



Quick Response Manufacturing in Dutch and Belgian SMEs in the manufacturing industry:
Significance & impact on human capital

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1 Introduction

Time has become a strategic competitive factor in the manufacturing industry in recent decades (Demeter, 2013; Godinho Filho et al., 2017a; Gromova, 2020). The customer expects not only timely delivery but also a choice, customisation, high quality and low prices (Siong et al., 2018; Suri, 2020). Flexibility and adaptability have become essential to achieve the short lead time desired by the customer, while also fulfilling their other requirements (Godinho Filho et al., 2017b; Siong et al., 2018).

Quick Response Manufacturing (QRM) aims to reduce lead times in production environments characterised by a high variety of products and customization (Siong et al., 2018; Suri, 2020). QRM has its origins in the early 1990s (Suri, 2020) and bears a strong resemblance to lean manufacturing. However, the difference compared with lean manufacturing is that QRM focuses on companies in an environment with strong product variation. QRM has also added new elements, such as *Paired-cell Overlapping Loops of Cards with Authorization (POLCA)* and *Manufacturing Critical Path Time' (MCT)*' (Godinho Filho et al., 2017b).

Central to QRM is lead-time reduction rather than production efficiency. Accordingly, this focus requires a redesign of the organisation to reduce lead times (Godinho Filho et al., 2017a).

Such a transformation in the organisational structure is one of the reasons why QRM is often not implemented in full (Godinho Filho et al., 2017b; Ostapenko et al., 2018). Moreover, the study by Godinho Filho et al. (2017a) reveals that many QRM-implementing organisations lack a complete picture of the possibilities that it offers and subsequently they do not use it to its full potential.

Apart from the increasing customer requirements in terms of delivery time, production technology is also subject to significant change (van Rhijn & Bosch, 2017), which has a major impact on production processes. Full automation is often impossible in assembly work, especially when it involves complex products in small volumes and strong variation (van Rhijn & Bosch, 2017). On the other hand, a hybrid production process where people and robots work together is much more successful in providing the desired flexibility and short lead time. Despite technological developments, people remain the most flexible production factor and they also make it possible to anticipate (changing) customer demands quickly and adequately (van Rhijn & Bosch, 2017). This means that well-trained, flexible and motivated employees are the key resources for organisations (van Rhijn & Bosch, 2017).

There are now several companies in Europe that apply QRM, and more companies that are considering introducing it. The introduction of QRM into an organisation is typified as an organisational change (Ostapenko et al., 2018). Managers often expect employees to behave differently when the organisational structure and work process change as a consequence of the redesign. However, this is rarely the case without training or education (Poell & Van der Krogt, 2008), which means that the expectations regarding QRM are not fulfilled in practice.



Interreg QRM project 4.0

The Interreg QRM 4.0 project supports small and medium-sized enterprises (SMEs) in the manufacturing industry in the Meuse-Rhine Euroregion by combining insights and tools from the domains of QRM and Industry 4.0 and thus reforming production with a view to ultra-short lead times.

The QRM 4.0 project is based on three complementary approaches: QRM (lead time reduction), Industry 4.0 (digitisation) and sociotechnical theory (human aspects). With the focus on these three approaches, the project's goal is to strengthen the competitiveness of SMEs in the manufacturing industry in the Meuse-Rhine Euroregion. SMEs are defined as small and medium-sized enterprises with fewer than 250 employees.

The project assists SMEs in the manufacturing industry in three different ways, namely through (1) information and inspiration (2) training, coaching and support and (3) the exchange of best practices. The systematic training and development of employees are necessary to achieve a permanent adjustment of behaviour in the short and long term and thereby realise the reductions in lead times (Ostapenko et al., 2018).

However, for any support to be adequate, more insights must be gained into the challenges faced by companies wishing to implement QRM. It is currently unclear in what manner Dutch and Belgian SMEs in the manufacturing industry implement QRM, as well as the extent to which they have knowledge of all QRM elements. It is also unclear to what degree knowledge

about QRM has been disseminated within the organisations, while there is also no clarity concerning which new competences are required of employees when a Dutch or Belgian SME in the manufacturing industry implements QRM.

Finally, there is a lack of insight into the extent to which the introduction of – and work based on – QRM principles influences employees' employability.

Objectives

The aim of this study is twofold. First of all, the intent is to gain insights into the way in which QRM 4.0 is put into operation in Dutch and Belgian SMEs in the manufacturing industry. The other objective is to gain insights into the competences required of employees when they work in a Dutch or Belgian SME that operates according to the principles of QRM.

On the one hand, the insights gained provide a picture of the actual application of QRM in the Dutch and Belgian SME practices. On the other hand, the required competences will come to the fore, which can help in designing training and boot camps for companies looking to implement QRM.

This knowledge can also be used in developing higher professional and vocational secondary education curriculums, especially if there are serious indications that increasingly more companies in the Dutch manufacturing industry are to introduce QRM.

The central questions to this study are:

- What do business owners or company directors consider QRM to be?
- What competences must employees have to implement and execute QRM in the desired manner?
- To what extent does QRM affect employees' employability?

Chapter 2 will outline the study's theoretical background, followed by an explanation of the research method in Chapter 3. The results of the study will be presented in Chapter 4, followed by the conclusion and recommendations in Chapter 5.

2 Theoretical background

This chapter will first explain what QRM is and then look more closely at the competences required of employees when the organisation operates according to QRM principles. A summary of QRM 4.0 will follow this, before the implementation process of QRM will be discussed. Subsequently, the impact of the introduction of QRM on employee employability will be explored in further detail. Finally, the chapter will conclude with the impact of QRM on employee employability.

2.1. QRM

With the emergence of Industry 4.0, customers expect fast delivery of their customised product in small batches, with high quality and at a low price (Gromova, 2020; Siong et al., 2018). Economies of scale – which have long been the basis for a low price – are therefore no longer possible, if at all. In order to optimally anticipate the challenges in the external environment, a new paradigm is required, which QRM provides (Gromova, 2020).

QRM is based on ten principles (Suri, 2020) that can be derived from four key concepts (Suri, 2010) and are particularly suitable for organisations operating in environments with a large variety of products, low volumes, and customisation (Siong et al., 2018).



The four key concepts are (Suri, 2010):

- 1) The power of time: the entire focus is on reducing lead times.
- 2) The organisational structure: the structure is designed so that lead times are as short as possible. QRM cells are preferred. A QRM cell comprises a group of employees with the necessary resources to independently prepare, plan and implement a (partial) product or service.
- 3) Understanding and using system dynamics: knowledge of the relationship between variables and lead times.
- 4) Reductions in lead times throughout the organisation, not only in parts of the organisation.

The four aforementioned key concepts have led to ten principles of QRM (see Table 1).

Table 1

Ten principles of QRM

Number	Principle
1	Find entirely new ways to execute work, focusing on lead times.
2	To remain flexible, plan no more than 70 to 80% of resources.
3	Measure lead times and reductions. Let this be the key critical performance indicator.
4	Reward reduction in lead time.
5	Use <i>material requirements planning</i> (MRP) only at the highest production and material planning level.
6	Motivate suppliers to implement QRM.
7	Tell your customers about the QRM programme and negotiate a schedule to deliver smaller batches without (significantly) increasing prices.
8	Eliminate functional barriers by working with QRM cells.
9	Make it clear to everyone in the organisation what QRM is and why it is important.
10	The main obstacle is not technology but the usual focus on cost and efficiency.

Source: "Quick response manufacturing: A companywide approach to reducing lead times", by Suri, R., 2020, Oregon: Productivity Press

Research by Gromova (2020) has shown that organisations that introduce QRM without large investments reduce lead times by 40 to 60%. The results are achieved by changing the organisational structure and working method (Gromova, 2020). However, even if companies have started working according to the QRM principles, they generally have not embraced each and every principle and QRM element (Godinho Filho et al., 2017a). This is explained by the more common focus on productivity, low costs and delivery dates. Principle 10 is the bottleneck here, as it proves difficult to let go of old convictions and embrace new ideas. Another explanation is that SMEs still do not make good use of the available methods and instruments to achieve the desired lead times. This may be due to unfamiliarity and a lack of experience with QRM methods and instruments (van Rhijn & Bosch, 2017). A third explanation is that it is a deliberate choice not to embrace all of the principles fully, as companies only embrace the QRM principles that fit in with their technological and organisational developments (Seppälä & Klemola, 2004).

2.2. QRM: Different use of human capital

One of QRM's four key concepts is the organisational structure. Setting up QRM cells creates a flexible organisation that can quickly meet customer demand. A QRM cell comprises a number of employees. All of the QRM cells together with the other employees constitute the organisation's human capital, which term refers to the skills, health, training and experience of the employees (Flores et al., 2020). Employees play a crucial role in reducing lead times (van Rhijn & Bosch, 2017) since they ensure that the organisation can respond quickly and flexibly to constantly changing customer demand.

The extent to which employees can respond quickly and flexibly to customer demand depends on several factors, which can be categorised under product design, production process and flexibility, employee motivation and education level, and available information (van Rhijn & Bosch, 2017). Employees can swiftly anticipate the specific demand by ensuring a design that comprises varying and processor-friendly elements that can be easily upgraded and modified (van Rhijn & Bosch, 2017). A flexibly designed production process including workstations with the right level of automation and technology to support employees also provides the opportunity to respond quickly to demand (van Rhijn & Bosch, 2017). The third factor affecting lead time involves employees' skills to handle automation and supportive technology. Finally, the extent to which the right information is available at the right time and presented in the right way has an influence on the possibility of achieving the desired quality and lead time (van Rhijn & Bosch, 2017).

We will take a closer look at the employees' skills below.

2.3 QRM: Required skills

A change in organisational structure based on QRM requires multi-skilled employees who are able and allowed to make autonomous decisions (Godinho Filho et al., 2017a). For this purpose, they require various specific competences, defined here as a combination of traits, skills, knowledge and experience required to perform work tasks (Flores et al., 2020). The table below shows the competences that employees have been found to need in an organisation that operates according to QRM principles.

Table 2
Competences required of employees in QRM cells

Competences	Authors
Learning attitude	(Godinho Filho et al., 2017a; Knol et al., 2019)
Proactive attitude	(Gijsbers et al., 2017; Godinho Filho et al., 2017a; Knol et al., 2019)
Adaptability	(Miqueo et al., 2020)
Flexibility	(Gijsbers et al., 2017; Miqueo et al., 2020; van Rhijn & Bosch, 2017)
Digital skills, information management skills and the skills to make decisions based on digital technology	(Gijsbers et al., 2017; Miqueo et al., 2020; van Rhijn & Bosch, 2017)
Knowledge of QRM techniques and tools, such as POLCA	(Stump & Badurdeen, 2012)
Collaborative attitude	(Siong et al., 2018)
Creativity	(Siong et al., 2018)
Communication skills	(Gijsbers et al., 2017)
Multidisciplinarity	(Gijsbers et al., 2017)
Insight into processes	(Gijsbers et al., 2017)



2.4 QRM 4.0

There is increasing reference to QRM 4.0, which is a contraction of QRM and Industry 4.0. Industry 4.0 is used to express the relationship between different parts of the manufacturing industry and new technologies such as big data, the Internet of Things, the cloud and horizontal and vertical systems integration (Flores et al., 2020; Miqueo et al., 2020). QRM 4.0 combines the strengths of QRM with the strengths of Industry 4.0 (Meier, 2020).

A focus on Industry 4.0 runs the risk of the interdependences between the different process steps sinking into obscurity as the concentration will be on data rather than team performance, problem-solving and process improvement (Butollo et al., 2019). This reduces the added value of experiential learning and employees' competences and development fade into the background. At the same time, new technological possibilities offer opportunities to provide employees with better support, which results in task rotation and thus competence broadening (Butollo et al., 2019).

2.5 Implementation of QRM

An effective QRM strategy requires an organisation-wide focus on reducing lead times (Principle 1). Therefore, the first step in the implementation of QRM is a change of focus in management from costs to lead times (Siong & Eng, 2014). Existing CPIs must consequently be adjusted to fit in seamlessly with the new focus on lead times (Siong & Eng, 2014). It is no longer recommended to aim for 100% machine occupancy, for example, but rather a

maximum of 80%, especially where critical resources are concerned, to avoid queues (Principle 2).

This is followed by the designation of the manufacturing critical path time, i.e. the number of calendar days that pass from the customer order up to the delivery of the complete order (Principle 3). Once these steps have been taken, a subsequent organisational change is to shorten the lead time (Principle 8) (Siong & Eng, 2014). For this purpose, Suri (2010) has proposed four fundamental organisational changes.

The first fundamental change is that the organisation of the work becomes a team responsibility. It is no longer the supervisor who determines when and by whom each task is performed. Within QRM, the team itself determines how the tasks are completed. In order to respond quickly and adequately to the strong variety of orders, employees must be broadly trained and able to perform many different tasks, which can be ensured through cross-training (Siong & Eng, 2014). In cross-training, employees are trained to be able to be deployed at different points in the production line or work cell. Cross-training can take place in various ways, such as through written work instructions and practicing different tasks.

Cross-training is also an explanation for the similarities and differences between one's own tasks and those of other team members (Schaafstal & Bots, 1997).

Cross-trained employees are more widely deployable and thereby more flexible than specialised employees who perform well in one specific task. Cross-training gives the team the opportunity to distribute tasks better and avoid overloads (Wu et al., 2018). Broader deployability requires wider training (for multiple tasks), which involves costs, and thus is admittedly a disadvantage of cross-training (Wu et al., 2018).

Widely-trained employees can rotate between tasks at the same level, which is also referred to as *job rotation* (Yauch & Hariyono, 2006). Job rotation has several advantages, including the wider variety of tasks and the lower risk of work-related overload (Yauch & Hariyono, 2006). Absenteeism and staff turnover are also lower in companies with job rotation (Yauch & Hariyono, 2006).

Despite the increased autonomy in task planning, the wider variety of tasks, as well as the opportunity to work on a complete customer order rather than simply a small part, there are also disadvantages. For instance, it places major demands on an employee's skills to be able to perform different tasks. There is a chance that the employee may forget learned skills or is unable to master them adequately due to a lack of practice (Tomašević et al., 2020; Yauch & Hariyono, 2006).

Finally, the team needs sufficient information to plan the tasks properly. This means that the team needs access to organisational systems such as material planning, sales forecasts, production capacity, etc. (Siong & Eng, 2014).

2.6 Employability

Employability is the chance of securing or keeping a job (Forrier & Sels, 2003) and it is also seen as the degree to which a person is able to see and realise career opportunities, both within and outside the organisation (van Emmerik et al., 2012). Employability depends on both individual characteristics (Van der Heijden et al., 2018) and the context, namely the labour market relevant to the individual (Forrier & Sels, 2003; Thijssen, 2000).

With the introduction of QRM, the employees' context will change, and thus also their employability. The employee is expected to change their basic attitude from a focus on costs to lead times, become more widely deployable, act more autonomously and be able to understand and process more information (Siong & Eng, 2014). Accordingly, it may not be the case that an employee who was employable in the old situation remains so in the new situation. There is also a difference between actual and perceived employability.

Employability can be viewed both objectively and subjectively. Objective employability refers to a person's level of education or labour market position, while subjective employability refers to a person's perception of the probability of obtaining a new job in the current or other organisation. Employee behaviour has been found to be better explained by subjective employability than by objective employability (van Emmerik et al., 2012): if an employee believes that they will not understand QRM and cannot implement the new way of working, they will not feel able to perform the new job. This will lead them to think that they are not employable internally and thus they will look elsewhere for a job in which their skills would suffice. It is also possible that objectively the employee has yet to master the necessary competences and requires additional education and training before they are employable (again) to the organisation.

With the introduction of QRM, employees' autonomy on the shop floor increases, and likewise the various required skills and the extent to which someone is able to finish a complete task (Siong & Eng, 2014). The sense of meaning and purpose in their performance and the feedback received might also increase. These are all elements as described in the Job Characteristics Model (Humphrey et al., 2007). According to Van Emmerik et al. (2012), work-related resources such as autonomy, feedback and variation in the work contribute to employee employability. They offer opportunities for learning and development on the one hand and job security and chances for promotion on the other. Van Emmerik et al. (2012) claim that autonomy provides the opportunity to show what the realised performance is, variety in work the opportunity to show skills in different areas and feedback the opportunity to improve. Earlier research by Seppälä and Klemola (2004), into the introduction of Lean principles – which show similarities with QRM – revealed that employees at all levels of the organisation value their work more thanks to the development opportunities created by the introduction of QRM.

Apart from the subjective and objective perspectives on employability, there are also the employee's and organisation's perspectives (Stoffers, 2014; Thijssen et al., 2008). Education and training – both on- and off-the-job – that employees attend to be multi-deployable make



them increasingly employable from both the organisation's and employee's perspective. However, with strong variation and low volumes, it is questionable whether the skills learned are actually used (Tomašević et al., 2020), especially if the focus is additionally on data (Industry 4.0) rather than the employees' competences and experiences (Butollo et al., 2019).

In other words, whereas QRM can reduce perceived employability in the short term, it can also result in higher perceived employability in the longer term as a result of development opportunities and more chances to show and utilise one's skills.

3 Methodological justification

In order to answer the central questions of this study, not only a literature review but also qualitative research was undertaken. In the latter, semi-structured interviews explored what executives (business owners or company directors) of Dutch and Belgian SMEs in the manufacturing industry consider QRM to be. An exploration of their understanding aimed to provide insights into the different perspectives (Nyumba et al., 2018) and the way in which QRM is actually implemented in both countries (Harrison III, 2013; McKim, 2017). The interviewees were also asked about the impact of QRM on the organisation's human capital and employee employability (see Annex 1 for the full questionnaire).

Nine interviews were conducted with ten respondents between February 2021 and June 2021. The respondents all worked in SMEs in the manufacturing industry in the Netherlands (seven respondents) or Belgium (three respondents). The respondents were found through the internet, the list of interested parties of the Interegg QRM 4.0 project and the researchers' personal networks by searching for companies interested in, or already working with, QRM. Many of the 53 eventually-approached companies proved unwilling to participate in an interview, as there was no response to the email and reminder sent. Companies that responded but did not want to participate indicated that they were 'too busy', did not work with QRM or did not belong to the target group because they did not work with 'high variety, low volume' products. A total of nine companies responded positively to participating in the study, and a total of eleven respondents were interviewed.

Due to COVID-19 measures, all interviews were conducted online via Microsoft Teams. According to Janghorban et al. (2014) an online interview has no drawbacks compared to a face-to-face interview. In order to document all of the information, the interviews were recorded with the consent of the respondents (Van Assema et al., 1992). The recordings were then transcribed and coded (Saunders et al., 2011).

4 Results

The eleven respondents had varying degrees of experience with QRM. Some were owners or directors of a company that had been working with QRM for several years, while others had recently taken the first steps towards implementing QRM.

4.1 A changing environment sparks interest in QRM

According to the respondents, globalisation leads to increasing competition, which increases the importance of a more efficiently organised – and therefore cheaper – production process. The human factor is expensive and not always available with the desired level of quality. Automation reduces the dependence on the human factor: "[we are moving] *more and more towards automation, robotisation, doing more with fewer people*" (R1). However, not every aspect of the production process can be automated. It also happens that the *return on investment* of automation, digitisation and robotisation is too low. Regardless of the level of automation, the respondents still see the employee as the crucial factor in the production process: "*Your process may be wonderful, but if you don't get the people on board, you are still empty-handed*" (R2). Technology is seen as a prerequisite for shortening the lead time: "*we want to reduce the lead time even more, but we need the technology to do so*" (R4). It is striking that some organisations opted for certain hardware and software solutions without prior analysis concerning which organisational structure they should support.

The need to switch to QRM is still low despite globalisation. The respondents stated that customers do not always ask for faster delivery times: "*Orders that have to be done within a month are a rarity*" (R5). However, the companies feel the need to be able to respond flexibly to customer requirement. The customer also increasingly expects a partner to think along rather than only supplying the goods. In other words, QRM does not always match the challenges that the respondents face: "*the QRM bit has brought us a lot, but in many areas, it has not exactly been the right shoe to fit us, but we have taken good note of the lessons we learned*" (R4).

4.2 Environmental scanning

Several respondents indicated that they were not yet working according to the QRM principles but were interested in the QRM concept. However, showing interest in a label such as QRM does not mean that companies actually know its contents or are prepared to invest in it, as they look around and become inspired by all kinds of trends. For instance, one respondent at a metalworking company said that their organisation is a small one and the production process is not subject to much change. The *batch size* turned out to be quite large and in the eyes of the respondent, the production speed was not 'yet' very relevant. He also kept an eye on the companies around him and had seen that a competitor was using QRM-like systems. He assessed that the investments were far from profitable. However, the company wanted to remain informed because the concept might become interesting in the future. Another respondent had a similar story: "*QRM is interesting, but not for our company as yet*". This company was active in a niche with a very stable market environment where the '*product lifecycle*' caused the wave movements in demand. The sensors that it produced worked for x number of years, and the machines in which they were used were so expensive that revision



of the sensors proved to be a lucrative business. Furthermore, the sensors were used in different industrial sectors, so that their customer portfolio was diverse and fluctuations were balanced out. Faster and more dynamic production was not yet in this company's interest. Another respondent said that the company owner had decided to implement QRM after extensive exploration. According to the respondent, this method could address the challenges faced by the organisation. One respondent – the owner of a company that had been working according to QRM principles for several years – gave the following answer to the question of whether other companies should do the same: *"You have to make a choice. Choose what you do and then do it"* (R9).

The respondents recognised the added value of exchanging knowledge and experiences with the QRM mindset, regardless of whether they were already operating based on QRM themselves: *"if you can look at your neighbour's best practice. Firstly, it's great fun, but it is also good to see what happens around you"* (R3).

4.3 QRM: what's in a name?

When it came to QRM training, the respondents who were already working according to QRM principles stated that it should be considered that employees are not always equally receptive to QRM terminology. For example, the term 'lead time' as a concept proved difficult to understand; employees are much more familiar with the term 'effectiveness'. It was generally regarded as important to use terminology that matched the employees' world of experiences and perceptions.

The respondents also considered it essential that employees were explained the usefulness and necessity of QRM. At the companies that had already implemented QRM, several employees had followed a QRM course with the intention of contributing to its implementation in the organisation. In order to properly implement QRM, it is important to secure the employees' involvement in the necessary change: *"they have to want it, that's the main thing"* (R4). Finally, according to respondents, employees quickly feel checked and controlled and afraid of being held accountable for errors or delays. *"The fact that mistakes are not punished but analysed to improve"* (R6) is difficult for employees to understand.

When companies consider to introduce QRM, an assessment is made regarding the time savings versus the additional costs resulting from its introduction and implementation, whereby the outcome is not always positive for QRM. Some companies only adopted some aspects of QRM. In fact, none had made an abrupt transition from 'no QRM' to 'full QRM': *"you are talking about a type of cultural change, and that just takes longer"* (R9). Respondents mentioned that they discovered that QRM ideas were sometimes applied without anyone realising, simply because the situation demanded it.

4.4 QRM raises expectations for competences and competence development

Some organisations indicated that assessing the current employees' competences is crucial when multiple QRM principles are implemented. Some workers will not be as broadly deployable as others: *"we have set up improvement programs to solve this"* (R9). The respondents highlighted the added value of well-trained employees: *"you have to have flexibility in your employees, otherwise you can forget the whole thing"* (R2). Employees are expected to be deployable on multiple production lines. The respondents also deliberately steered towards this: *"the production manager has an overview of all employees, of where they can be deployed. I run it over with him every month, what his plans are, to say, like, I will deliberately do or not do this to enhance the knowledge"* (R2). *"and to let those who are a bit slower, also do those other products that are known to take a bit more time"* (R3).

This steering towards all-round employees takes place regardless of the extent to which the company has implemented QRM. In order to make and keep employees all-round employable, the companies mainly used on-the-job and cross-training. It was usually expected to take several years to get all of the employees to the desired level: *"it takes a lot of effort and time, especially in the first two years"* (R9). In this context, it was considered important to look at the nature of the work: *"a production worker cannot do the same as an engineer. So, we have actually formed two sub-cells within one team"* (R10).

Most respondents stated that there was a flat organisational structure with a large degree of autonomy for the employees on the shop floor. For example, they were involved in the design of protocols and work regulations: *"we always ask for the input of the employees in such matters"* (R3). Employees do not always find it easy. There appears to be a difference between actual and perceived autonomy: *"you can give them responsibility, but they have to be able to take it"* (R8). This also sometimes proved to be a bottleneck in the introduction of QRM and thinking along

with the organisation of the work process. If employees have more experience with autonomy, they often dare more: *"I also see beautiful initiatives now whose content I don't know, but it is great"* (R9). Taking up the autonomy offered on the shop floor requires a lot of coaching: *"so you have to keep asking questions about how others think it can be solved"* (R9).

4.5 QRM changes the nature of work as well as engagement

Based on the respondents' experience, employees within a QRM context are highly motivated in their work. In terms of reasons, the good working environment, feeling part of the company and proper pay were mentioned, among other aspects. *"you have to offer them a good working environment... and that they really feel that they are part of the company"* (R1). The involvement in the product from start to finish also motivates employees: *"so they really make it from beginning to end, and that makes them feel like that too, I believe"* (R2).

Because the batch sizes are smaller, QRM contributes to increasing motivation. Doing the same work for a longer period of time creates monotony, whereas smaller batches make the work more varied. The respondents also said that the work alternated more because employees were all-round and could be deployed at different places in the organisation. In order to get and keep people motivated for QRM, the respondents considered it important to let employees come up with ideas themselves and let them know that it is not all about efficiency but rather also effectiveness. Starting with small groups of workers seemed to be working well.

4.6 QRM 4.0

Strikingly, respondents stated that the administrative burden in their company had increased in recent years. The administrative workload was considered high: *"one order is six emails from the customer, and in each email, there are PDFs that have to be processed and distributed within the organisation from logistics work order, for instance, to production"* (R3). In their view, reducing the lead times and increasing efficiency could be achieved by further digitalising and automating the administrative process. Some respondents also mentioned that bringing together interdependent administrative positions facilitated cross-training and reduced the time lost between sales and the drawing department, for instance.

One respondent said that their company was still working with a *workaround* for administrative processes. This allowed them to optimise the new work process before they were to redesign the IT systems: *"a lot goes by mail now"* (R10). They were working with two pilot cells at the time: one for more standard products, and one for customised products. By first optimising the processes in the pilot, they expected they could make a better choice regarding the design of the supporting IT process.

4.7 Employability

The wide employability that arises among employees because they are all-round deployable and increasingly able to oversee the entire work process was seen as added value, not only for the organisation but also for the employability of the employees themselves. In the opinion of the respondents, this certainly increases their employability: *"if someone is not interesting to another company, they are probably not interesting to us"* (R5). In other words, the employees will become more employable both internally and externally in the long term due to their increasing wide employability.

In the short term, employees consider whether the initiated development towards QRM is interesting for them and whether they can do it: *"most people are not afraid to change, but to fail"* (R4). This may lead to departure or a change of position. The respondents indicated that they would continue to discuss this with the employee as much as possible and that they were open to various solutions: *"if it has no further impact on their performance, the person can simply remain at that level. Then that is fine too"* (R1).

It is also seen as important to pay attention to people who are not or cannot become multi-deployable for multiple duties, such as lower-educated workers and young disabled employees receiving benefits: *"they are more prone to overdemand and stress"* (R5). QRM eliminates the simple tasks from the process. If this is overlooked or dismissed, QRM will reduce the employability of precisely these vulnerable groups in the labour market. Nevertheless, the respondents stated that they had also been able to find a solution here: *"this has resulted in a very stable team with a number of young disabled team members, who can work independently with more varied work, but with structure and a bit of responsibility"* (R4).

5 Conclusion and recommendations

QRM is potentially interesting for many SMEs in the manufacturing industry, yet not every company uses it. One reason not to opt for QRM is the investment required versus the potential return. It has been found that the promised savings and reductions in lead times are not always easy to achieve in practice.

If an SME in this industry opts for QRM, not all principles are easily embraced. According to Van Rhijn & Bosch (2017), SMEs are still making insufficient use of the available methods and instruments to achieve the desired lead time reductions, possibly as a result of unfamiliarity and lacking experience with QRM methods and instruments. Another reason mentioned by respondents and identified by Seppälä and Klemola (2004) is that companies adjust the method so that it better suits the technological and organisational developments.

The cultural and organisational changes required to fully utilise QRM are costing organisations significant time. For example, take the training of employees so that they have the necessary competences to be widely deployable: according to the respondents, this will take several years, and even then not all employees will be able to participate in the desired change. This means farewell to some and a search for another suitable place for others. Especially the vulnerable groups in the labour market – such as lower-educated workers and young disabled employees receiving benefits – face a greater risk of losing their position as QRM makes jobs more complex.

Employee training and education are considered important by the companies interviewed. They devote considerable effort to training and educating their employees. Coping with autonomy, a learning and proactive attitude, flexibility, multidisciplinary and process insight are the main skills to master. Once they have been trained, the employees are highly sought after both internally and externally, and thus their employability is high. Even so, the employees remain loyal and happily continue to work for the company that trained them. In other words, investing in the employability of human capital pays off.

5.1 Recommendations

- In order to encourage the use of instruments and methods to reduce lead time, organisations will need to be better informed about the possibilities of QRM (van Rhijn & Bosch, 2017). It is recommended to start with an inventory of QRM's methodologies: which are easily applicable (quick wins), and which require structural changes?
- Moreover, SMEs should start a community to learn from each other's experiences (van Rhijn & Bosch, 2017). The exchange of experiences and instruments and methodologies used may contribute to a broader implementation of (parts of) the QRM concept.
- A finding by Godinho Filho et al. (2017a) that was confirmed in this study was that it is extremely difficult to let go of the old beliefs, which revolve around productivity, low cost and a focus on delivery time and thereby obstruct a full implementation of QRM, in favour of an

idea where lead times take centre stage. If training were to focus on changing this mindset, QRM could be implemented better, which in turn would translate into better results. Greater know-how of QRM would also enable companies to better assess whether QRM meets the challenges that they face.

- Let technology be supportive, not guiding. In other words, if the organisation wants to shift the focus to lead times, what technology can support that?
- Little research has been conducted on the impact of QRM on the required competences and employee employability. This study has sought to help fill this knowledge gap, although it is limited in terms of generalisability. The ten participating companies were only a small part of the SMEs in the manufacturing industry that have implemented QRM. It was also a cross-sectional study that did not cover the change in required competences and the development of employees' employability once QRM is further implemented and experience has grown. Further research on the impact of QRM on the required competences and employee employability is necessary.
- It would also be interesting to look into the experiences with QRM of employees in various positions within the organisation. What influence does the introduction of QRM have on their work experience, perceived employability, work stress and development? For this purpose, a questionnaire could be distributed among the employees of companies that have implemented QRM.

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Appendix 1 Topiclist

Questionnaire QRM

Introduction (5 min)

Points to mention:

- Introducing the general research
- Informed consent file
- Structure of the interview

1 QRM perspective (10 min)

Points of interest: sociology of expectations

Q: Which waves of technological developments do you foresee in the upcoming years?

- Where did you get the inspiration and information about this 'technological future'?
- How do you anticipate and navigate your company in this sea of technological innovations?
- Which strategic considerations have been made over the last couple of years?
- Does digitalization (economy 4.0) make a focus on lead time more relevant/ easier/ ...)?

Q: What do you think about QRM?

- What is the relevance of shortening the lead time?/ how do you see the relevance of lead time?
- How will the focus of customers on lead time have possible organizational implications?
- How does your organization try to improve the lead time?
- What is the impact of this focus on lead time on the organization?
- What is the role of technological innovations hereby?

2 Competences (10 min)

Q: What competences are needed in order to implement and execute QRM?

- What has changed in your organization for your employees because of the focus on QRM?
- Or: what do you think will be the changes in your organization for your employees when you start focusing on lead time?
- What (new) competences and skills are asked for, now there is a focus on QRM/ lead time? → wat mij betreft een echte "employability" vraag. Als de vraag gefocust wordt op "implement QRM, past die prima. Dit dient van wel in de vragenstellen helder te zijn.
- What is the difference between layers within the organization?

3 Employability (10 min)

Q: What is the influence of QRM/ focus on lead time on the employability of the employees?

Employability is about gaining and keeping work

- Are employees learning new (relevant) competences and/or skills? Which one?
- Are employees more attractive for other organizations? How do you know?
- What is the difference in employability between layers within the organization?
- What do you do with employees who are not willing/able to change/ learn the newly needed competences and skills?
- How do you secure (borgen) that the employees preserve the new competences and/or skills for future employability?

4 Job design and autonomy (10 min)

Q: What is the influence of QRM on (knowledge - see 3. Employability), information and planning autonomy:

Information flows inside the organization:

- To what extent has QRM increased or decreased the need for different types of information inside the organization?
- Do employees have access to the right information when they need it? Do you think QRM has increased or decreased the availability of information?

Planning inside the organization and QRM:

- How has your planning changed since the implementation of QRM?
 - Has there been a change in daily planning? How has this changed?
 - Has there been a change in long-term planning inside the organization? How has this changed?
 - Did QRM have an impact on the flexibility of workers to shift tasks? How has this changed?

5 Outro (5 min)

Points to mention:

- ✓ Thank you for your time and sharing your insights with me
- ✓ Are there any topics/ feedback/critique you want to share?
- ✓ Follow up (transcripts, email them for final approval, anonymity/privacy)
- ✓ Other needs. What could Zuyd provide to support/improve the regional QRM community?

Appendix 2 Respondents

- R1: Director, mechanical industry, 10-50 employees, Netherlands province of Limburg
- R2: director, medical industry, 50 employees, Netherlands Limburg
- R3: Operations Manager, medical industry, 50 employees, Netherlands province of Limburg
- R4: General Manager, manufacturing industry, 100 employees, Netherlands province of Limburg
- R5: Director, high-tech industry, 10-50 employees, Netherlands province of Limburg
- R6: Owner, metalworking industry, 10-50 employees, Belgium
- R7: Director, mechanical industry, 10-50 employees, Belgium
- R8: Owner, metal industry, 50-100 employees, Belgium
- R9: High-tech company director, manufacturing industry, 10-50 employees, Netherlands province of Zuid-Holland
- R10: Quality manager, company in water treatment technology, 100-150 employees, Netherlands province of Zuid-Holland