Choice Navigation: Towards a Methodology for Performance Assessment

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Abstract

Based on the increased demand for product customization and the intensified competition, manufacturing companies are today more than ever required to deliver product variants in an efficient manner. Research on mass customization has, up until now, primarily focused on clarifying the organizational capabilities defining successful mass customizers. Choice navigation is identified as one of the three fundamental capabilities. The process of building this capability does not occur as a discrete event, it is a change process. Based on literature review and analysis, this paper addresses the change process in relation to implementation of the choice navigation capabilities. A framework for performance assessment, supporting implementing of the choice navigation capabilities, is forwarded.

1 Introduction

A broadly recognized trend of today's markets is the demand for customized products and services meeting the individual customer's needs. Simultaneously today's manufacturers are faced with demands for delivering products faster and cheaper. These market trends happen in concurrence with the increased saturation and globalization of markets. Consequently, today's manufacturers are on top of the demand for customization, also faced with increasing demands for operating in an effective & efficient manner.

Perfectly suited to this challenge, mass customization arose as a concept and an operations strategy in the late 80's, combining the ability to deliver products that meet the individual customers' needs, as well as having an efficiency similar to mass production [Davis, 1989]. Since then, research has focused on clarifying the fundamental, or defining, characteristics of the firms that successfully adopts the mass customization strategy. This has led to the introduction of three fundamental dimensions in enabling the mass customization ability. The three dimensions are by [Salvador et al., 2009] framed as the three fundamental mass customization capabilities; Solution space development, robust process design and choice navigation.

This paper focuses on the process of building the choice navigation capability. This capability, or rather set of capabilities, refers to the ability to support customers in the process of selecting the solution or variant that fulfils the customer requirements out of a pre-defined solution space, and maximizes the customer value. Several researches and practitioners in the industry have adopted the three fundamental capabilities, and continued this line of research, defining and developing a more comprehensive understanding of what characterises and constitutes a successful mass customizer [Fogliatto et al., 2012; Lyons et al., 2012; Piller & Tseng, 2010; Walcher & Piller, 2011]. However, recent studies report that experience in industry adopting and building these capabilities, is for many companies an unsuccessful quest, leading to in worst cases company closures [Piller et al., 2012b]. Based on this knowledge, we argue that the industry lacks more detailed and comprehensive guidance, on how to undertake the transition from conventional approaches at manufacturing, to mass customization as a manufacturing strategy. Research on mass customization has also lately increasingly focused on the "how to" of mass customization, in order to provide improved guidance for companies in the organisational transition, when following a mass customization strategy, e.g. [Partanen & Haapasalo, 2004; Pollard et al., 2011].

The same situation holds true when focusing on choice navigation. Significant amount of research and valuable knowledge have been generated on what choice navigation is about, including how to develop product configuration systems. However, the topics of how to support the transition towards MC, and additionally the process of building the choice navigation capabilities, have thus so far only been scarcely addressed.

An alternate method of supporting organisational change, which is often addressed in other streams of literature, is the use of performance management. In relation to this, Nielsen, Brunø and Jørgensen [Nielsen et al., 2012] have introduced an overview of metrics and a framework for measuring a company's performance as a mass customizer. However, as the metrics only focus on solution space assessment or mass customization in general, no guidance is given in regard to choice navigation.

The purpose of this paper is based on this shortcoming in the existing literature on mass customization to answer the following research questions:

How can performance assessment support the implementation of the choice navigation capabilities? What performance assessment methodologies are appropriate?

In order to answer this, the choice navigation capability is

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further detailed in the following section by the use of central literature In section 3, a model is introduced describing the dimensions along which performance assessment is relevant in the context of choice navigation. Based on this model, relevant performance assessment methodologies are based on the literature review introduced in section 4. In conclusion, the results of the literature review are discussed, and direction for potential further research is given.

2 Choice Navigation - What is it about?

What performance assessment methodology is appropriate depends on the object or artefact of measurement, as this defines what is relevant to measure, and how measurement can be done. As the fundamental capabilities of mass customization are defined at a rather abstract level, it is challenging to relate this to specific activities, or activity-areas, in a firm. Based on the aforementioned premise, the principal questions are: What is choice navigation really about? What does the choice navigation capability mean in an industrial context? Which activities, systems and human competencies does this abstract and high level capability refer to?

The choice navigation capability is by [Salvador et al., 2009] defined as, the capability of "supporting customers in identifying their own solutions, while minimizing complexity and the burden of choice". By this definition it is revealed that, the concept of the choice navigation capability, builds on assuming a causal relation between the efforts required of the customer to identify the solution, and the customer satisfaction. Consequently when customers e.g. are exposed to an assortment of too many choices, the cognitive cost of evaluation outweighs the value of increased variety [Huffman & Kahn, 1998; Piller et al., 2012a]. Based on this knowledge, companies are required to simplify the navigation of their product assortment.

It could seem as if MC-scholars are more or less in agreement on the underlying phenomena of choice navigation. However, if the literature on mass customization and choice navigation is reviewed, it is revealed that the conception of the choice navigation capability varies.

Some authors, e.g [Da Silveira et al., 2001; Fogliatto et al., 2012] describes choice navigation as a customer manufacturer communication, involving the transfer of knowledge from manufacturer to customer, and vice versa. Hence a knowledge transferring process done by so-called agents of information transfer, which in this connection are described as the manufacturer and its customers. In contrary to this, other authors, e.g. [Franke & Piller, 2003; Heiskala et al., 2010; Mortensen et al., 2008; Trentin et al., 2013] describe choice navigation, as a configuration system involving the use of dedicated IT support, in the form of a product configurator, also referred to as choice board, or customer design system.

Investigating the underlying view of the choice navigation capability in these cases, it is evident that in both [Da Silveira et al., 2001; Fogliatto et al., 2012] the choice navigation capability is described as primarily relating to the agents of information transfer, whereas the view on choice navigation in the perspective of [Heiskala et al., 2010] primarily relates to the configuration system, its features, user interface layout and ability to configure a variety of products as well as undertake data migration.

Instead of arguing for or against these different views, the choice navigation capability has more recently by e.g. [Forza & Salvador, 2007] also been described from a more holistic perspective. Building on this, the implementation of the choice navigation capability is more than just implementing a configuration system, it is about managing organizational change, which involves both changes in systems and people. Following this, we suggest that this process should be viewed from a socio-technical perspective [Trist, 1981].

2.1 Choice Navigation from a Socio-Technical System Perspective

Viewing this concept from a socio-technical point of view, it is implied that a company's capability to perform choice navigation does not rely entirely on the technical systems, but to some extent also on the people using the system, whether internal sales people or external customers.

Based on the above, we argue that choice navigation as depicted on Figure 1, consists of both social assets, such as behaviour, routines and skills of e.g. sales personnel, as well as technical assets such as information systems, tools etc. Based on this, we argue that the choice navigation capability is to be viewed as a higher level abstract capability, which is constituted by a set of more concrete capabilities.

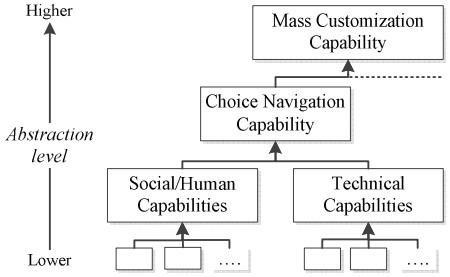

Figure 1 Choice navigation as a socio-technical system capability with multiple abstraction levels.

Another argument for taking a more holistic and socio-technical system perspective on the choice navigation capability, is found in the following definition of capabilities, which both encompasses human assets, and technical assets. According to [Boer et al., 2001], capabilities can be described as "Integrated stocks of resources that are accumulated over time through learning, or established through deliberate decisions. These stocks of resources include internalised behaviours, technical skills, organisational routines, and corporate assets such as information systems, databases, libraries, tools, and handbooks".

3 Transition Towards Choice Navigation

Mass customization calls for a transformed company [Boynton et al., 1993]. As highlighted by [Salvador et al., 2009], this transformation is not something that can be

realized in a single event, it is an on-going or continuous improvement activity.
The purpose of this paper is to clarify performance assessment methodologies, that can give valuable feedback on the implementation of the choice navigation capabilities, so that corrective actions can be taken.
Based on the viewpoint that the choice navigation capability is comprised of both social and technical capabilities, key questions in relation to this are: *How to understand and model the process of building the choice navigation capabilities? Which performance constructs can be identified, i.e. along which dimensions can performance of this socio-technical configuration system be described?*
In relation to the first question [Boer et al., 2001] has introduced the model depicted in Figure 2, which describes the central constructs in the process of building capabilities for continuous innovation.

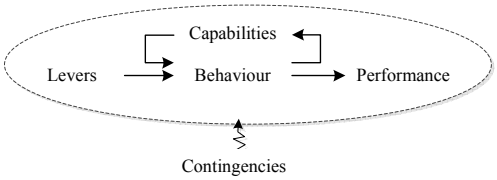

Figure 2 CIMA behavioural model by [Boer et al., 2001].

As the model in Figure 2 links elements such as capabilities, performance and levers, we have chosen to take point of departure in this, in modelling of the central elements involved in implementing the choice navigation capabilities. The outcome, which is depicted at Figure 3, shows how the choice navigation process, which consists of interplay between behaviour of the technical system and the social system, determines the choice navigation performance. Furthermore, the choice navigation process is affecting the choice navigation capabilities, by e.g. development of routines based on repeated behaviour. The choice navigation process is in turn affected by the capabilities of the company, and the levers brought in use, e.g. IT systems, etc. Finally the levers utilized are based on feedback or control information from the performance of the process.

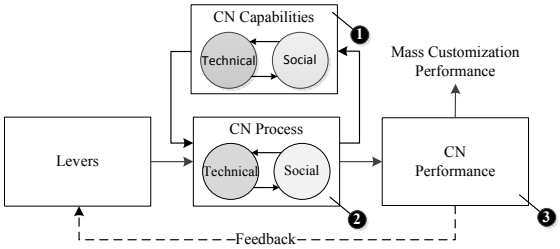

Figure 3 Behavioural model of the socio-technical CN system, outlining the three dimensions of performance assessment. Model is based on modifications to model of [Boer et al., 2001].

Based on the constructs of this process in building the choice navigation capabilities, three dimensions have, as depicted at Figure 3, been identified potential in describing the performance of this process:
1) The degree to which the capabilities have been built
2) The choice navigation process performance
3) The output performance of the choice navigation process

In addition to these three performance dimensions, it is also relevant to describe the performance of the mass customization process. This is however not included as an additional dimension, as it is believed to be hard to distinguish between the performance of choice navigation, and the performance of the mass customization process.
According to the three aforementioned dimensions, as well as literature review, relevant performance assessment methodologies are introduced in the subsequent section.

4 Performance Assessment Methodologies

It has for long been recognized that performance assessment has an important role to play in the efficient and effective management of organizations [Kennerley & Neely, 2003]. This topic has, as reckognized by among others [Folan & Browne, 2005], also gained focus in an ever-increasing number of academic fields.
The research on performance assessment was initiated in management accounting in the beginning of the 20th century, and later gained a broader role into non-financial disciplines, such as operations management, marketing, and human resource management [Chenhall & Langfield-Smith, 2007]. Organisational performance is as highlighted by [Cameron, 1986] among others, by no means a simple phenomenon; rather, it is a complex and multidimensional concept. There are several purposes of conducting performance assessment, [Melnyk et al., 2004] highlights one which quite accurate defines the purpose of performance assessment in this context;
"closed-loop deployment of organizational strategies, allowing relevant information to feed back to the appropriate points facilitating decision and control processes".
Assessment of organisational performance, in order to provide control information, has split into two main streams in literature; one stream focusing on metrics, performance measures, performance measurement systems, and approaches to performance management, e.g. [Folan & Browne, 2005; Melnyk et al., 2004; Neely et al., 2005]. The other stream of literature, which is dominatantly within quality management literature, focuses more on the use of capability maturity frameworks, in the assessment of organisational capabilities, e.g. [Maier et al., 2012].
Despite different approaches and focus, the two streams of literature both provide methodologies for feedback, recommendations and control information enabling assessment of an improvement effort. In order to clarify what performance assessment methodologies are appropriate, central contributions within each of these streams are reviewed in the following, and reference is given to the three performance dimensions identified in above.
The performance measurement methodologies are assessed agains three criterias:
1) *What is measured?* Do the methodology encompass performance assessment by quantitative performance measures or assessment of organizational capabilities?

2) *Non domain-specific?* Are the methodology non specific for a particual domain, i.e. are the methodology more generally applicable.
3) *Operationalizable?* Are the methodology operationalizable, i.e. not only conceptual.

Only the performance measurement methodologies meeting the three requirements are introduced in the following.

4.1 Performance Measurement and Management

Performance measurement has its roots in early accounting systems, the first financial ratios and budgetary control procedures was developed in DuPont and General Motors during the early 1900s [Neely et al., 2005]. Since then the demands from managers, to assess the effectiveness and efficiency of specific areas, have resulted in a proliferation of approaches to performance measurement [Chenhall & Langfield-Smith, 2007]. Today, basically all areas of an organisation are in the scope of performance measurement and management, each with distinct perspectives and purposes.

The research on performance measurement can according to [Folan & Browne, 2005], be said to give recommendations on four different levels or dimensions. Recommendations for:

1) Individual performance measures
2) Structural frameworks (set of performance measures)
3) Procedural frameworks (process of building performance measures systems)
4) Performance measurement systems (the integration of the above)

The term performance framework refers, as stated in [Folan & Browne, 2005], to the active employment of particular sets of recommendations. What is in common for most of the performance measurement frameworks and systems are, that the performance measurement boundaries, dimensions and relations in between the measures are given.

Rather than giving an extensive review on literature on performance measurement and management, the objective of this paper is more to clarify performance assessment methodologies relevant for choice navigation.

Based on this focus, the literature review concentrates on performance measurement systems and structural frameworks. Literature on individual metrics and literature on procedural frameworks are thus omitted. For a review of individual performance measures we refer to [Chenhall & Langfield-Smith, 2007] . Similarly, for a more extensive review of the available performance measurement frameworks we refer to [Folan & Browne, 2005; Neely et al., 2005; Pun & White, 2005].

The performance measurement methodologies found relevant based on the criterias listed in the following. For each method, it is in brackets indicated, which of the performance assessment dimensions, depicted at Figure 3, the metholody is supporting.

AMBITE performance cube [2,3]

The structural performance framework introduced by [Bradley, 1996] is specifically designed to suit a so called Business Process Reengineering process. The framework consists of three dimensions:

- Business processes: customer order fulfilment, vendor supply, engineering, manufacturing, etc.
- Competitive priorities: time, cost, quality, flexibility, environment
- Order-delivery type: make-to-stock, assemble-to-order make-to-order, engineer-to-order.

With regard to these three dimensions, combinations of different strategic performance indicators (SPI's) can be generated. Each of these strategic performance indicators can be broken down into lower level indicators. This breakdown is done context specific, and the performance indicators are thus customised to the context of application. In addition to the structural framework [Bradley, 1996] also introduce a procedural framework for PM system design. This describes how to link the performance indicators with the company's strategy statement and business processes.

Balanced Score Card (BSC) [2,3]

One of the most recognized and broadly applied performance systems or frameworks is the BSC, which was developed by [Kaplan & Norton, 1992]. The BSC approach gives a holistic view of the organization by simultaneously looking at four different perspectives on performance; (1) Financial, (2) internal business, (3) customer, (4) innovation and learning. BSC is based on this a good example of a performance assessment system that employs a balanced set of financial and non-financial measures. The BSC approach is based on the principle that a performance system should provide managers with sufficient information to address the following questions:

- How do we look to our shareholders (financial perspective)?
- What must we excel at (internal business perspective)?
- How do our customers see us (customer perspective)?
- How can we continue to improve and create value (innovation and learning perspective)?

The performance measures to be utilized in the BSC system is initially to be formulated during the system development process, according to the BSC system design methodology.. Based on this, no performance measures are explicitly pre-defined by the approach.

Comparative Business Scorecard [2,3]

With point of departure in the balanced scorecard, [Kanji, 1998] introduced the Comparative Business Scorecard. This framework is based on adaption of TQM principles to monitor progress and performance toward towards excellence. To enable this the performance measures focuses on the drivers of success; delight the stakeholders, ensure stakeholder value, process excellence and organisational learning.

As noted in [Kanji, 1998] this framework is merely an attempt to go a step further and extend the understanding of the four BSC perspectives. The framework is in methodology and structure, thus not radically different than the BSC.

General Motors Integrated Performance Measurement System [2,3]
This integrated performance measurement system is an outcome of significant investments within General Motors in the early 90's, in the design of a performance measurement and feedback system, consisting of 62 measures [Gregory, 1993]. The framework is, in order to provide valuable input in a complex organisation, designed to be applied at various organisational levels, with specific measures for each level. The measures can generally be split in measures of results, e.g. quality and responsiveness, and measures of the process of strategy implementation. The measures ensures that employees retain their focus on continuous improvement through teamwork in the key business activities.

Integrated Performance Measurement Framework [2,3]
Similarily to the approach of General Motors, the Integrated Performance Measurement System of [Medori & Steeple, 2000], encompasses multiple measures. The structural performance framework is composed of five sub-systems each with distinct purposes of performance measurement, and each with different performance measures. The five sub-systems of the performance framework interact and co-ordinate in a controlled fashion. The integrated performance framework does not include any procedural elements, besides a set of principles that should be considered alongside the framework.

Performane Prism [1,2,3]
The Performance Prism framework introduced by [Neely et al., 2002] offers a new approach to measuring organisational performance in that it integrates strategy, capabilities and performance measures. The framework is built upon the argument that one of the greatest fallacies of measurement design is that performance measures should be derived from strategies.
The performance framework includes five inter-related and weighted aspects;

1) Stakeholder satisfaction; who are the organization's key stakeholders and what do they want and need?
2) Stakeholder contribution; what contributions does the organization require from its stakeholders?
3) Strategies; what strategies does the organization have to put in place to satisfy the wants and needs of these key stakeholders?
4) Processes; what critical processes does the organization need to operate and enhance these strategies?
5) Capabilities; what capabilities does the organization need to operate and enhance these processes?

To each of the aspects of the framework specific performance measures are given, accompanied by their results, trends, targets, standards, initiatives and action plans. These data-sets are included in scorecards to facilitate the performance management. The measurements are furthermore connected with each other through sets of hypothetical relationships called "success map". Together the five viewpoints provide a comprehensive and integrated framework for managing organisational performance.

Results and Determinants Matrix [2,3]
The performance measurement framework introduced by [Fitzgerald et al., 1991] is especially developed for the services businesses. The framework employs a distinction between measures of results, and measures of the determinants of the results. The frame work involves several measures, e.g. competitiveness, liquidity, capital structure and market ratios, that according to the author do not vary across the three generic service types, which is identified.

Strategic Measurement Analysis and Reporting Technique (SMART) [2,3]
The Strategic Measurement Analysis and Reporting Technique (SMART) system, also known as the Performance Pyramid, is designed by [Lynch & Cross, 1992]. The system is designed with the intent of creating a management control system of performance indicators, that can assist in defining and sustaining organisational success. The framework employs a hierarchical view of business performance measurement, in the sense that it is modelled as a pyramid with four hierarchical levels of objectives and measures. The SMART system includes a 10 step procedural framework describing the performance assessment process.

Structural Performance measurement matrix [2,3]
[Keegan et al., 1989] have proposed a structural performance measurement framework which seeks to integrate different dimensions of performance. The framework is modelled as a 2x2 performance measurement matrix, that categorises performance measures based on two dimensions; financial versus non-financial and internal versus external.

In addition to the performance measurement systems described in above, a number of more conceptual performance measurement systems have been identified; Dynamic Performance Measurement Systems (DPMS) Integrated Performance Measurement Systems (IPMS), Framework for multinational companies, and the ICAS performance measurement framework. Furthermore, a number of more procedural focused performance measurement systems or frameworks have been identified, for an overview of these we refer to [Browne et al., 1988].

4.2 Capability Assessment Methodologies

The assessment of organisational capabilities, is another promising way of providing feedback and control information in process improvement initiatives. The purposes or drivers for adopting a capability based approach to performance assessment are however, as highlighted by [Maier et al., 2012], other than process improvement. Some might adopt capability assessment based on imposed conformance requirements. In other cases customers may explicitly require compliance with certain frameworks, or the competition on the market place may implicitly require compliance.
Capability assessment frameworks are generally designed to assess the maturity of either the entire organization, or a

selected domain, e.g. process or functional area. The capability assessment is typically conducted by appraisal of the activities done, against a predefined set of criteria's, which most often is gathered in a framework. Process improvement is a central Total Quality Management (TQM) concept, and much of the research on capability maturity assessment, has been done within quality management. The use of capability maturity assessment frameworks has since the concept of measuring maturity was introduced in the early 90's proliferated across a multitude of domains.

The work on capability framework can generally be split up into capability maturity models, and capability grids, which according to [Maier et al., 2012] can be distinguished on three aspects; work orientation, mode of assessment and intent.

As with the performance measurement frameworks, the aim of this paper is not to conduct an extensive review, due to this only the grids and maturity models that are identified as relevant in this context, are addressed in the following. For a more comprehensive review of capability assessment frameworks we refer to [Maier et al., 2012].

Based on an extensive literature search [Maier et al., 2012] have identified 61 maturity grids. Before conducting the review, the number of methodologies for review have been narrowed down to 24 based on requirement to among other things a grid-based approach. Utilizing the criterias from section four in the review of these grids, five grids have been identified relevant.

Similarly [Kohlegger et al., 2009] review based on extensive literature search, and preliminary filtering, 5 maturity models. If the three criterias listed introductory in section 4 are utilized in evaluation, only the CMM model is found relevant.

The capability assessment metholodgies found relevant is described in the following. It is for each indicated in brackets which of the performance assessment dimensions depicted at Figure 3 the methodology is supporting.

Capability maturity models (CMM) [1]

The Capability Maturity Models (CMM) was first developed at the Software Engineering Institute (SEI) at Carnegie Mellon University [Paulk et al., 1993]. Where the focus of the first CMM models was to support assessment software development within a number of sub-processes, an integrated capability maturity model (CMMI) has later been introduced [Chrissis et al., 2003].

The integrated model consists of 22 process areas, and supports product development in general. The capability maturity model works as a multi-level maturity ranking process, where a number of important areas, relative to an organisations' performance, have been clarified. For each of these areas a number maturity levels has been defined, each with distinct capabilities, i.e. practices, methods, skills, tools etc. By auditing the practices done in a company, the capabilities and maturity levels can be identified. Due to this, progressively greater levels of performance are reflected, as an organisation matures in general or within specific areas.

Communciation Grid [1]

Based on the stand that effective communication is key to avoid problems within engineering design, the communication maturity grid has been developed by [Maier et al., 2006]. The purpose of this framework is to assess the maturity of the communication of the engineering design activities. The grid measures the maturity within 5 process areas against four generic maturity levels.

Design Process Audit Grid [1]

A good design is key for company success. Based on this [Moultrie et al., 2007] has developed the design process audit grid. The grid is developed to assess the maturity of the design processes within SME's. Based on 24 process areas the activities in design from requirements capture to introduction in manufacturing are asessed against four maturity levels.

Innovation Audit Maturity Grid [1]

The innovation audit maturity which is introduced by [Chiesa et al., 1996], focuses on the product development processes through which innovation and innovation management is performed. The grid consists of 8 process areas each with 2-4 sub-questions. The audit methodology uses a two level approach a rapid assessment and an in-depth audit.

Product and Cycle time Excellence Maturity Grid [1]

The purpose of the Product and Cycle time Excellence (PACE) maturity grid is to assess and improve the progression of the new product development process [McGrath & Akiyama, 1996]. The PACE maturity grid encompasses 10 process areas related to product development, and measures against four levels of maturity.

R&D Effectiveness Maturity Grid [1]

The maturity grid for measuring R&D Effectiveness is developed by [Szakonyi, 1994] based on several decades of experience and work with a number of companies. The framework measures 10 processes related to R&D.

5 Conlusion & Discussion

There seems to be general agreement between the industry and academia that the competition on the market place displays a trend of higher price competition combined with the demand for customization. The requirement of companies to meet the individual customers' demand at a reasonable price continues to characterize a central challenge for industrial manufacturers today. Based on this, successfully managing the radical organizational change that following it requires to follow a mass customization strategy, is still an important topic. The purpose of this paper is to support clarification of a methodology for assessing the performance of the choice navigation process. The aim of the research is to enable an improved management of the organizational change in the process of building the choice navigation capabilities.

According to the conducted literature review and analysis, a variety of methods for giving feedback and control information on performance have been clarified. In

answering if any methods are appropriate for giving relevant feedback information to the process of implementing the choice navigation capabilities the first step is to review and discuss the available methods at a typological level.

Two types of performance assessment methodologies are identified from existing literature on quality management and process improvement; 1) performance measurement systems and 2) capability maturity assessment frameworks.

Use of metrics in performance measurement systems enable the provision of information on the output performance of the choice navigation process is. As highlighted by [Neely et al., 2005] this enables that the efficiency and effectiveness of the process can be quantified.

Another type of input is given if the capabilities in relation to the choice navigation process are assessed. As noted by Maier this type of assessment enables that the maturity of the process, understood as what collective assets, e.g. skills, routines, tools, systems etc. have been built around the process can be evaluated.

We consider both types of performance assessment as highly relevant in giving feedback information to the process of implementing the choice navigation capabilities. Based on this we suggest that the discussion is more centralized on how to actually combine these, than on which is most beneficial. As a first step in establishing a combined and customized methodology for performance assessment, the existing methodologies need to be assessed. For this purpose the focal paper contributes to existing literature on mass customization with a socio technical system model describing which constructs are relevant in the performance assessment. With the use of this model, the existing literature on performance assessment is reviewed and classified. The research thus enables that a performance assessment metholodogy supporting the building of choice navigation capabilities can be proposed based on further research.

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