree of satisfaction and the customer will likely feel a stronger attachment to the solution (Pine and Gilmore, 1999). The experience level of customisation is therefore strongly related to personalisation. Hence, customers are primarily individual persons or relatively small groups. Many fashion and service products, for instance, are highly personalised and aim at giving the customer specific experiences. Examples are entertainment, personal care, wellness and travel. Many examples show that configurators for these types of products aim at special values of the products for the customers. But for many customers, ordinary products may be looked at with extra dimensions of personal valuation. Customer's concern for the environment may for instance give more preference for ecologic products.

A major distinction regarding markets/customers is between business-to-business (B2B) and business-to-consumers (B2C) and an important dimension here is the degree of personalisation. Personalisation is most relevant in relationship with B2C and a high degree of personalisation towards individual customers or small groups of customers generates special requirements to products but, on the other hand, this also raises new opportunities for increased volume. As already indicated the software of products may offer user driven customisation and, thereby, increase the emotional based satisfaction. In order to create good support for the experience level, it is important that the available options are matched properly with the customer needs and it is important to analyse, what effect different attributes have on customers, whether they are real or imaginary attributes.

An important aspect of this customisation level is authenticity (Gilmore and Pine, 2007). There is a tendency that customers are becoming more sensitive and expect higher and higher quality of goods and services. Practically all consumers desire authenticity. Every person is unique and he is intimately aware of his own uniqueness and values it. The consumer sensibility for authenticity evidences itself and, whenever informed, individuals independently purchase any item with which they are intensely involved. According to this theory, many companies fail if they act differently than they announce that they do. In such cases, there may be a great risk that configuration will give a negative effect. If a company claims to be very conscientious, it may very fast loose great respect, if it is disclosed that some products for instance are produced by children and perhaps under poor circumstances.

Because of the endless opportunities with software and computer based hardware, this dimension can often be paid more attention. For mobile phones, for instance, it is very often the embedded software, which distinguishes the models from each other. Even further, the software often determines the interface and how the products can be operated. Hence, mode of operation and interface design are two very important means for giving the customer a special experience from using the product.

Means for good configurator support on the experience customisation level are to present the perhaps unseen values of products and to provide good and reliable guidance to the user, to display consequences of choices. If the options are limited, it is important to be selective regarding customer segments. However, some customers may be intimidated by getting a wrong message. In many cases it is like balancing on a knife edge; if you fall, you may cut yourself.

3.4. Customisation: Learning Level

At the top level of customisation, the learning level, special services must be offered that may result in further impact on the involved customer. A product in traditional sense may be in focus but special aspects of the product will lead to a learning process for the customer. Often, this is related to complex products with many functionalities, which require substantial customer support. Again, many services of this kind can be provided by embedded software. A well known example is that many such products can offer in-built tutorials, help support and assistance for troubleshooting.

A large amount of features and services may be added to the products and such services may identify a range of subjects that represent a gap between the customer's knowledge and what the product can offer. Consequently, the transformation of the customer is a key issue on the learning level.

For products, which are very much in focus on the learning level, the lower customisation levels may also be identified, i.e. a modular or otherwise configurable product may be offered and appealing attributes may be presented, but the addition of the learning level should create further attraction from the customer towards the underlying product.

The customer's knowledge gap may be related to different areas and the product may be difficult to understand. Perhaps the product must fit into complex processes at the customer's site and it may be difficult for the customer to estimate, how the product can fulfil the requirements. Maybe the customer for the first time engage in a complex sales process so many issues are new for such a customer. Therefore, it should be possible for the customer to find answers to questions about issues, which the customer finds difficult. If customers are unable or unskilled to make decisions about such issues, trustworthy guidance must be included, perhaps along with the configurator. In this way, the configurator is integrated with the product or it can be seen as a part of the product.

Like for the previously presented customisation levels, adding such additional features also requires a precise segmentation of customers in order to attract the attention and initiate a relationship with new customers. Too many features may give a negative effect and well skilled customers for instance may find this kind of support as a barrier, so it is important that the configurator is able to adjust itself to different customer types.

4. Customer-Product Learning

As described, the model for customisation has a dual view with customers/demand at one side and product/supplier at the other side. In particular, this must be considered carefully on the learning level. Hence, any kind of misalignment between customers and the product during the sales process must be avoided. The observations above indicate that two variables are important to consider.

1. Customer-Product Knowledge Gap divided into Small and Large
2. Customer-Product Relationship divided into Loose and Fixed.

If those two variables are combined in a two times two matrix as in figure 3, the four cells can be used to characterise different situations and to form a number of recommendations.

The typical starting point is cell 1, where customers enter with a large knowledge gap and establish a loose relationship with the product. The ideal situation is cell 4, where the customer's knowledge gap is reduced significantly and a fixed relationship to the product is formed. The matrix shows then that there are three different routes to follow from cell1 to cell 4. Probably the most typical route is to go via cell 2 as illustrated by transition A and C but examples show that the route via cell 3 is also possible – transition B and D. An ideal route could be to go directly from cell 1 to cell 4 as illustrated by transition E. In this case, the customer-product relationship is building up more or less as a result of the learning process.

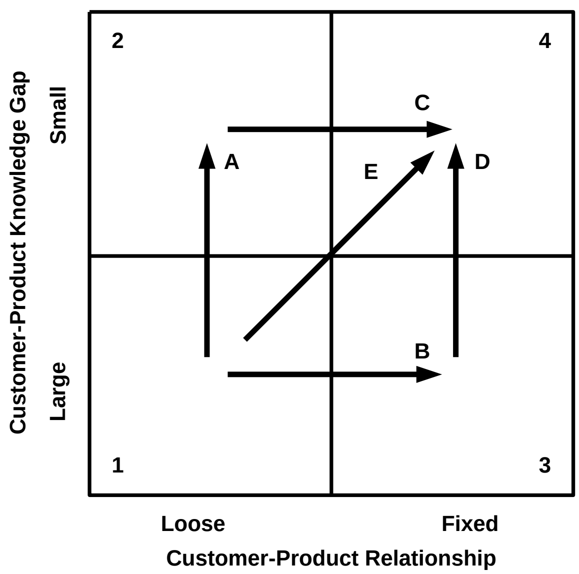

Figure 3: Customer-Product learning model.

Example 1: A building is in many ways a complex product, and the sales process can be difficult to manage in an optimal way. Especially for customers, who are buying or renting for the first time, a number of issues may be complicated to understand and to decide about. A number of authorities have requirements and regulations about buildings, so what are the constraints and what rights does the owner or the tenant have? Operation and maintenance of buildings must be performed adequately, but there are many alternative methods and it may be difficult to choose an appropriate solution. Financing may also be complicated and in order to develop budgets it may be difficult to calculate economic estimates regarding e.g. heating expenses, maintenance expenses, financial payments, tax payments, etc. Therefore, support for customisation of this kind must include the possibility to be guided sufficiently about these issues and potential customers should be able to learn from it – figure 3, transition A. However, it is important that it is presented as features, which can be used on demand or when wanted. This must be offered in the right way because such features may attract and appeal to certain customers but, in contrast, they may be irrelevant or troublesome for others. It is important also to focus on building up the customer-product relationship.

Example 2: Mobile phones have also a large number of features and may be complicated to learn to use. If a customer considers a new version or generation of the current phone, it can be assumed that the knowledge gap is already reduced (transition A) and the remaining transition is C. Hence, the sales process must focus differently regarding new customers and existing customers.

Example 3: LEGO has besides the well-known building bricks also a product called Mindstorms. A quick look at the product web site shows clearly that we have a rather complicated toy at hand. Yes, actually this is supposed to be at toy for both children and adults. But Mindstorms is a rather big success, especially for children. The complex nature of the product is not at all hided. From the home page, a link to the Technical Support page is provided and almost the first declaration is that this is the place to go for advanced users. This indicates that it is aimed at and limited to customers, who are already convinced. If they are not, a number of easily understandable and convincing video clips are offered. Furthermore, many different guidelines, instructions, tutorials, trainings and courses are offered from the web site. The content of the web site illustrates that the two routes via cell 2 and 3 are not guided separately. The transition D seems to be the best guided transition because it is found in the support sub site, where transition B is already assumed. In contrast, the site illustrates that it does not provide much support for transition A for new customers. Although it is guided from the front page, it is performed primarily as general video clips and for detailed information references are made to the support site.

The three examples above show that although much attention is set on a possible customer-product knowledge gap, well aimed solutions are not prepared for building up a consolidated customer-product relationship. Further empirical studies should be performed to confirm the identified situations.

In addition, further ingredients of guidelines for customer-product relationships should be developed and will be elements of future research. Obviously, the aim is to enable the selection of important support features for ensuring that relationships are built up to a consolidated level during the sales process.

5. Conclusion

If product design is performed with respect to Mass Customisation (MC), customisation issues are normally very important to consider and, in order to support this, a model for customisation has been developed and presented. The model arranges customisation in four different levels of customisation, ranging from a structure level at the bottom, through a performance level and an experience level to a learning level at the top. The model underlines the importance of seeing customisation from both a customer/demand side and a product/supplier side. Designers must decide how far up in levels the customisation should be developed.

The customisation model can be applied to many products and many markets or customers and the development of configurators will depend on these application areas. A major distinction regarding markets/customers is between business-to-business (B2B) and business-to-consumers (B2C). An important dimension here is the degree of personalisation because a high degree of personalisation towards individual customers or small groups of customers generates special requirements regarding customisation. Implementation of such requirements, however, may also raise new opportunities for increased volume.

Many applications of configuration and use of computer based configurators provides a range of opportunities for adding new dimensions and it is argued that the presented model for customisation on different levels can add more value to a product and make it more attractive for customers.

The highest level of the customisation model, the learning level, is the particular focus of this paper. Different situations related to this level is described and, based on a number of observations, an additional model is developed. In this model, two variables regarding 1) customer-product knowledge gap and 2) customer-product relationship are related to each other in a two times two matrix. This matrix can function as a basis for considering different designs of how customers could be guided through sales processes. The matrix is also used as a foundation for characterisation of different examples. The examples indicate that there may be a need for further focus on building up the customer-product relationship to a consolidated level.

References

Berman, B. (2002). **Should your firm adopt a mass customization strategy?** Business Horizons, 45(4):51–60.

Bishop, R. H., & Ramasubramanian, M. K. (2002). **What is mechatronics**. In: R. H. Bishop (ed.) The Mechatronics Handbook, 2002, p. 1272. CRC Press.

Chen K., Bankston J., Panchal J. H., Schaefer D. (2009). **A Framework for Integrated Design of Mechatronic Systems**. In: Collaborative Design and Planning for Digital Manufacturing, Springer London (2009), ISBN 978-1-84882-286-3, p. 37-70.

Davis, S. (1989). **From future perfect:** Mass customizing. Planning Review.

Du, X.; Jiao, J.; Tseng, M. M. (2000). **Architecture of product family for mass customization**. In Proceedings of the 2000 IEEE International Conference on Management of Innovation and Technology.

Faltings, Boi; Freuder, Eugene C., Ed. (1998). **Configuration - Getting it right.** Special issue of *IEEE Intelligent Systems*. Vol.13, No. 4, July/August 1998.

Gilmore, J. and Pine, J. (1997). **The four faces of mass customization.** Harvard Business Review 75 (1).

Gilmore, J. and Pine, J. (2007). **Authenticity.** Harvard Business School Press.

Isermann R. (2009). **Mechatronic Systems: A short introduction**. Springer Handbook of Automation, 317-331.

Jiao, J., Tseng, M. M., Duffy, V. G., and Lin, F. (1998). **Product family modeling for mass customization.** Computers & Industrial Engineering, 35:495–198.

Jørgensen, Kaj A. (2003). **Information Models Representing Product Families.** Proceedings of 6th Workshop on Product Structuring, 23rd and 24th January 2003, Technical University of Denmark, Dept. of Mechanical Engineering.

Jørgensen, Kaj A. (2009). **Customisation Design - Levels of Customisation.** In: Proceedings of MCPC2009 conference, 4.-7. October, 2009 in Helsinki.

Jørgensen, Kaj A.; Petersen, Thomas Ditlev; Nielsen, Kjeld (2010). **Customisation and Modelling Applied to Electronic and Mechatronic Products.** In: Proceedings of NordDesign2010, 24.-27. August, 2010 in Gothenburg.

Lampel, J. and Mintzberg, H. (1996). **Customizing customization.** Sloan Management Review, 38:21–30.

Männistö, T.; Peltonen, H.; Soininen, T.; Sulonen, R. (2001). **Multiple Abstraction Levels in Modelling Product Structures.** Data and Knowledge Engineering no.36, pp.55-78, 2001.

Pine, B. Joseph (1993). **Mass Customization - The New Frontier in Business Competition**. Harvard Business School Press, Boston Massachusetts, 1993.

Pine, J., Victor, B., and Boyton, A. (1993). **Making mass customization work.** Harvard Business Review 71 (5), 71(5):108–119.

Pine, J. and Gilmore, J. (1999). **The Experience Economy: Work Is Theater & Every Business a Stage**.

Reichwald, R., Piller, F. T., and Möslein, K. (2000). **Information as a critical succes factor or: Why even a customized shoe not always fits.** In Proceedings Administrative Sciences Association of Canada, International Federation of Scholarly Associations of Management 2000 Conference.

Sabin, D.; Weigel, R. (1998). **Product Configuration Frameworks - A survey**. In IEEE intelligent systems & their appplications, 13(4):42-49, 1998.

Salvador, F.; de Holan, P. M.; Piller, F. (2009). **Cracking the Code of Mass Costomization.** MITSloan Management Review. Vol 50, no. 3, Spring 2009.

Silveira, G. D., Borenstein, D., and Fogliatto, F. S. (2001). **Mass customization: Literature review and research directions.** Int. Journal of Production Economics, 72:1–13.

Simpson, T. W. (2004). **Product platform design and customization: Status and promise.** In: Artificial Intelligence for Engineering Design, Analysis, and Manufacturing., vol. 18, 2004, pp. 3-20.