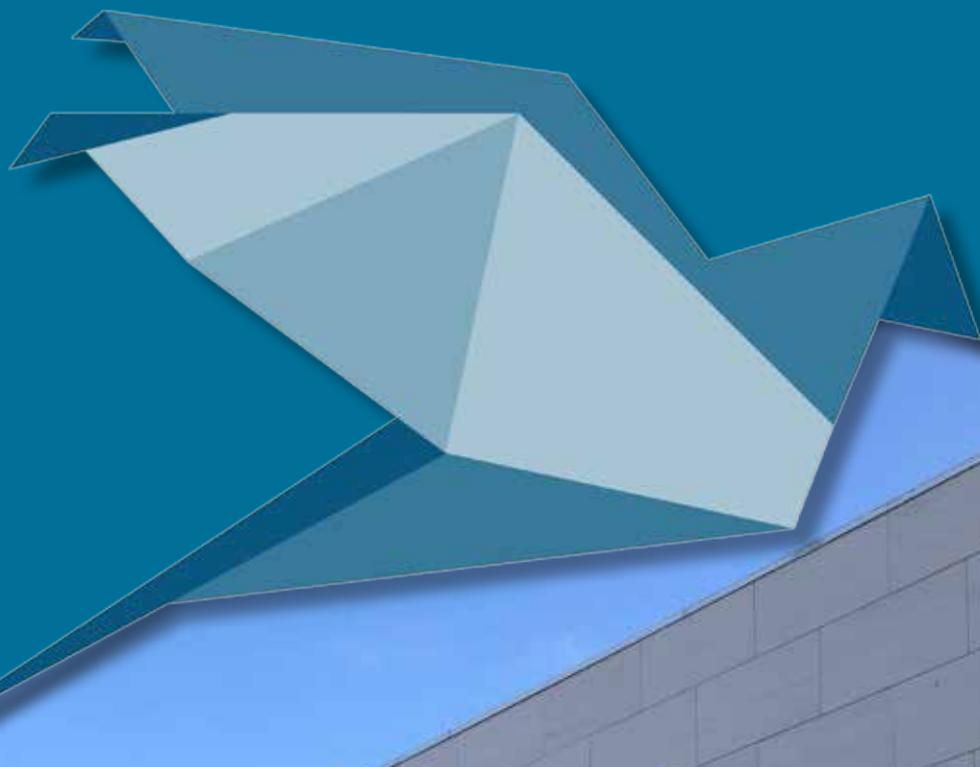


Reducing Time-To-Market through Quick Response Manufacturing

How an international high-tech company
achieved an 70% reduction of lead-time
and discovered unexpected benefits
throughout the organization




OI ELECTRONICS


danmark

Company profile

In 2014, OJ Electronics celebrated their 50-year anniversary as one of the worlds leading manufacturers of electronic control modules for under-floor heating and HVAC modules. Corporate headquarters are located in Sønderborg, Denmark, with R&D, Production and Customer Service in close proximity. OJ Electronics employs 150 employees and is represented on the global market with sales and support offices located across the globe.

A new corporate strategy

While celebrating their 50-year anniversary, the company announced a new record, having exceeded 30 million USD in revenue. To promote even further growth, the corporate strategy was modified to encompass the requirements of operating successfully on the modern global market: A stronger position was required, and focus was put on further development of already established markets in order to cement the position as industry leader. As a result, the existing product portfolio was

to be expanded through launch of new products and revisions and updates to already existing products, thereby gaining crucial competitive advantages on the market.

Goals and ambitions

R&D envisioned a one-stop-shop within Production to which they could turn for all prototype needs. This meant Operations had to alter their perspective from one of a departmentalized view into one focused on end-to-end processes.

The choice fell on adopting the Quick Response Manufacturing-philosophy, since QRM focuses on increasing productivity in a high mix / low volume environment, and is designed to manage a high level of variation.

This corresponds perfectly with the conditions surrounding the manufacture of prototypes.

This is done through the implementation of independent production cells with designated resources and a high degree

of cross-trained employees, as opposed to the high degrees of specialization often seen when operating within a lean context.

The main tenet of QRM is the reduction of lead-time through elimination of time through-out the processes, in this case from product kickoff to delivery of prototype products.

The initial target was set at a lead-time reduction from 10 days to 3 days, requiring a reduction of 70%, which would allow them to capitalize on the benefits of quicker Time-To-Market. (Figure 1)

Benefits of QRM

Quick turn-around on prototype production to R&D would enable rapid detection of quality issues, which in turn would reduce the required time and costs associated with New Product Introduction (NPI).

To achieve this, the QRM strategy defined the Targeted Market Segment (TMS) as prototype manufacturing, with dedicated resources and employees. The cell was to be responsible for every step of the process; from project kick-off to prototype delivery, including all administrative processes, shop floor planning, production and test, thus achieving the goal of the one-stop-shop envisioned.

Figure 1: Not only does a reduction in time-to-market allow faster new product launch, it also allows faster product updates.



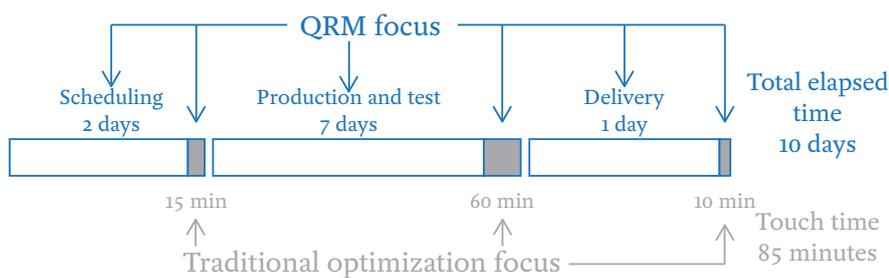


Figure 2: Traditional optimization techniques such as SMED and 5S focus on touch time. QRM has focus on the total elapsed time from product kick-off to delivery of the prototype. It is this total length of time that was targeted for a 80% reduction.

To drive this mentality home, QRM relies on a single, focused metric for evaluation of the performance in the QRM cell, from which there is positive correlation with traditional metrics such as Quality, Cost and Delivery.

This metric is known as Manufacturing Critical-path Time (MCT) (Figure 2) and represents the total calendar time from order receipt to first delivery. QRM constantly strives to reduce this number to increase operational agility and productivity.

As an added bonus, this single metric is easily understood by employees, and eliminates the risk of sub-optimization often encountered when using traditional KPI's for performance evaluation.

QRM road map

The first step in developing a QRM-cell is to define the Targeted Market Segment (TMS) to ensure the cell will produce items where lead-time is a crucial factor, to enable the cell to make a big business impact.

Once the TMS is defined, it is further refined into the Focused TMS (FTMS), which is a clear

definition of the responsibilities of the cell.

The TMS was defined solely as prototype production, but analysis of the historical values correlated with the expected increase of prototypes to be developed following the corporate strategy, warned of high levels of variance regarding not only frequency of orders and their magnitudes, but also of the individual process times associated with the orders.

This made sizing of the QRM cell and resource allocation a difficult task, since a large capacity would be required, but only rather seldom.

The average demand for prototype production was calculated to require one to two team members, but due to the high variance in prototype order arrival, order size and product complexity, a total of three team members

were allocated to ensure the cell would be capable of fulfilling the demands within time.

However, this left the cell with a large and uneven surplus capacity, and for that reason the TMS was expanded into the FTMS, to also cover several standard products in the high mix / low volume category, which prior to the implementation of the QRM cell had been produced by the Service department and flow lines.



I believe many industry leaders are dissatisfied with the speed of processes in their organization. Once you start working with Quick Response Manufacturing, you will see that there finally is a way to handle this.

- Allan Ohlsen,
Logistics Director, OJ Electronics

This meant prioritizing the production of prototypes, and filling the lulls in demand with a selected sub-part of sales orders with an adequately low volume, which would otherwise burden the Service department and lean flow lines.

This not only enabled the cell to maintain a degree of utilization corresponding to the expected levels of variance, but also allowed the standardized production to flow smoothly, having to adapt to far fewer interruptions from low volume orders.

To handle this expansion into the FTMS, the cell was dimensioned to three team members at approximately 80% utilization. The 80% utilization was calculated using System Dynamics and included analysis of variance in the arrival of orders, their size and their complexity (Figure 3).

The team members dedicated to the cell ensures that the expected peaks in prototype demand can be handled even in the case of dysfunctional variance.



I experience improved deliveries and better cooperation between R&D, PTA and Production, which results in shorter lead-time. This is highly valuable for our projects with the short time-schedules associated.

- Tom Kragh,
R&D Director, OJ Electronics

The remaining 20% capacity is used to absorb variance in demand, dysfunctional variation, cross-training and continuous improvements, driving MCT ever further down.

Designing the QRM cell

Once the TMS had been expanded into the FTMS, calculations were made based on expected future prototypes and time studies of the flow from kickoff to delivery, including all administrative processes.

Brown-paper mapping was used to show which products were expected to go through which processes, in which order and for how long. From this, the required technologies and resour

ces could be determined, along with the human competences required.

The cell itself was equipped with adequate workstations containing soldering equipment, mounting fixtures and testing equipment, along with the required IT to enable the cell to be 100% autonomous with regards to both administration, planning, production and test of prototypes, thus fulfilling the requirements for a one-stop-shop set forth by R&D and the required 3-day MCT goal.

The only exception to this was the Surface Mounting Device (SMD) for the printed circuit boards, which is used by the standard production, but this issue

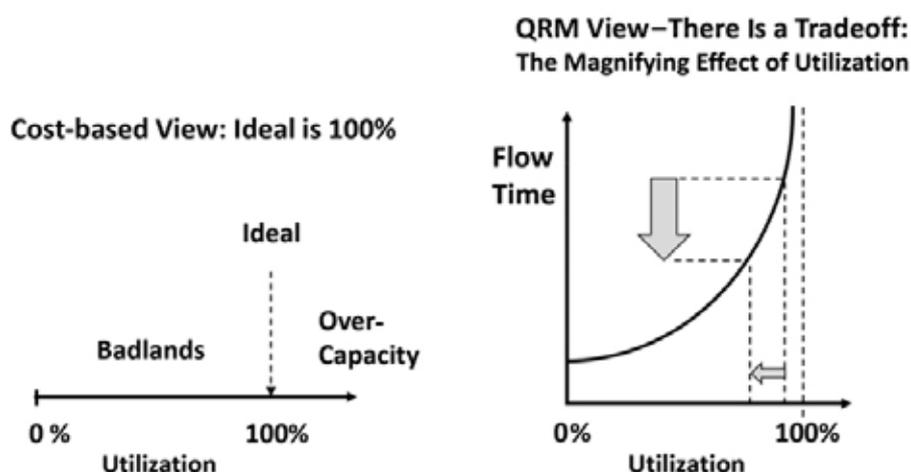


Figure 3: QRM argues that the norm of pushing utilization as high as possible has a drastically detrimental effect on flow time and thereby MCT. As a consequence, QRM advocates seeking a level of utilization calculated on the basis of variance within the FTMS and lead time goals.

was solved with the utilization of Time Slicing (TS), which ensures the cell has daily access to the SMD.

The wave-soldering machine is also external to the cell, but has a very low degree of utilization, so TS was deemed unnecessary.

Also present in the cell are two very important whiteboards: One for visual shop-floor planning, and one for managing continuous improvements and cross-training plans.

(Picture 1 and 2)

Structured implementation

Implementation of the cell itself was conducted in three separate phases.

During the first phase, all three employees were allocated to the cell.

In order to ensure highly motivated team members in the cell,

who were willing to learn the multitude of highly varied tasks, hiring was conducted internally from across the company, resulting in one employee from Service, one from the SMD and one from the warehouse.

In this initial phase, focus was on cross-training the team members, achieving stability in the production and understanding MCT and capacity calculations and their importance. To ensure this was possible, the degree of utilization was set at a low 50%, which was enough to cover production of prototypes, but only a limited number of high mix / low volume items.

This enabled extended cross training, to allow all members of the cell to complete all processes and functions contained within the FTMS, including administrative processes and cross departmental communication with R&D, project engineers, Purchasing, PTA, warehouses etc.

Having such a low degree of utilization allowed all team members to be able to handle both administrative and production processes within weeks. The most difficult task to adjust to turned out to be the responsibility of shop-floor planning and ensuring proper understanding of the Bill Of Materials (BOM).



Implementing the QRM cell is the major contributor to our increased performance in introducing new products. We have achieved the 70% reduction we set as goal, and we now have the one-stop-shop envisioned.

- Lone Gloy,
Production Manager,
OJ Electronics



Picture 1: The daily work is planned and distributed among the Team Members, and the daily utilization of the cell is calculated and displayed in a visually intuitive manner. The notes are color-coded, with green and blue representing prototype and standard low volume production, respectively. Pink is maintenance, and brown and yellow indicates the planning of cross training and continuous improvements, which are treated exactly as if they were production orders.



This first phase lasted approximately 4 months, at the end of which the three team members were fully cross-trained, had gained expertise in shop floor planning, rough-cut capacity planning, and the calculation and interpretation of MCT data. Thus, a steady and consistent pace of production was achieved.

In the second phase, emphasis was put on further reducing the MCT and thereby improving the productivity.

The utilization of the cell was increased to 80% by adding a number of high mix / low volume products to the FTMS. This was possible due to the team members being fully cross-trained, and the 80% utilization still allowed ample time to ensure focus on continuous improvements.

During the second phase, the required competences of the



We applied for this position because the notion of combining hands-on work with administrative duties was interesting. We are now fully cross-trained and enjoy the satisfaction of planning our own work and handling the products from A to Z.

- The QRM Team Members, OJ Electronics

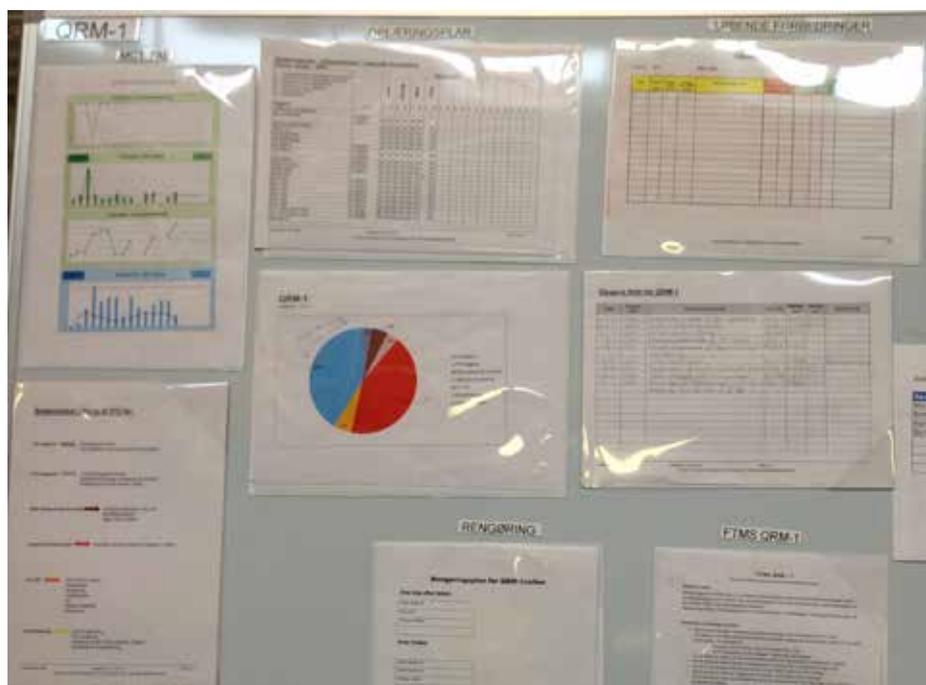
team were expanded to also include the capability to adjust the Bill Of Material of prototypes and products as required, further reducing the burden on other manufacturing support departments.

The improvements intended for phase three will be selected based on their potential for further reduction of the MCT.

Daily life in the cell

The cell now operates autonomously without a leader, and refers directly to the Production Manager. (Picture 3)

The members of the cell start each day spending 10 minutes planning the work to be done and discussing the proposed improvements suggested on the whiteboard. (Picture 1)



Picture 2: :The whiteboard used for cross-training, continuous improvements and to show historical data of of the performance of the QRM-cell.

Responsibility for hosting these morning meetings rotate between the team members on a weekly basis. Required preparations include conversion of sales- and prototype-orders to production orders using the ERP-system, making production order cards and placing them on the planning whiteboard. The team member is also responsible for checking the required materials necessary for the day's production are present, and for rough-cut capacity planning to calculate the minimum expected production time for the day.

Once the meeting has started, the production orders for the day are distributed among the team members, and activities relating to cross training and improvements are scheduled. Depending on whether the utilization of the cell is below, at or above the planned 80% utilization, a color-coded marker (green, yellow or red) is displayed to allow management to gauge the state of the cell at a glance.

Results and benefits

At the time of writing, the cell is in phase two, having stabilized the material and information flow, both internally in the cell as well as in the interfaces to other departments.

As a result, the lead times of both prototype production and high mix / low volume products are stable at 3 days, achieving the required goal of a 70% reduction in lead time even before the project has been completed.

Likewise, quality has increased since faulty products are detected and either corrected or discarded before further resources are added. As a result, quality-associated costs are expected to decrease significantly.

It should be noted that these results, while impressive on their own, have been achieved even before the added benefit of the upcoming continuous improvements have come into effect. The lead-time is therefore expected to decrease even further over time, exceeding the initial target



The introduction of QRM has resulted in making prototype production an integrated part of the development process. The cell is responsive, moves fast and accepts frequent changes and challenges as a natural part of day to day life.

- Poul Andersen,
Product Manager,
OJ Electronics

set by management, and providing ever-increasing benefits across the organization.

It is through projects like this that OJ Electronics will continue to distance themselves from their competitors, and cement their position as a strong leader on the global market, reaching their corporate growth targets.

Picture 3: The QRM Team Members each have a dedicated workspace with full access to all required tools: ERP-access, electrical assembly tools and equipment for testing, which enables them to operate autonomously and become the one-stop-shop envisioned.





We support a faster Time-To-Market by having fast and flexible prototype production facilities in Denmark. This has been achieved using Quick Response Manufacturing.

- Allan Ohlsen,
Logistics Director, OJ Electronics



The NPD process used to be too long and was a source of some frustration. Now, with the QRM cell, we have sped up the process significantly and freed resources with major time savings as a result. The improved speed does wonders!

- Arendt Clausen,
Production Technical Manager,
OJ Electronics



QRM Danmark is pioneering the use of Quick Response Manufacturing to achieve corporate visions by designing solutions targeted at shaping the organization to fully support strategic goals.

This has been achieved in industries such as metals, textiles, electronics and graphics, and has included administrative and manufacturing processes, including areas of high customization.

We have successfully worked with corporations ranging from 20 employees to more than 16.000 in Denmark, northern Europe and the Baltics.

We strongly believe that any corporation in any industry can benefit significantly from our work, so give us a call, and let us see what we can do for you.