Bosch Production System

Lean Logistics Implementation in TTPO

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Bosch Termotecnologia SA

Termotecnologia

1977

Foundation of Vulcano

1983

Robert Bosch acquires majority of shares

1988

Brand Vulcano was created

1992

Installation in Aveiro of R&D department

1993

European leader in water heaters

1996

Start production of boilers

1998

Bosch worldwide responsibility for water heaters

2002

Name change to BBT TERMOTECNOLOGIA PORTUGAL SA

2007

Start production of solar panels

2008

Name change to BOSCH TERMOTECNOLOGIA PORTUGAL SA
<table>
<thead>
<tr>
<th>Key Indicators</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (Mio. €)</td>
<td>194</td>
<td>207</td>
<td>230</td>
<td>235</td>
</tr>
<tr>
<td>Exportations (% sales)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Heaters</td>
<td>76</td>
<td>77</td>
<td>80</td>
<td>81</td>
</tr>
<tr>
<td>Boilers</td>
<td>91</td>
<td>90</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>Production (Tsd units)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Heaters</td>
<td>974</td>
<td>1.021</td>
<td>1.049</td>
<td>1.203</td>
</tr>
<tr>
<td>Boilers</td>
<td>133</td>
<td>124</td>
<td>132</td>
<td>166</td>
</tr>
<tr>
<td>Nº Workers</td>
<td>1.008</td>
<td>1.001</td>
<td>1.078</td>
<td>1.133</td>
</tr>
</tbody>
</table>

**Nº1 Water Heater Manufacturing Company in Europe**
Centre of Competence for “Water heating”

- Product Management and Marketing
- Product Development
- Manufacturing
- Sales and Logistics
Bosch Termotecnologia SA

**Water Heater Basic Segment**
- W125/135 5L
- AS0 6/7/10/13L

**Water Heater Comfort Segment**
- Compact 11/14/18L
- Outdoor 10/13/16L
- Celsius 11/14/17L

**Water Heater High Output Segment**
- World 1 24L
- World 2 27/30L

**Domestic Boilers**
- GZT1 24kW
- GZT1 HRD 30kW

800 different Gas Water Heater Models
120 different Boiler Models
80 different electrical Water Heater Models

Electric Storage Tank
- HS / HE
- Mini Storage Tank

Electrical Water Heaters and Showers
- S / HE
- PowerStream
- Electrical Shower

Solar Technology
- Supply for all Europe
- Solar Collectors
- Comfort Solar Kit

Gas Valve
GWT Market Volume V-Ist 07 (Value and units) and TT share by region (in red)
Sales in 55 different countries

America
- Bolivia
- Brazil
- Canada
- Chile
- Columbia
- Costa Rica
- Guatemala
- Mexico
- Panama
- Peru
- USA
- Venezuela

Africa
- Algeria
- Egypt
- Morocco
- South Africa
- Tunisia

Middle East
- Iran
- Israel
- Jordanian
- Lebanon
- Syria
- Turkey

Europe
- Austria
- Belgium
- Bulgaria
- Croatia
- Czech Republic
- Denmark
- Estonia
- France
- Germany

United Kingdom
- Greece
- Hungary
- Italy
- Latvia
- Lithuania
- Nederland
- Poland
- Portugal

Oceania
- Australia
- New Zealand

Asia
- China
- Singapore
- Taiwan

Terms of the subsidiary
Bosch Termotecnologia SA

TTPO Markets
Domicile of Subsidiary
Sales Partner
Bosch Production System

What is it?

Customer Satisfaction and Business Success

- Quality
  - Cost
  - Deliveries

- Process Orientation
- Pull System
- Standardization
- Perfect Quality
- Flexibility
- Transparent Processes
- Waste Elimination
- Continuous Improvement

Associate Involvement and Empowerment

Employee Satisfaction
BPS@TTPO

BPS Strategy 2006-2012

Premises

- Standardized and Flexible Processes
- Defined Material Flow
- Defined Information Flow

Goals 2010

- 100% service level
- Reduction of 50% in GEZ
- BPS Maturity – Level 4

Customer satisfaction through optimum processes, fewer costs and no waste.
From Push to Pull

Control Principles

Pull - Principle

Synchronous Production (JIS)

Consumption Control

Kanban 2 boxes Etc.

Push - Principle

Demand Control

FZ MRP BOA

JIS – Just in Sequence
FZ – Cumulative quantities concept
MRP – Material Requirement Planning/Management resource planning
BOA – Load-oriented release of orders
From Push to Pull

Before Pull and Leveling projects

- Production planning system derived production orders from customer order bases on start\end dates for each production step at a higher planning level!

- Logic:
  - Order entry
  - Production
  - Delivery

Yearly planning

Monthly/Weekly planning

Production planning

Shop floor – “GEMBA”

Customer
From Push to Pull

Before Pull and Leveling projects

Gross Demand (forecast or customer order)

Comparison with current inventory

Net Demand

Bill of Material Backward scheduling

Production order replenishment sent to pre-processes

Process repeated in the next planning point

- Undefined inventory – Through-put time not consistent
- Deviations from the target state where the rule – production plan could not be adhered to
- Pre-processes protect themselves against these uncertainties by creating flexibility with the help of buffers
From Push to Pull

With Pull principles implemented

- Production planning initiated at pacemaker!!
  All other pre-processes are controlled based on consumption

- Logic:
  - Order entry
  - Delivery
  - Production

Yearly planning

Monthly/Weekly planning

Production planning

Shop floor – “GEMBA”

Customer
From Push to Pull

Concepts and Steps

- 1st step – Implement pull controlled by consumption using kanban: Supermarkets
  - The pacemaker is decoupled from the upstream process by a supermarket
    - FIFO is not possible
    - The various variants lie ready for the pacemaker
    - The consumption of a variant from the supermarket acts as a trigger for the upstream process
    - The pacemaker and the upstream process are able to produce completely independently of each other (sequence, lot-size, etc)
    - The stock level in the supermarket depends on the quantity consumed by the pacemaker during the period that the upstream process needs to produce the parts again
From Push to Pull

Supermarket Influencing Factors

Supplier

- Replenishment time
- Lot size
- Process stability

Supermarket

- Demand fluctuations
- Demand quantity\ frequency
- Required supplier service level

Customer
From Push to Pull

Concepts and Steps

- 2nd step – implement pull controlled by synchronous production with security buffer
  - The right quantity is produced and delivered in the right order of sequence and at the right time
  
  FIFO is now possible
  - The sequence is set by the pacemaker process
  - Both processes work in the same type sequence and same lot size
  - The cycle times of both processes are very similar
  - Availability and change-over times are very similar
  - There is a “frozen zone”: the time between the transmission of the sequence from the pacemaker to the upstream process and the consumption in the pacemaker process – sequence cannot be changed by either processes in this frozen zone!
From Push to Pull

Concepts and Steps

- 3rd step – implement pull controlled by synchronous production
  
  - The right quantity is produced and delivered in the right order of sequence and at the right time

- Eliminate security buffer
- Fish bone layout
From Push to Pull

TTPO complexity

- With the actual complexity (114 different processes), it’s not possible to implement fish bone layout and one-to-one processes.
From Push to Pull

Our strategy for 2008 - 2010

What is a synchronous process in TTPO:

- The right quantity is produced and delivered in the right order of sequence and at the right time
- FIFO rack’s (security buffer) exists for each downstream process
- Security buffer for each downstream process is \(<2h\)
- Target: 1 upstream process to 1 pacemaker process, if not possible than 1 upstream process to \(n\) pacemaker processes being \(n\) as close to 1 as possible
From Push to Pull

Information Flow behind Material Flow for Pull systems

Supermarkets: kanban control

- Kanban is a card that signs up visually a consumption in a supermarket – It’s the trigger to order a reposition.
From Push to Pull

Information Flow behind Material Flow for Pull systems

- Synchronous production vs. kanban control

  - How to sign up the next consumption without using production plans?
  - How to standardize and use also kanban cards?
    - TTPO solution uses IT support tools in SAP – Electronic Chute – and implementing one-way e-kanban
From Push to Pull

Running Projects

- Compact Water Valve Assembly

**Starting Point** after pull implementation

SNP = 16 uni
(standard number of parts)

LOG SAP

PRD
(Production plan)

SNP = 16 uni
(standard number of parts)

CA2
CT = 23.2” (1 uni)
CT = 14’ (32 uni)

CA3
CT = 23.2” (1 uni)
CT = 14’ (16 uni)

WIP = 2000 uni
125 supply cycles
(≈9h)

C1
CT = 50.4” (1 uni)

C2
CT = 50.4” (1 uni)

C3
CT = 50.4” (1 uni)

CKD
CT = 112” (1 uni)
From Push to Pull

Running Projects

- Compact Water Valve Assembly

- Step 1 – Layout Changes to allow process oriented material flow and process dedication

SNP = 16 uni
(standard number of parts)

Not Standard
CT = 14’

CA2
CT = 23.2”

CA3
CT = 23.2”

WIP = 2400 uni
(≈10h)

CT = 14’

C1
CT = 50.4”

C2
CT = 50.4”

C3
CT = 50.4”

CKD
CT = 112”
From Push to Pull

Running Projects

→ Compact Water Valve Assembly

→ **Step 2** – Layout Changes to allow process oriented material flow and synchronous production

- **SNP** = 16 uni (standard number of parts)

- **CA3**
  - **CT** = 23.2”
  - FIFO C1 (9 supply cycles)
  - FIFO C2 (9 supply cycles)

- **CA2**
  - **CT** = 23.2”
  - FIFO C3 (9 supply cycles)
  - FIFO CKD (6 supply cycles)

- **WIP** = 528 uni (≈2.3h)

- **LOG SAP**

- **PRD**
  - (Production plan)

- **C1**
  - **CT** = 50.4”

- **C2**
  - **CT** = 50.4”

- **C3**
  - **CT** = 112”

- **CKD**
  - **CT** = 14’

- **Standard!!!**
Running Projects

- Compact Water Valve Assembly

- Step 3 – Synchronous production improvements

SNP = 16 uni
(standard number of parts)

LOG
SAP

PRD
(Production plan)

C1
CT = 50.4"

C2
CT = 50.4"

C3
CT = 112"

CKD

CA3
CT = 23.2"

FIFO C1
(3 supply cycles)

FIFO C2
(3 supply cycles)

FIFO C3
(3 supply cycles)

FIFO CKD
(6 supply cycles)

WIP = 192 uni
(≈0.9h)

CT = 14’

CT = 14’

CT = 120’
Standard!!!

CT = 23.2”

CT = 23.2”

Termotecnologia
From Push to Pull

Lessons Learned

- Quick communication of the consumption to trigger new stock to be replaced is the key to synchronous production and inventory reduction. This save space and costs;
- There is little room for errors. In addition, quality inspection and poke-yoke must be implemented in the sequencing step to guarantee that the sequenced components match the assembly sequence perfectly;
- IT system must be a mirror of the steps in the material flow: it must reflect exactly what’s happening in GEMBA;
- The transportation must be “perfect” and flow of materials must be assured;
- A SNP (standard number of parts) must be implemented towards all value stream;
- Some of the initial results are very negative, problems are highly exposed due to the inexistence of security buffers: when a process problem or bad parts surfaced on the production, the entire process has to be slowed or even stopped. It’s highly important to have a continuous improvement process supporting all activities;
- A step by step methodology is the key success factor;
- People must be involved and must understand perfectly the system: Employees and systems must properly manage exceptional scenarios;
- Just-in-time is a mean to improve performance of the system, not an end.
Everything is possible. BPS

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