Mass Customization: Customizing for the Human Aspect of Operations Management

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Abstract. There is a tendency that the consumer market is getting more and more individualized as an effect of people craving customized products, and producers seeing this as an opportunity for earning more money on a product or service customized to a customer's specific needs. This customization increases the complexity tied to the product, not necessarily for the consumer, but typically for the producer. As the complexity of products are moved closer to the producer, the job of producing and/or assembling the end-product gets more complicated. For instance, a higher degree of flexibility will be needed, if compared to traditional mass production where one typically produces in bulk. This will again demand more from the organization and its employees in form of more responsive systems, machines, processes, and not least employees. In this paper we suggest a self-assessment form to measure the individual job satisfaction at the shopfloor and take one step in the direction of customizing the daily work of employees in mass customizing companies.

Keywords: Mass customization · Job design · Job satisfaction · Job coordination

1 Introduction

The core of any business model is to increase the value of a product through value creating activities. Today, end-customers are getting more comfortable buying online and specifying what they want with individualized products. The digital revolution is changing almost every industry and their business model, making the world more custom. The advances in manufacturing technologies and information systems have made it possible for companies to rapidly develop and manufacture products to meet customers specific needs economically viable [1].

Mass Customization (MC) as a business strategy puts the customer in center of operations, seeking to exploit the fact that every customer wants individual fitted offerings. MC can be defined as the ability to manufacture a high volume of product options for a large market that demands customization, without substantial tradeoffs in cost, delivery, and quality [2]. This business strategy has slowly replaced or, in some cases, supplemented mass production in the industry [3]. MC has gained increased focus over the past years and companies in various manufacturing industries such as

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electronics, furniture, jewelry, clothing, pharmaceuticals, food and beverages, etc. are focusing on how to meet the market demands with individual needs and wishes efficiently. According to Pine [4], principles for MC include speed, information, on-demand operations, dispatching, no finished goods inventory, digitalization/automatization, and modularization. If applied right in a manufacturing company, customers will experience the joy of numerous choices alongside prices and delivery times that can be expected from a mass producer. Three core capabilities are identified for mass customizers [5]; First, to design a solution space (SSD) that always hold offerings of interest to the customer. It is not a goal to make everything for everybody, but to be able to constantly update the product portfolio to reflect customers ever changing needs within the line of business the company is in. The second core capability is often denoted choice navigation (CN) and addresses how to help the customer to identify the exact right product from all possibilities without experiencing fatigue or mass confusion during the process. Often this is solved with the introduction of product configurators. The third capability is robust processes (RP), which points at the company's ability to fulfill orders rapidly and in any sequence they might appear. This last capability covers both technical and human aspects of the processes.

A key factor that facilitates MC is the way the work is organized within the company [6]. People are vital to the process. Viability depends on sufficient operator skill to handle increasingly complex shop floor tasks that stem from customizing products at a high speed. Only with the help of skilled people, both on the production line and in the design and engineering processes, will digital technologies enable MC to be economically feasible. MC companies operates with short delivery time and operators often have a sense-of-urgency towards delivering the product in good condition and at the right time.

Literature indicates that people with a high level of motivation and satisfaction at work often translate these positive experiences into a productive workforce [7]. In the same way MC companies understands the end-customers need for individualized products, one should also consider the need to distinguish according to operators' preferences at shopfloor level. Often in a production line the complexity of the activity may vary, and therefore in some workstations the work conditions are manageable for some, however, for others these activities and conditions give a greater strain on the operator. Short planning horizons might further add pressure to some employees. Let's also recognize that in i.e., manufacturing of modules, entirely different situations can be found, where small batch production of variants might dominate the scene.

The purpose of this research is to gain a greater insight into how job satisfaction criteria are met at the shopfloor in MC companies, and to form a basis for designing work-packages on an individual level. By developing a self-assessment form for this, companies can better understand how to optimize and customize, not only for end-customers, but also the everyday work of the operators.

The remainder of the paper is structured as follows; First, relevant work on the topic of job satisfaction is presented. Next, the research approach and context are described. Then, we present a self-assessment form for understanding and adjusting work conditions at shop-level in manufacturing companies. This includes a consideration of how MC is related to job satisfaction. Finally, the work is concluded, and limitations and future work is described.

2 Job Design

"Imagine designing the role of a police officer. Illustrative work design decisions include the following: Which activities should be grouped together to form a meaningful job? Which decisions should be made by officers and which by their supervisors? Should individual jobs be grouped together into a team? Can one build in routine tasks amid complex ones to ensure officers are not overwhelmed by demands? These decisions about the content and organization of officers' tasks, activities, relationships, and responsibilities will affect outcomes at multiple levels, including individual officers, such as how engaged they feel or their level of strain; the wider organization, such as whether the police service achieves its targets; and society, such as how effectively crime is detected and prevented." – elaborated by Parker and Sharon, [8].

Interest in the topic of job design, also called work design, arose as a response to the wide-scale adoption of scientific management principles in the design of early industrial jobs. The general thought was to design work systems with standardized operations and highly simplified work so that people could be just as interchangeable as standardized machine parts. A problem with this approach was that most people did not find the routinely, repetitive jobs motivating. This led the researcher Frederick Herzberg to specify that, to motivate employees to do good work, jobs should be enriched rather than simplified [9, 10]. This is when job design emerged from studies of alienating and meaningless jobs, where psychological research on the subject has motivation at its core [11]. At an individual level, job rotation, job enlargement, and job enrichment emerged as motivational countermoves to simplified jobs, where job enrichment is said to be the most important as an effect of its emphasis on increasing employees' autonomy [8]. The correlation between job design and job satisfaction has been researched. The results of studies confirms that there is a significant relationship between job design and job satisfaction [12, 13]. Additionally poor job design will undoubtedly bring about dissatisfaction [14]. Another study suggests that jobs which are interesting, motivating, and meaningful often supply employees with a high level of satisfaction, which translates into a productive workforce that can meet business goals [7].

Job design is defined as the system of arrangements and procedures for organizing work, including the set of activities that are undertaken to develop, produce, and deliver a product [15]. Work consists of five core job characteristics: Job variety, job autonomy, job feedback, job significance and lastly job identity [16]. For more in-depth literature on the topic of the five dimensions see [8]. Following beneath is a closer look at the core job characteristics through the dominant motivational model of job design, the job characteristics model (JCM) (Fig. 1):

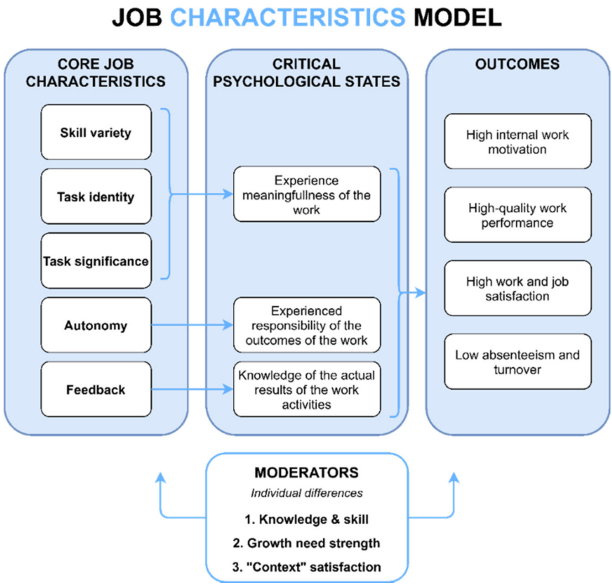

Fig. 1. The Job characteristics model, this recreation is based on the work of Oldham & Hackman [16]

Skill Variety: Refers to the range of abilities needed to perform a job. Monotony is not what most people look for in their dream job; conversely, employees want to be able to enlist various skills throughout their employment to avoid getting bored. Employee motivation will increase if your team members are using a variety of diverse skills in their positions, rather than one set skill repeatedly.

Task Identity: Means the extent to which a job involves completing an identifiable piece of work from start to finish, with a visible outcome. Motivated employees will be more likely to complete tasks if they identify with them and have seen them through from start to finish.

Task Significance: The extent to which a job is important to and impacts others within and outside of the organization is known as task significance. When employees feel that their work is significant to their organization, they are motivated to do well, and this will lead to increased employee productivity.

Autonomy: Measures each employee's level of freedom and ability to schedule tasks. Employees like to be able to make decisions and have flexibility in their roles.

Feedback: Refers to the degree to which an employee receives direct feedback on their performance. A team needs feedback to motivate employees in the long term.

Job content is a continuous process and should not be a single event that produces lasting structural changes in the design of work [17]. Campion [11] found that a group of highly trained, disciplined, and motivated workers were a key resource for the success of the MC-strategy in the National Bicycle Industrial Company. Oldham,

Hackman [16] cited for job design, remarks the lack of appropriate workforce skills, as the major cause of Toyota's problems in implementing MC in the late 1980s. This implies an already link between job design and MC, as well as confirming the need for satisfied employees to get the best out of a MC strategy.

3 Research Approach

The research is based upon a dedicated literature review to identify key aspects for optimal job design and a conceptual work on how MC companies can optimise the operators daily work routine by organizing work at shopfloor level. The study is part of the joint research and innovation project BeneFIT, funded by the Norwegian Research Council, and the project aim to solve highly relevant real-life challenges through a collaboration between researchers and problem holder. There are several employees with different competences, tasks and needs which makes the coordination on shopfloor level complex and throughout this research we will introduce a preliminary system for assessment criteria for optimising for operators within manufacturers with MC as a business strategy.

The first conceptual step, the development of the assessment form described in this paper, will be followed by another paper on results and findings from the self-assessment. The planned research design of the self-assessment results will include empirical data collected from approx. 100 operators in five different MC manufacturers. Through case studies within the manufacturers, it will be detected how the operators handle the enormous solution space daily, such as how inspired, comfortable, and motivated the work is perceived. Respondents of the suggested assessment form will be selected based on relevant competence and therefore represent operators at shopfloor and middle management.

4 Results and Discussion

Several researchers have previously suggested a link between MC and job design and describe it as challenging to succeed with MC as a business strategy without job satisfaction among operators [11, 16]. When comparing the MC Principles with the Job Characteristics, it is quickly revealed that there are several correlations between the two. For instance, a MC company with a large product-portfolio, and no finished goods inventory, needs to have high speed in production to meet customer demands towards delivery time. Which again would demand highly specialized operators who most likely would experience a high degree of fluctuating workload. Or rather, a workforce with a high degree of skill variety. Task significance can also be said to higher than in traditional mass producers where they have inventory of finished products, whereas every produced product will go to a specific customer, and not to an inventory where it may lay for a long period of time before it finally, and hopefully, finds its way to the end-customer. Another correlation is the information principle matched with the job characteristic feedback, there will be no feedback without information (Fig. 2).

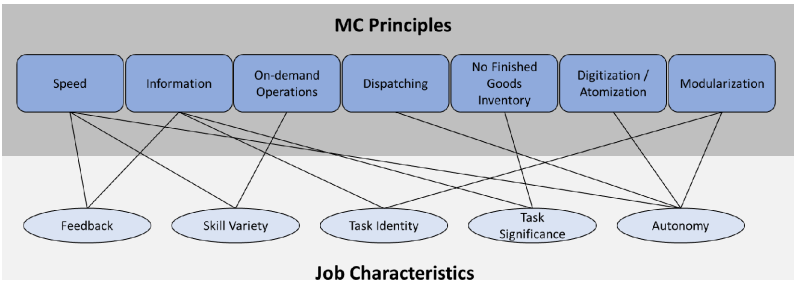

Fig. 2. Examples of correlation between MC principles and job characteristics.

This match between the principles and the characteristics makes us believe that MC companies are arranged for, or at least, has a good starting point for achieving a high degree of job satisfaction. However, this is only an assumption at this point, therefore we want to assess this through an assessment form.

When something is assessed at shopfloor level, for example with regards to ergonomics, it is often done for the 'average person'. However, for optimal results and solutions from such assessments there is a need to distinguish the individuals. The same challenges arise when studying the different value-creating activities. The work in a factory is composed of many different activities and types of work. For some, there are activities that are too challenging/time-pressured/physically heavy, and therefore the job becomes a place filled of stress and lack of control, while for others, the same activity is perceived motivating and satisfying. The goal of using this form is simply to get a greater insight into job satisfaction on an individual level. Which again will be crucial to be able to customize for a higher degree of satisfaction at the shopfloor, and therefore contribute to a higher productivity. Which is key resource for the success of the MC-strategy [18]. To meet the customers varying demands, with respect to volume and type of individual needs, operators in a MC company may have to move work-stations several times a day due to short-term demand. Once the needed amount of a component is produced, further movement may be necessary. Such a situation where operators need to orient on the instant need of the factory to face new order mixes never seen before can be demanding and have great strain on some, while not on others. By customizing it is possible to evenly balance the activities so everyone will have more of the activities themselves find motivating to gain a more productive workforce [7].

This research propose a form which is based on the five job design dimensions: variety, autonomy, feedback, significance, and identity. Through the eyes of job design, we will assess work with regards to the five dimensions (Fig. 3).

Self-assessment form: Job satisfaction								
	Questions	Yes			No	Satisfied?		Comments?
		Day	Week	Month		Yes	No	
Skill variety	Does your work consist of varying tasks?							
	Do you feel montony?							
	Is the range of abilities needed to perform your job challenging?							
	Do you ever get bored at work?							
Task Identity	Are you completing an identifyable part of the product or function?							
	Can you see a visual outcome of your work?							
	Do you feel you pass on work to early?							
	Does your work contain too much responsibility?							
Task Significance	Does your work contain elements that feels significant?							
	Do you find any of your tasks insignifcant?							
	meaningful?							
	Is your work important for the end customer?							
	Is your internal customer satisfied with your delivery?							
Autonomy	Do you have any freedom in your work to make own decisions?							
	Is it elements you can't decide/influence?							
	Can you influence on job-rotation?							
	Would you prefer more desicion-support?							
Feedback	Do you get significant feedback?							
	Is the feedback structured and constructive?							
	Does the feedback motivate you?							
	Does the team reflect on feedback together?							

Fig. 3. A minimized version of the form on job satisfaction.

When using the proposed question-form for the first time, it is important to have a common understanding of how it is supposed to be answered, even tough is seems simple and straightforward. This should preferably be presented for everyone in advance. When one does the assessment on a personal level, it should reflect the persons individual preferences and when possible, explain the thoughts behind the reasoning, in the comment section. This way the scientist, production management and/or other employees can get a better understanding of what entails a satisfactory job environment for the individual. The results from this form could ultimately be a supplement to the competence-matrix which is used by the production management when organizing and coordinating the operators. The results may also help managers by shedding light on which workstations include the heaviest or most unmotivating activities, which again could be candidates for automation, or to ensure a fair distribution of work tasks among the operators.

How often this assessment tool should be used will vary from company to company based on the situation. This is also supported through the recommendations from Sinha and Van de Van [12], who points out that organizations should be redesigned constantly and consistently to meet the changing need of workers as well as changes in the work environment.

When one does the assessment on a personal level, it should reflect the persons individual preferences and explain the reasoning behind the scores noted in the form. This way the production management and/or other employees can get a better understanding of what entails a satisfactory job environment for the individual. This process would ultimately create a fine meshed overview of the employee's satisfaction at every single process, which again could be a tool for the production management when organizing and coordinating the operators. Such a tool may also help managers by

shedding light on which workstations includes the heaviest or most unmotivating activities to ensure a fair distribution of work tasks to achieve a high degree og satisfaction among operators.

5 Conclusion

The large variety found in operations within a MC company, such as one-of-a-kind manufacturing and assembly on one hand, and batch production of standardized modules on the other, constitutes an interesting arena for job-assessment, since operators are multi-skilled and have experience from different job situations.

The proposed assessment form for job satisfaction on an individual level raises the possibility of customizing the coordination and workload of the human capital at shopfloor level. This has the possibility of raising job satisfaction individually but also as a whole, and therefore contributing to a more efficient production. However, the effect of more individualized coordination at the shop floor may oppose other wanted effects or routines. One could for example experience that job-rotation would be limited as an effect of the customization, and therefore it is a possibility that it could lead to a more specialized workforce. Nevertheless, we do believe that it could also do the opposite if the implementation and continuous use is done with sufficient involvement from both employees and managers.

Another potential use is with regards to hiring new operators. When the assessment is done, one would have an overview of all the current operators, what tasks is the least liked, and therefore one could more easily locate the type of person which would fit the need on the shopfloor to the highest degree. From an automation viewpoint one could also assess what processes and tasks are best to automatize or digitize, with regards to satisfaction of the operators.

With regards to future work, one should evaluate the content of the assessment form and perhaps split it into several forms, personal and objective assessment. Then the assessment tool must move into an in-depth testing phase and exchange of experiences at the shopfloor.

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