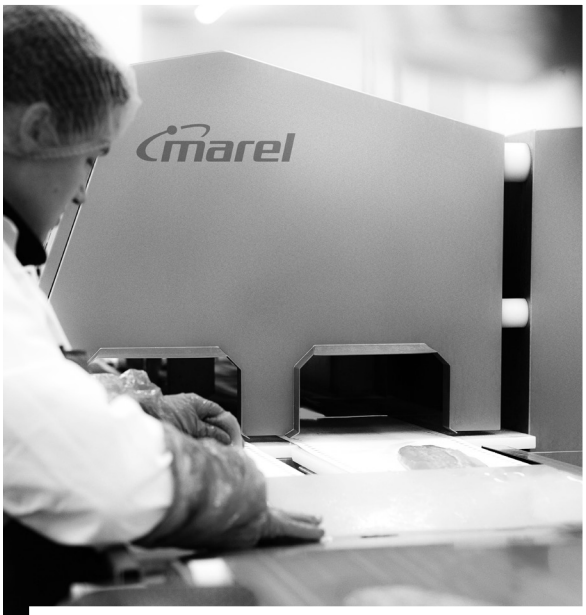
Center for Quick Response Manufacturing
University of Wisconsin-Madison

QRM PROFILES

Marel Manufacturing System Drives Speed and Quality Throughout its Global Operations



The QRM Center is a university-industry partnership dedicated to improving manufacturing competitiveness through research and implementation of lead time reduction principles.

Marel Creates Customized Manufacturing Plan Blending QRM and Lean

by Kathleen Watson

How does a multinational organization made up of 4,000 employees of different cultures who speak different languages and perform different functions at sites in 30 countries develop a dominant, enterprisewide, unifying strategy that is understood and embraced by all?

Marel, which designs and manufactures highly customized food-processing equipment, faced that challenge after nearly three decades of expanding through acquisitions. It purchased Stork Food Systems in 2008, a firm with U.S. roots dating to the 1850s that had its own blend of acquisitions, history, culture and manufacturing practices. Equal in size to what Marel had become, Stork introduced even greater diversity into the parent company's operations and culture.

Fred Vijverstra, Global Manufacturing Director

With the acquisition of Stork, Marel's international profile now includes, in addition to multiple sales offices and its Iceland headquarters, 17 manufacturing sites in Iceland and the United States, the Netherlands, Brazil, China, Singapore, the UK, Spain, Denmark, Norway and Slovakia.

The global economic crisis of 2008–09 led to changes in Marel's top management. Aligning the sales function to achieve one consistent image, one identity, one "voice" to the customer emerged as a primary goal. "Customers saw us as a conglomeration of different companies," says Global Manufacturing Director Fred Vijverstra.

A parallel goal was to effectively capitalize on synergies within and among Marel's various facilities. Each had developed its own unique operational process improvements, but there had never been a structured way for those to be shared.

Netherlands-based Vijverstra, a 20-year Marel veteran who holds a degree in mechanical engineering, was charged with helping to integrate the conglomerate's strengths through the design, implementation and oversight of a new manufacturing strategy that would help meld Marel's disparate cultures and processes. He brought together an equal number of representatives from Marel and Stork; they agreed that the focus had to change from the organization's

Company Profile
Founded 1983
Headquarters: Iceland
Presence in 30 countries
17 manufacturing plants worldwide
4,000 employees

Products and Services
Design and manufacture of single piece of equipment to entire system
Replacement Parts

Markets Served
Processors of poultry, fish, meat

Awards:
AGRAme Award 2013: Best New Poultry Product for Gulf Market
Winter VIV Europe 2014 Innovation Award

www.marel.com

differences to a new vision that recognized the organization's similarities.

It took until 2010 to formulate and formalize what was to become the Marel Manufacturing System, or MMS, and until 2011 to be ready to introduce and roll out the new approach to its 17 manufacturing facilities.

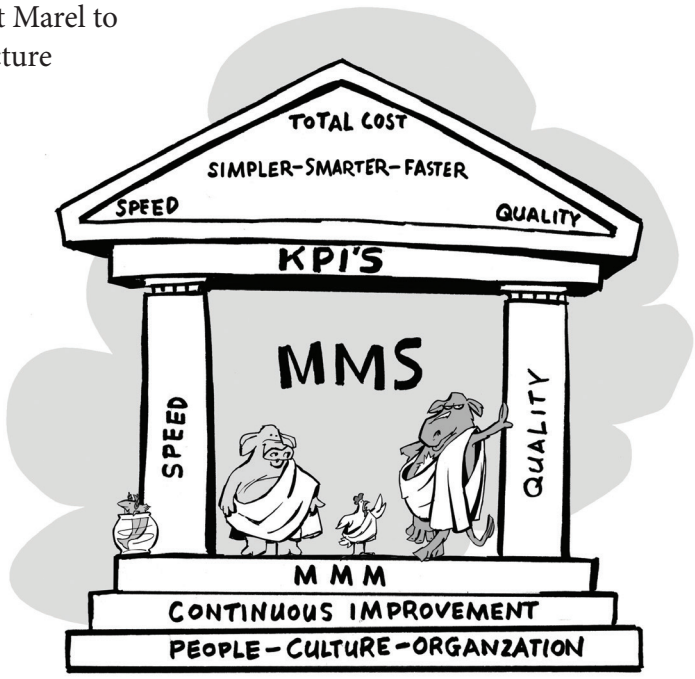
Varied customer base means varied customer needs and equipment

Examining Marel's customer base and order history made clear that because of the company's high-mix, low-volume production, attempting to capitalize on economies of scale wouldn't make sense.

Although some food-processing equipment has fairly standard characteristics, most is highly customized. One machine, for example, might simply sanitize and section poultry or remove bones from meat. Other equipment might perform more-precise operations: laser-slicing of meat to deli-thin specifications, for example, or creating fish, chicken or beef portions of an exact weight and shape.

One Marel customer might need a piece of equipment that constitutes just one phase of overall processing. Another might want Marel to design and manufacture a complete food-processing system that integrates multiple machines customized to perform a series of sequential steps from cleaning, to deboning, to sectioning, to grinding, to weighing, to packaging and labeling.

Marel also produces complex stand-alone machines that can perform a variety of functions. For example, Marel designed a "floating factory" for seagoing vessels that cleans, debones, and forms fish into portions of a prescribed weight — all accomplished with a singular piece of equipment that has an extremely compact footprint.



This illustration encompasses all key elements of MMS, including humorous depictions of the food products its equipment is designed to process: fish, pork, poultry and beef.

> "Speed is the common denominator for success in today's world, and it's something everyone can understand. The power of time has become the center of all decision-making; it comes before all other considerations — even cost."
> — Fred Vijverstra

Speed identified as common denominator

Marel was already a leader in its field; however, the global leadership group working on the unifying effort identified speed as the most important and powerful aspect differentiating how Marel operates. Members agreed that elevating the importance of speed in all operations would give Marel a unique identity and competitive strategy, and it would provide its employees with a unifying shared vision and goal.

The focus on speed, along with cellular manufacturing — both key components of Quick Response Manufacturing (QRM) — addressed the reality of Marel's high-mix, low-volume product characteristics and led Marel to draw heavily on QRM for its new global master plan.

New MMS focuses on speed, a key QRM tenet

The holistic approach that now unifies all of Marel's locations is known as the Marel Manufacturing System, or MMS. Its foundation is continuous improvement, its pillars are speed and quality, and its overriding goal is to ensure that Marel will always be its customers' supplier of choice.

The unwavering pursuit of increasing speed in all operations provides Marel employees at every location with a common goal and a common metric. Speed, a QRM tenet expressed as lead time reduction, is measured not only in production, but also in engineering and design, order entry, materials procurement, shipping, and all support functions.

"Speed is the common denominator for success in today's world, and it's something everyone can understand," Vijverstra says. "The power of time has become the center of all decision-making; it comes before all other considerations — even cost. But in the end, the focus on speed will improve all other parameters."

"MMS is based on core fundamental principles such as speed, a team-based environment, continuous improvement, one-piece flow, and responsiveness. Philosophies and methods used to create a foundation for the MMS are QRM, Lean, Six Sigma and TOC, the theory of constraints."
— Pètur Arason

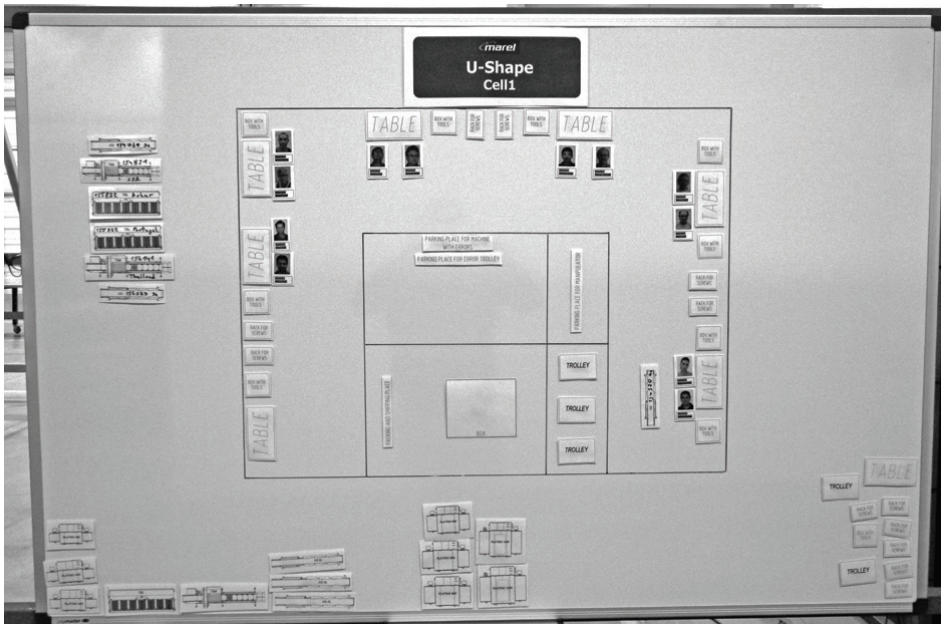
Diverse sites, cultures, operating practices challenge MMS implementation

Iceland-based Global Manufacturing Strategy Manager Pètur Arason, who has worked alongside Vijverstra, notes that operational staples incorporated in MMS come from "the knowledge residing in 17 different manufacturing sites that were merged under one vision and strategy. MMS is based on core fundamental principles such as speed, a team-based environment, continuous improvement, one-piece flow, and responsiveness. Philosophies and methods used to create a foundation for the MMS are QRM, Lean, Six Sigma and TOC, the theory of constraints."

"To achieve different results, you have to do something different," Arason stresses. His 12 years of working with Lean and continuous improvement in general — eight of those at Marel — have provided a solid foundation for nurturing innovation, a core value for the international food-processor.

Arason and Vijverstra have introduced MMS around the globe. They remark on how highly autonomous the Marel culture is — and how challenging it can be to convince people, especially in mature locations with longtime procedures in place, that there will be benefits in transitioning from existing traditional manufacturing methods to a more QRM-based approach.

Adding to implementation challenges, not all Marel sites conduct the same scope of operations. Some include sales, service and full manufacturing (purchasing, parts production and assembly), some have only manufacturing, and some have combinations of functions. Most still are what Arason and Vijverstra call "traditionally organized." Lean practices are used in only a handful of plants, and few have



This white board depiction of a U-shaped cell layout at the Nitra facility shows the current machines being assembled there and the number of employees needed for each stage of operations. The cell was designed to accommodate assembly of four different product families. Some small machines require only three stages of the cell, while bigger machines use all five stages. An extra staging area in the middle of the cell creates space to set aside a machine that has delays. A rack in that area holds parts that are pulled from another cell or the warehouse.

incorporated a cellular structure, a key component of QRM.

QRM and Lean are complementary. Cellular manufacturing — a QRM concept — boosts manufacturing speed, and Lean dictates having on hand only the number and size of tools needed.

Vijverstra and Arason also realize — and accept — that not all sites will interpret or apply MMS principles in the same way. Each site is being allowed to experiment, keeping what works from existing ways of doing things and adding new elements, all under the umbrella of MMS and with the overarching goal of enhancing speed on every front.

Cells go beyond teams

The cellular approach brings together an autonomous team that completes a sequence of operations in a defined area. Cross-training fosters smooth operations and reliable output, as team members master multiple skills, enabling them to fill in where help is needed to keep things flowing or when someone is absent. Cells can be designed for office tasks as well as for the shop floor, or office functions can be combined with manufacturing in a common cell.

When explaining the advantages of creating multiple cells that operate independently, yet often require duplicating equipment, Arason says, "People think it's a crazy idea because it will cost so much."

In counterpoint, he explains that there can be economies. "Our sites always need laser cutters," he says. "If you buy a smaller one for a cell to provide a custom solution for a select product group, you likely will be able to buy three for the price of a larger one that would have to perform a much broader range of tasks or serve a whole range of products. They key is to view the purchase not in terms of numbers of machines, but in terms of the overall investment and of the benefits those multiple purchases will provide."

Nitra facility takes the implementation lead

A year after the 2011 MMS rollout, which was described as "mandatory," facility management teams were required to submit plans detailing how they were going to initially implement MMS as well as how broader adoption of it would continue.

Vijverstra knew that a successful pilot project would help demonstrate how to apply MMS and what it could mean to Marel locations around the world. He found his case study in Nitra, Slovakia, where an existing Marel operation that was producing ovens, standard machines and conveyors had expanded by renting space in a separate building. The expansion created an opportunity not only to rethink existing operations, but also to design, from the ground up, a layout that more closely reflected the foundation of cellular manufacturing that had been successful elsewhere.

Pètur Arason, Global Manufacturing Strategy Manager

Vijverstra seized the opportunity. "I wanted to see in practice what I had envisioned," he says. Because he was overseeing the expansion, he had a high level of input related to the changes that would occur.

What he calls "old thinking" at Nitra would have dictated employees in one building operating a group of machines that performed laser-cutting, bending and welding

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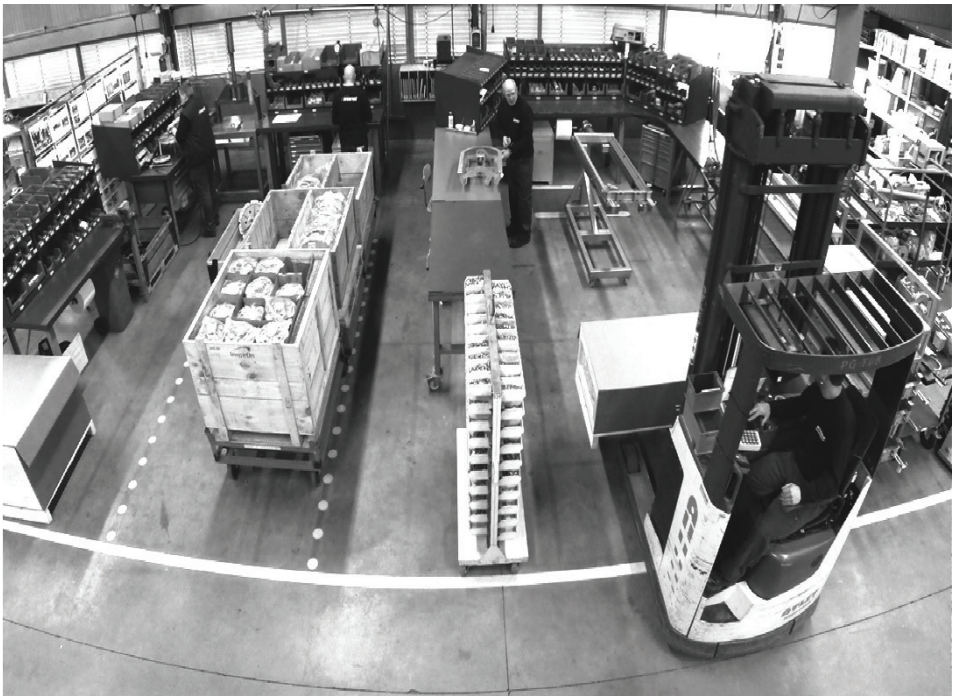


Activities in the overhead-conveyor cell at the Boxmeer plant include picking of parts, assembly and packaging. Smaller parts are stored along each side, and large parts are delivered via forklift truck. The cell actually is made up of two U-shaped cells; corner wheels are assembled on the left, and frames are assembled on the right. Packed end products occupy the center.

to produce parts, and then sending those parts to the second building for assembly. Using principles of MMS, he recommended that Nitra create two facilities or "competence centers." The original building was designated to produce ovens, and the rental was designated to produce standard machines and conveyors.

The new cellular-influenced floor plan required relocating some equipment as well as investing in additional laser cutters, press brakes, bead-blasting machines, cranes and forklifts, to name a few. Duplicating this basic equipment made it possible for each competence center to focus on a particular product and to serve four end-product cells in one facility and three in the other.

Each competence center also had its own support functions: procurement, warehousing, planning, production control, management, and manufacturing engineering. All resources needed to produce a particular product were secured by cell members, who also assumed ownership of each function.

Boxmeer facility follows Nitra's lead

The speed-related goal for Nitra operations was to reduce lead times on two oven models from 12 weeks for one and 16 weeks for the other to just 10 weeks for each. Employees used value-stream mapping to measure and then reduce wait time between each step of the process. They also analyzed equipment size, function and placement, developing plans to make better use of shop-floor space.

By educating personnel, creating new shop-floor layouts, investing in more equipment, outsourcing some steps and finding local suppliers for select purchased items — all QRM principles — the Nitra operation achieved its 10-week lead time goal within 18 months of implementation.

Marel's Netherlands Boxmeer plant had been supplying Nitra with multiple parts needed to produce ovens. As Nitra was implementing and finding success with MMS internally, the Boxmeer operations started to become the bottleneck.

So Boxmeer began merging principles from QRM and Lean. QRM's focus on speed, the concept of cells, and manufacturing critical-path time (MCT) combined with Lean's 5S and visual management to cut in half the lead time for parts production. Time required to process materials being received at the plant was reduced from three days to one day, and a cell created to produce overhead conveyor parts achieved a lead-time reduction of 10 days; parts that used to take 15 days to produce now take just five days.

"Boxmeer employees used QRM to keep lead-time reduction in their sights and to be continually measuring it, and they used Lean tools where applicable to reduce lead times," Vijverstra says, clarifying that they use Lean tools only when applicable, as there are a number of Lean practices that don't apply to a low-volume, high-mix environment.

Gainesville makes Quick Response Office Cell its first step

In the U.S., Marel's plant in Gainesville, Ga., which makes equipment for processing poultry, leveraged QRM principles and methods as part of its MMS implementations in office operations.

The time from receiving an order to releasing it for production at Gainesville often reached — or exceeded — six weeks. Tracking and analysis revealed too many hand-offs between departments and customers. Sales, customer service, sales engineering, engineering and manufacturing all were involved, each contributing in its own way to extending order-processing time.

And as is often the case with custom products, numerous customer-initiated specification changes trickled in after orders had been placed, adding to delays.

Marel modified the standard QRM definition of MCT — Manufacturing Critical-path Time — to cover "the longest average time for a machine type to go from receipt of the purchase order until it is released to manufacturing." (The standard definition covers customer creation of order to delivery of the first piece of that order to the customer.)

Gainesville staff conducted two forms of tagging to help measure MCT: 1) order tagging, which recorded the date and time each step was completed, and 2) resource tagging, which tracked activities performed and the time spent on each. Tagging revealed which operations were absorbing the most resources.

Staff interviews and historical analysis of orders provided more data. Consolidating and analyzing the information helped narrow the focus to engineering and sales engineering as sources of the most significant delays.

In QRM terms, there was too little "touch time," when something was being worked on, and too much "wait time," the idle time between steps. Discussions of how to redesign the order-receipt and -creation process included input from students affiliated with the QRM Center. The recommendation: Create a Quick Response Office Cell, or Q-ROC, that would handle orders for relatively standard machinery — equipment that had few if any custom features.

A lesson along the way reinforced the importance of the QRM tenet of narrowing a new cell's goals to a specific and defined FTMS — Focused Target Market Segment — for which cell members can take full responsibility. It's unfair to hold people responsible for results unless they truly own and control the entire process.

Volunteers and recruited staff members from sales engineering, product engineering and electrical engineering made up the cell. Because Marel employees know that they gain value by expanding their knowledge and experience, the cross-training opportunity that came with participating in a cell attracted plenty of willing participants.

The cell launched in 2013, and to date, there has been improvement toward achieving a 70 percent overall reduction in the engineering order-processing time and a 50

MMS in Action

Boxmeer Achievements
- Reduced lead time by 65% for a key product, from 14 days to 5
- Reduced picking time by 80%, from 10 hrs to 2
- Increased throughput over 70% for a key product without capital investments

Nitra Achievements
- Reduced lead time 25% after creating U-shaped cells; after 2 years, achieved 65% reduction, from 30 days to 11
- Increased inventory turns from 5 to 12 over 2 years
- Reduced cost an average of 5% for multiple products after creating U-shaped
- Reduced lead times by suppliers of conveyor motors has yielded annual cost saving of 1.5M EUR

Gardabaer Achievements
- Reduced lead times by 30% in high-volume standard products by implementing flow
- Increased inventory turns from 5 to 9 over 2 years

Des Moines Achievements
- Reduced shop floor travel time by 90% after creating dedicated machine cell
- Reduced lead time from 15 days to 4, also as result of dedicated machine cell
- Saved investment funds of over $100,000 USD by implementing cellular approach and investing in a used machine

percent reduction in the time to process engineering change requests related to new orders.

Lessons learned guide the future

Marel has learned that constant re-evaluation leads to continuous improvement, whether in the office, on the shop floor or in the training room.

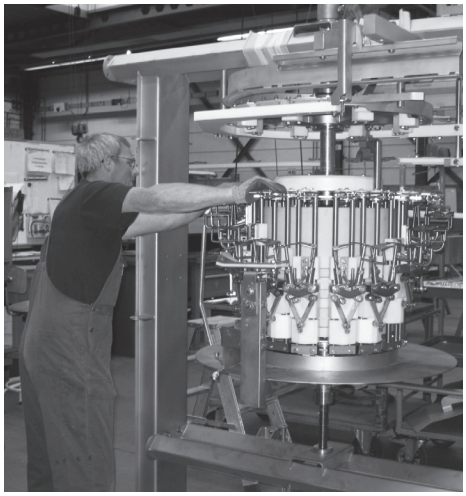
The biggest challenge to seeing MMS spread throughout Marel has been training. "It's good to have a vision," Arason says, "but how do you transfer the knowledge in an efficient way? How do you train people to become active problem-solvers?"

Marel has invested in presentations and animated videos, all with the goal of reaching approximately 4,000 employees around the globe with the basics of the Marel Manufacturing System and its emphasis on speed.

Of course, knowledge alone won't accomplish goals; employees at each facility need to interpret concepts for application in their own operations and processes. To help make that happen, Marel often brings in outside experts as change agents. "Most times, employees are like flowers that need water. When someone helps them understand the reason for the change and how it will work, they blossom," Arason says.

"In some cases, progress was slow not because of people on the shop floor, but because there were managers who were dragging their feet," Arason explains. "They felt threatened and were afraid of losing their power. 'What will happen when we set this process free?' they wondered."

Instituting MMS across Marel does not mean that all sites function alike. "No one will do it exactly the same," says Vijverstra, "but we need to have some boundaries.



An employee assembles a machine on the shop floor. A nearby computer enables access to ERP and PLM systems, and a white board displays key performance indicators (KPIs), planning for cell operations, and elements of Lean's 5S pillars. All control tasks at this facility are handled on the shop floor.

MMS provides a shared strategy and a framework for achieving our common goal of speed, of taking time out of our operations."

Center for Quick Response Manufacturing (QRM)

Established in 1993, the Center for Quick Response Manufacturing at the University of Wisconsin-Madison is a partnership between industry, faculty and students, dedicated to the developement and implementation of lead time reduction principles.

For more than two decades, the QRM Center has helped over 200 companies of varying sizes from a wide array of industries reduce lead times in all aspects of their operations to become more competetive in the global marketplace. The Center can point to a respectable track record, with several member companies realizing lead time reductions exceeding 80%, cost reductions of up to 30%, and on-time delivery improvements to over 99%.

For more information, check www.qrmcenter.org, join our QRM LinkedIn group or contact us directly at 608-262-4709.

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