Achieving Fast And Reliable Deliveries With A Robust TOC Solution Simple Enough To Be Supported By Standard ERP Systems

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Abstract

In today's competitive environment, long lead times, poor due date performance and the inability to adapt to customer's demand changes are no longer tolerated. As a result, many companies have made significant investments in the implementation of constraint and demand-driven planning & execution approaches such as the Drum-Buffer-Rope (DBR), Dynamic Buffer Management (DBM) and Replenishment (TOCR) solutions offered by Theory of Constraints (TOC) and LEAN. These solutions are designed to provide faster and more reliable deliveries and higher throughput with a minimum of cost and investment. However, due to the perceived limitations in functionality of standard ERP systems to support the requirements of especially complex hybrid environments such as "engineer-to-order" (ETO), "make-to-order" (MTO), "assemble-to-order" (ATO) and "make-to-stock" (MTS), and/or the perceived high cost to modify these systems, many have chosen expensive 3rd party Advanced Planning & Scheduling software requiring highly trained resources or have opted to build complex in-house-developed Spreadsheets and Databases to provide the information support outside their standard ERP system. Especially large organisations complain that this practice not only makes IT support costly, complex, and a significant business risk, but also jeopardizes the fast roll-out of best-practices such as TOC (and duplication of results achieved elsewhere).

This paper presents a case study of how ABB, the largest supplier of power and automation technology globally, in partnership with Goldratt Research Labs and SAP, overcame exactly such a challenge. After many successful implementations of TOC over a period of 15 years (see appendix for sample results achieved), ABB identified TOC as a key strategic enabler to competitiveness and as an Operational Excellence "best-practice" to include in their rollout of best practices using their preferred ERP platform (SAP) as part of a global "One-simple-ABB" initiative.

In the past, one of the major obstacles with the mass-deployment of TOC in ABB has been the lack of support from commercial ERP systems. This resulted in many in-house developed & 3rd party IT systems that made integration of systems, data exchange, centralized IT support and sustainability both costly and a major business risk. In addition, quite often the lack of support from ERP systems was mentioned as an obstacle to the implementation of TOC on the shop floor. Recent new developments and simplification by the Goldratt Group in TOC's planning and execution rules for managing operations & logistics (S-DBR, TOCR and DBM) meant that, for the 1st time, commercial ERP systems such as SAP could potentially support the deployment of TOC within ABB and due to the potential generic applicability of these solutions, could cater for all the variations and complexities in their 300+ factories around the globe without the need for 3rd party systems.

This was a hypothesis worth testing, so ABB assembled a team of experts from ABB, Goldratt Research Labs and SAP. To focus the team and accelerate the definition and communication of the critical ERP modifications, Dr. Eli Goldratt recommended that the team use TOC's "Strategy & Tactic Tree", a new strategy tool developed by Dr. Eli Goldratt to identify, define and communicate all the changes in process, policies and measurements necessary and sufficient to achieve an organization's growth and stability targets. This tool and associated collaborative and concurrent development and testing process, allowed the team to define, communicate and test the IT blueprint that answered the What, How to and Why for all the modifications that was needed in the ERP system (SAP). This approach played a major part in achievement of the necessary buy-in from key stakeholders and successful implementation and achievement of rapid business results at the pilot plants in Czech Republic and Korea. Based on the results achieved and the high level of satisfaction from all stakeholders, the "TOC in SAP" solution can now be systematically rolled out to any of the 300+ ABB factories around the world

Keywords: Theory of Constraints (TOC), Simplified Drum-Buffer-Rope (S-DBR), TOC's Buffer Management (BM), Enterprise Resource Planning (ERP) and SAP.

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Introduction

ABB, the largest supplier of power and automation technology globally, like many other global manufacturers, have been under increasing pressure from all stakeholders over especially the last decade to achieve and sustain competitive advantage based on operational excellence. Customers expect improved reliability, availability, shorter lead times and competitive prices; Shareholders expect stable, profitable growth and Supply Partners expect better visibility and improved prices. Competitors, reacting to similar pressures, have also embarked on their operational improvement programs, which means even if the company improves, it can fall behind when it improves at a slower rate than competitors.

ABB's Operation Excellence Program (OEP), which is based on combining best practices from Theory of Constraints (TOC), LEAN and other improvement methods, has been recognized internationally as one of the most successful global programs in industry. The OEP program has delivered outstanding and consistent results (see sample list in appendix of results achieved by ABB factories from their TOC & LEAN implementations), and the objectives and methods of the program have been entrenched into the culture and DNA of the organization.

Despite these successes, the standardization and rollout of their TOC and LEAN practices to their 300+ factories have been slowed down and sometimes even blocked by a major conflict (represented in Figure 1 below). To ensure that ABB can leverage its best practices in all business units, the group responsible for ABB's Operational Excellence Program must have a way to rollout best-practices efficiently and effectively which requires a standardized approach and methodology. At the same time, leveraging best practices means OEP must have a way to ensure outstanding results are achieved for each business unit, which requires a customized (not standardized approach)

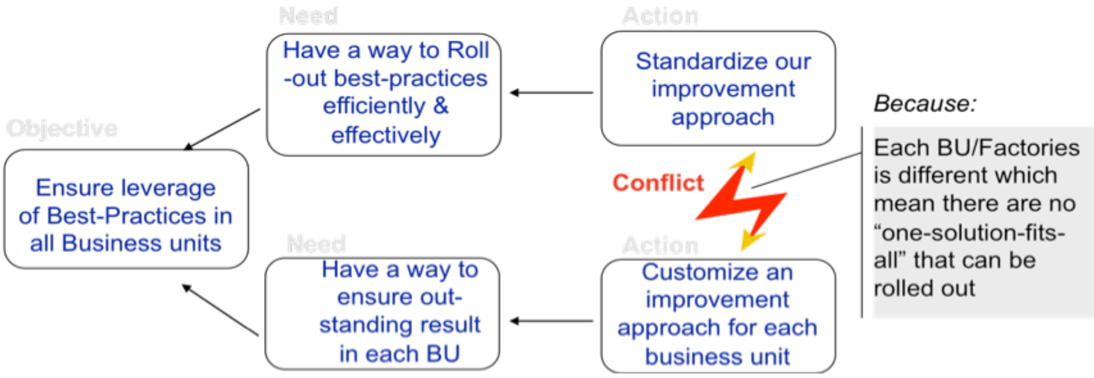

Figure 1. Conflicting Tactics to leverage Best-Practices within ABB

No wonder ABB's OEP group felt they were stuck "between a rock-and-a-hard place". They realized the key assumption blocking resolution of this conflict was that each BU/Factory is different which means that there is no "one-solution-fits-all" that can be rolled out; or at least a solution that might fit the majority of cases or require only minor modifications to adapt to specific BU characteristics without compromising the results.

This unresolved conflict is similar to the one that caused so much frustration for the IS managers within ABB (represented in Figure 2 below). To ensure ABB can create a long term competitive edge, they must have efficient and effective finance, HR and other business processes and related controls which require the deployment of a common ERP platform across ABB. In addition, in order to ensure tightly integrated systems and financial reporting, they need to limit the selection of Supply Chain Management (SCM) and Manufacturing Execution Systems (MES) used by business units. On the other side, in order to create and sustain a long term competitive edge, ABB must continue to improve customer services and sales through operational excellence and efficiency which requires ABB to allow each site to develop or choose their own ERP and or 3rd party SCM and MES systems.

Since ABB did not want to jeopardise in any way the level of operational performance, over the years, each of the 300+ have been able to chose which ERP, SCM and or MES system they want to use, making centralized IT support a costly and very complex challenge. Again, the key assumption preventing resolution of this conflict was that each BU/Factory is unique and that using a common ERP platform and or limiting choices as to which SCM & MES methods and IT systems will jeopardize either results or ownership.

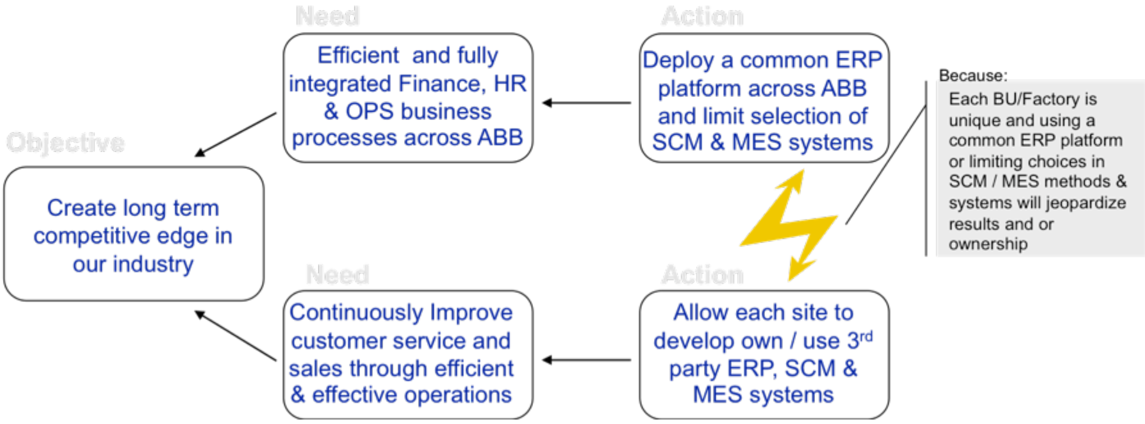

Figure 2. Conflicting Tactics to leverage a common IS platform across ABB

ABB realized that they had to find a way to break these two conflicts.

The solution to the first Operational Excellence approach conflict was the group's Operational Excellence Program that continued to win support through continuously developing, testing and publicising the many TOC/LEAN successes within ABB as "the way" for all factories to achieve operational excellence. Implementation of TOC/LEAN best-practices is handled through a generic ABB Gate model (see figure 3 below)

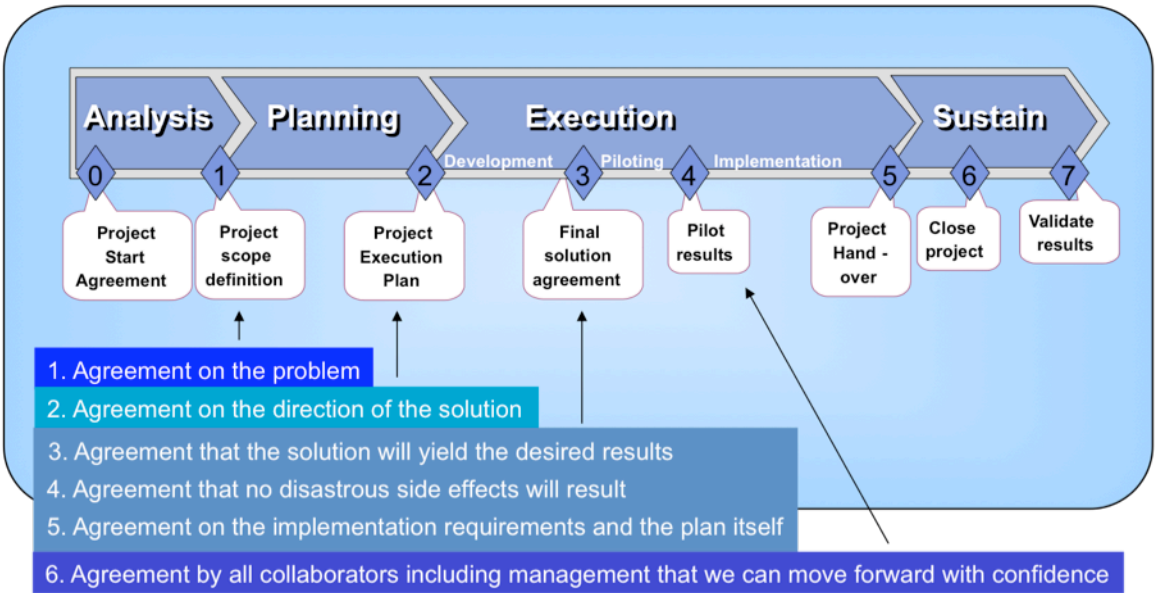

Figure 3. ABB Gate model for implementing Operational Excellence best practices

The solution to the second IT system standardization conflict was an initiative ABB called "One-simple-ABB" (OsA). In March 2007, ABB signed a strategic agreement with the German-based ERP provider, SAP to help deploy common SAP ERP software through its global operations to help unify and simplify some of ABB's most important business processes. As a result of numerous acquisitions, ABB at one time had more than 500 ERP systems and 70 different ERP brands in operation across its businesses. The OsA initial target is one ERP per country, and ultimately one ERP platform per region for all of ABB. A common ERP platform would enable a high degree of standardization in the human resources, finance and administration and corporate governance functions as well as in the operational excellence "best-practices" such as TOC/LEAN.

The only remaining questions were whether SAP would be flexible enough or whether the TOC/LEAN best-practices, in conflict with the opinion of many experts, could be made simple enough to be supported within a standard SAP implementation (i.e. without the need for costly 3rd party solutions unless in cases where it was absolutely necessary).

To find an answer to this question, the joint research initiative was launched in early 2007 with representatives from Corporate Research and Development, Corporate IT, Central Planning, ABB Brno Instrument Transformer factory (1st Pilot factory) and Goldratt Research Labs to leverage their experience in developing and implementing simple and reusable TOC solutions within standard ERP systems for other companies.

Since ABB already had more than 20 successful implementations of TOC (See Appendix) and made a strategic decision (as part of their "One-Simple-ABB" initiative), that SAP would be the preferred ERP system, the scope given to the Project Team was to find a way to design a TOC based solution that would cater for all ABB's complexities but which could still be incorporated in a standard SAP implementation (i.e. with only minor modifications). To recognize these objectives, the Project was titled "TOC in SAP".

In this paper, the authors share the specific research objective of the ABB "TOC-in-SAP" initiative, the research strategy, and a review of the literature including the latest developments in Theory of Constraints by Dr. Eli Goldratt, Eli Schragenheim and Dr. Alan Barnard that made it possible to define a simple and robust enough TOC solution. The paper also includes the process used to define and test a "TOC-in-SAP" blueprint as well as results achieved from the initial pilots and future roll-out plans within ABB.

RESEARCH OBJECTIVE

The research objective of this study is to construct a simple reusable TOC-based operations planning, execution management and continuous improvement (focusing) solution and incorporate this into SAP.

To meet the research objective, the supporting targets were:

1. Develop an overview of TOC-based planning and execution management IS support based on literature.
2. Define a simple reusable TOC solution blueprint (using the "Strategy & Tactic Tree" method develop by Dr Eli Goldratt) that can be implemented into SAP.
3. Implement and test the reusable solution using a "weak" market for testing with minimum risk.

RESEARCH STRATEGY & ANALYSIS

The plant manager of the 1st pilot factory directed the team:

> *"Even though it might appear as if our processes and products are complex due to the large number of end product variations, multi-level Bill-of-Materials made up of thousands of parts and materials, manufactured with relatively complex process steps, we actually have products and processes that can be managed with simple rules - so please give me a Simple Tool."*

On advice from Dr. Eli Goldratt, the team representing the pilot factory, BU, Global Operations Development Group, Manufacturing IS, the local SAP team and TOC experts used TOC's Strategy and Tactic Tree thinking process tool to define and validate the generic planning, execution and ongoing improvement requirements and to ensure that each proposed change is really necessary and sufficient to achieve the overall business objectives.

The second step in the research was to identify common challenges which were addressed by past TOC implementations and or which had to be addressed by further TOC implementations based on feedback from stakeholders in Sales, Procurement, Planning, Operations and the Operational Excellence Program responsible for ongoing improvement.

Figure 3 below shows that a factory's throughput, lead-time and reliability performance is compromised by mainly 5 root causes. These include over- or under-committing capacity, materials or purchased parts not being available on time, releasing too much WIP (e.g. due to batching) or releasing WIP too early (e.g. due to long MRP lead times), unsynchronized priorities and other hidden problems normally related to local optima policies or behaviours.

Figure 4. Five causes of poor Throughput, Lead-time and Due-Date Performance in Operations

The identification of these causes allowed the team to identify five mechanisms that were needed to achieve optimum flow through operations:

- **For Sales**: How do we quote reliable due dates with an internal constraint (so that we don't over-commit but also not under commit)?
- **For Procurement** How do we set and maintain the correct levels of raw material and purchase part inventory?
- **For Planning**: How do we control the release of WIP in hybrid environments of ETO, MTO, ATO and MTS so that we don't release too much or too early, but also so that we don't release too little or too late which would starve any capacity constraint?
- **For Operations:** How do we prioritize and synchronize changes in priority (i.e. when Murphy strikes) of all production and replenishment orders?
- **For Ongoing Improvement:** How we know where to focus limited resources to continuously remove local optima and ensure process improvement and capacity elevation is done on only the capacity constraints?

The next step in the research was to decide which of the available planning, scheduling and execution mechanisms should be used to ensure the objectives of the above 5 challenges could be met regardless of the complexity and variation in the type of flow in a factory.

SELECTING A ROBUST QUOTING, BUFFERING, RELEASE CONTROL AND PRIORITY MECHANISM

To ensure that the choices of the five mechanisms needed were directly aligned with ABB's overall business strategy and to ensure that each of these changes would be defined and communicated accurately, the team, on recommendation of Dr. Eli Goldratt decided to use TOC's strategy and Tactic tool. Figure 5 below shows the Strategy & Tactic Tree the team developed to show how the 5 mechanisms are connected to the overall business goal.

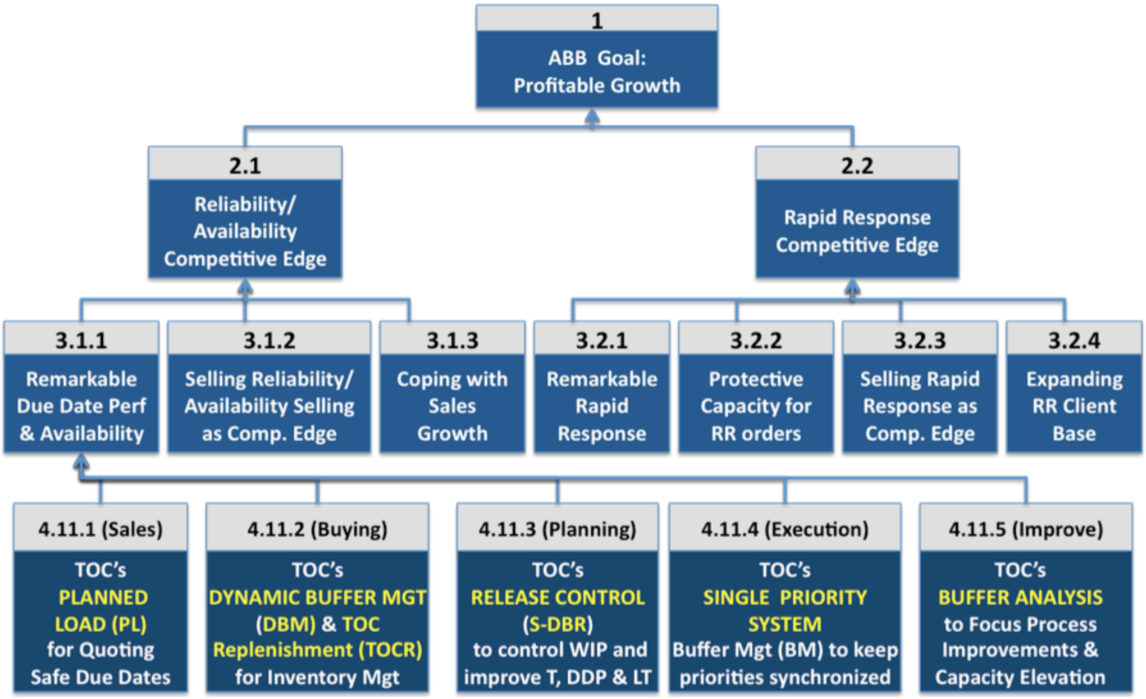

Figure 5: ABB Strategy & Tactic Tree for identifying 5 critical Ops Management mechanisms

In their quest for focus and simplicity, the team selected the more robust S-DBR (Simplified Drum-Buffer-Rope) **Release Control** approach of TOC, which uses a single TIME buffer instead of Kanbans (small stock buffers which require stable processes, product mix and demand) to control the release of products onto the floor and for setting and maintaining the correct priority for works orders. Traditional Drum-Buffer-Rope is used in the few cases where touch time is more than 40% of the average lead time, where there are dependent setups on a capacity constraint and/or where due date commitments to customers cannot be influenced. DBR includes two time buffers; one to protect the capacity constraint from starvation and one to protect customer order due date and a more detailed "Drum" schedule to better exploit the Capacity Constraint's potential through re-sequencing

S-DBR also provides a simple yet effective way of quoting safe due dates using the "**Planned Load**" concept, which uses the backlog of orders on the capacity constraint plus the % of the remaining time buffer, to provide a safe estimate of when a specific order will be ready for shipment.

The **Dynamic Buffer Management & Replenishment mechanism** of TOC provides a simple yet robust way for sizing, replenishing and resizing stock buffers of raw materials, purchased parts, components or finished products at any stock location. Sizing of stock buffers is done based on the "maximum forecasted demand within the reliable replenishment time" where "replenishment time is the sum of order lead time and supply lead time. This simple formula shows the leverage in reducing order lead time (or increasing order frequency) from say monthly to weekly. Such a reduction will enable the factory to carry four times less stock with the same service level as before – a leverage point normally missed in many implementations. Once Stock Buffers have been sized according to the above rule, stock is simply ordered and shipped as frequently as possible based on actual consumption (target is daily ordering and shipments). The "dynamic" part of DBM refers to a mechanism of using the buffer zone penetration (each stock buffer is divided into equal red, yellow and green zones) to determine when and by how much to resize. If the buffer is frequently in the red, the stock buffer should be increased while if it never comes out of the green zone, it can be safely reduced.

To establish a **Single Priority System**, which can be used in hybrid environments where there are ETO MTO ATO and MTS.TOC recommends releasing orders based on their buffer status and to re-sequence the "work-to-list" for each department based on buffer status. A fourth (black) zone is used to categorize orders that are already late. Black orders are always at the top (highest priority), then red orders, then yellow and then green

Figure 6 below shows that Works-orders for ETO, MTO and ATO will have time buffers assigned (each time buffer has of three equal zones of red, yellow and green). Work-orders for MTS products or Purchase-orders for "Buy-to-stock" materials or parts using stock buffers has the same three equal buffer zones, using a Black Zone to indicate "stock-out" and a Blue Zone to indicate "above target".

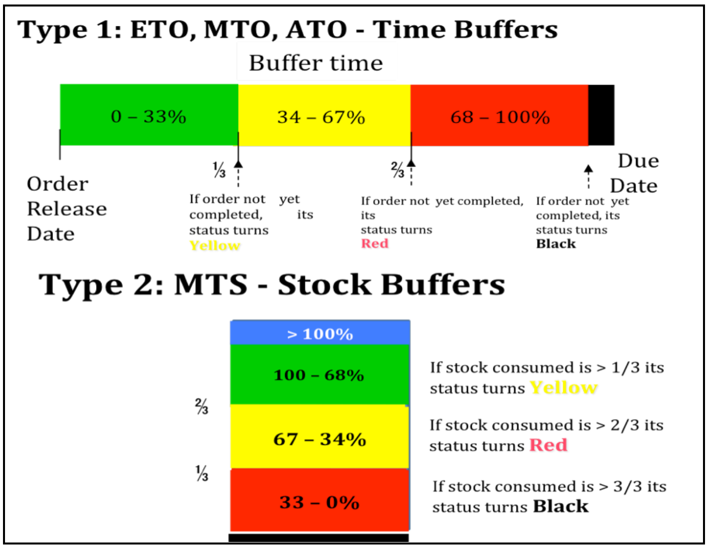

Figure 6: Time and Stock Buffer Zones

When an order is released, it is released according to its buffer status. When an order's progress is delayed due to Murphy, its status will go from green to yellow to red, automatically being assigned a higher priority each day based on how critical it is to work on that order to ensure high due date performance or availability.

Finally, the last mechanism needed was the **Focusing Mechanism** to focus process improvement and capacity elevations only on capacity constraints and major disruptions to flow. Similar to the dropping river analogy used by Dr. Ohno to identify remaining disruptions to flow (the rocks), TOC uses analysis of the reasons why stock or time buffers went into the red or black (over-due or out-of-stock" to focus improvement efforts.

*For readers interested in the details of these five mechanisms, we recommend reviewing the PowerPoint slides of this paper available from Dr Alan Barnard (alan@goldratt.co.za).

RESEARCH PROJECT TIME LINE

Due to the importance of the project, it was planned and monitored carefully using the Critical Chain Project Management (CCPM) method, which allowed this project to be complete in record time of less than 9 months. The project was launched in February 2007 and went live November 2007 with the 1st pilot in Brno (Czech Republic). The timeline of the project is presented in Figure 6 below.

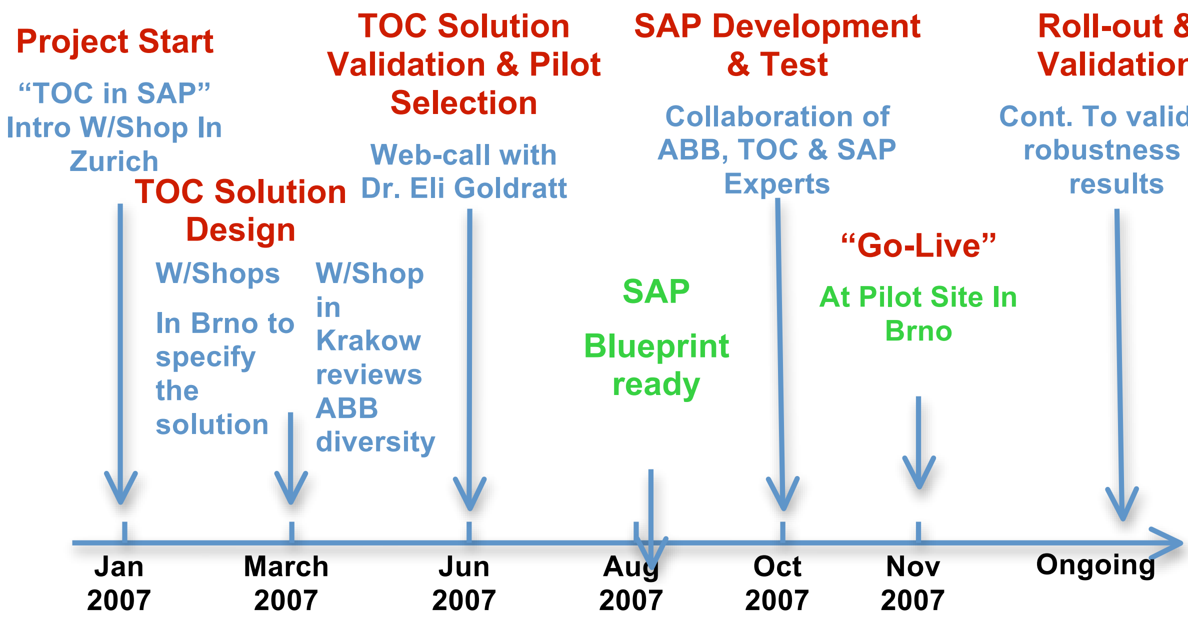

Figure 6. Timeline of the "TOC-in-SAP" Project

IMPLEMENTATION

The project team created a blueprint, describing in details the defined functionality. The blueprint showed that around 80% of the TOC-in-SAP functionality needed could be achieved within a standard SAP configuration, with around 20% requiring extensions (using ABAP's or LIS).

The main functionality included in the construction developed is described below.

PLANNED LOAD

Planned load is used to calculate the planned time of the production order in the constraint. Based on this we define the reliable due dates (the planned load plus 1 / 2 of the buffer) and the release date to the production (the planned load minus 1 / 2 of the buffer). The calculation is made based on the loading of both the primary constraint and secondary constraint. The end of the planned load gives the first possible date for work on the primary CCR (that is, casting), used for calculating the planned ex-works date and to evaluate the load versus capacity on the secondary constraint (that is, mould). The system will check if there is enough capacity on the secondary constraint, using the same criteria as the primary CCR. If the secondary CCR planned load date is earlier than the primary CCR date, then it is possible to achieve the date determined from the primary CCR. Otherwise, the system gives the decision to the planner. If the date is earlier than standard lead time, standard lead time is used. If the date is later than the standard lead time, the calculated date is used.

Customers typically order several products in the same sales order. Therefore, *it is possible to enter data for several materials (items) and execute the evaluation for all of these in one check* (Schragenheim and Burkhard 2007c; see Figure 7).

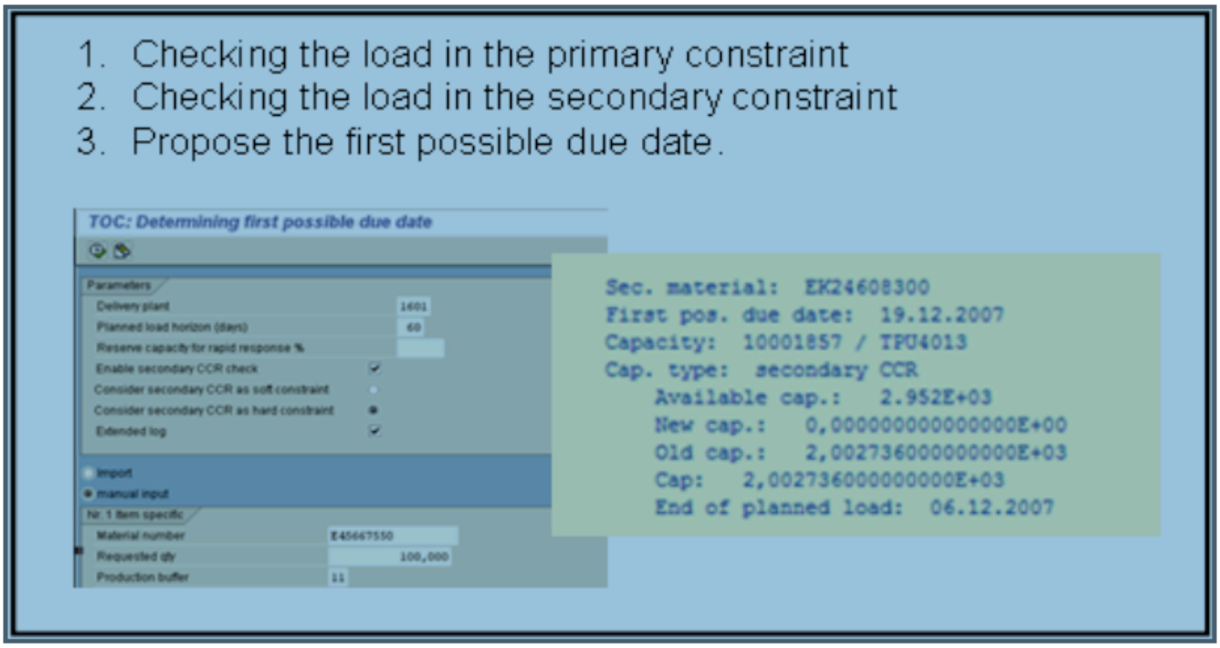

Figure 7. Decision on the First Possible Due Date Based on Planned Load Concept.

The implementation of the planned load is one of the key features of the implementation and it is based on the S-DBR approach and Eli Schragenheim's recommendations (Schragenheim, 2007c).

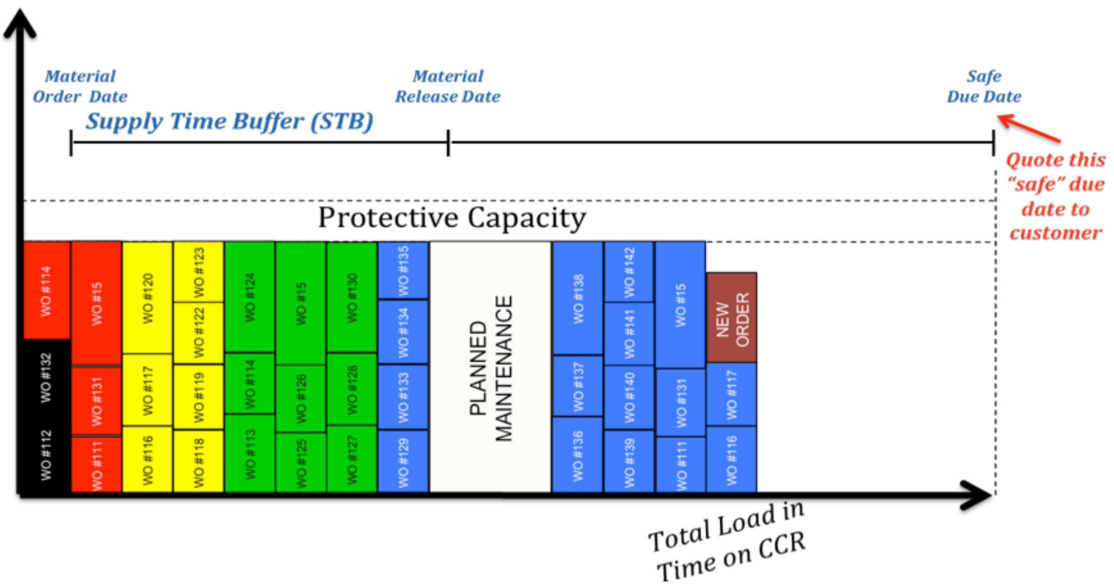

Figure 8. Predicting Forecasting the Safe Due Date

DYNAMIC BUFFER MANAGEMENT & REPLENISHMENT

Initial Buffer sizing is supported via a customized report with the calculations to determine buffer target levels based on "maximum demand within reliable replenishment time". These recommendations can be set to auto-update the system in a mass update at the beginning of the project.

Replenishment can be implemented using one of the standard stock replenishment policies within SAP using a "Replenish up to Target Level + External Demand" setting.

Dynamic Buffer Resizing is done through monitoring buffer penetration and reporting those Stock Keeping Units (SKU's) that meet the criteria for resizing. Typically, the decision as to when and by how much to resize follows the standard guidelines published by Dr Eli Goldratt in "TOC Insights for Supply Chain Management".

CHOKING THE RELEASE OF ORDERS TO THE PRODUCTION PROCESS

The limited release of orders to the production process uses the planned load approach, that is, the release time of the production order is defined based on its planned timing in the constraint. See Figure 8 above. Orders are released based on their buffer status priority.

SINGLE PRIORITY SYSTEM

The single priority system is implemented in SAP through a simple resort of "work-to-list" based on an order's calculated time or stock-buffer status. An order with a buffer penetration of more than 66% will be red and appear on the top of the work-to-list of any department and an order with buffer penetration less than 33% will be green and appear at the bottom of the list. Workers are expected to follow the priority strictly, and if they cannot (e.g. if a drawing or part or tool is missing) to escalate this immediately to management for expediting.

FOCUSED PROCESS OF ON GOING IMPROVEMENT (POOGI)

TOC's continuous improvement mechanism uses reason recording of shipping buffer red zone violations. Data regarding which resources are causing buffer penetration into red and black zones (automatic) and the reasons for this (manual selection from a list) are collected for later analysis and continuous improvement as shown in Figure 9 below.

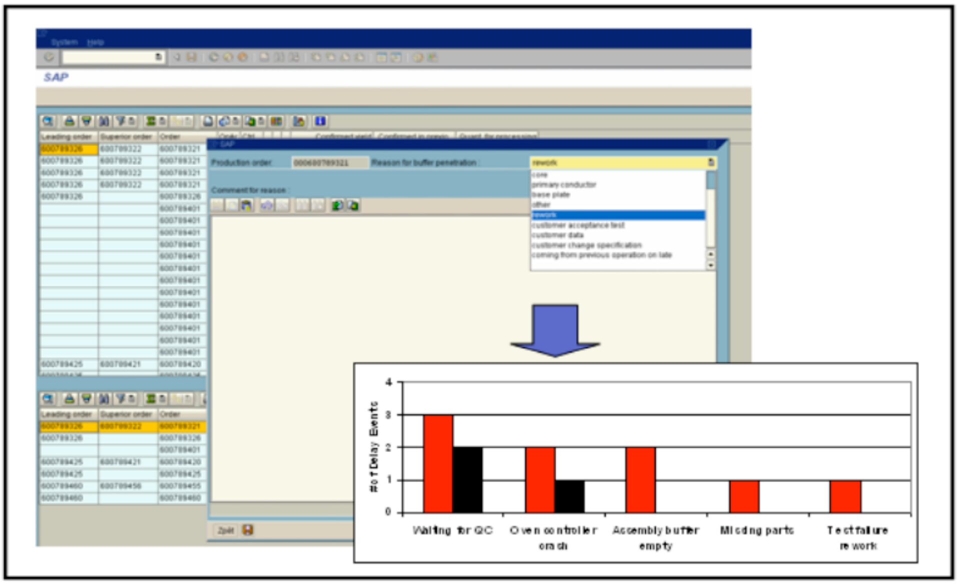

Figure 9. Collecting Data about Red or Black Zone Penetrations.

CAPACITY REQUIREMENTS PLANNING

Capacity Requirements Planning allows managers to monitor the load of any resource and to plan their capacity increase or reduction needs. In addition, if planned load > 80 % of standard factory lead time, the system raises a warning and the capacity needs to be increased. The planner informs sales about longer than normal lead times. If planned load for the constraint is more than 50% of a production buffer, a warning is raised and a decision should be taken on how to increase the capacity immediately.

RESULTS ACHIEVED

The project team has implemented "TOC-in-SAP", including support for planned load, buffer sizing, replenishment, dynamic buffer resizing, time buffer based release control of production orders, a focusing mechanism based on buffer penetration analysis (POOGI) and capacity requirements planning. The features have been implemented in such a generic way that they can be copied to other factories wishing to implement similar support into their SAP systems.

The first pilot factories are very satisfied with the results:

"*The "TOC in SAP" solution provides realistic delivery times instantly, has removed separate time-consuming planning and re-planning in Excel, releases correct orders into the production (not too much, not too little, not too early, not too late) and prioritizes them during execution based in their buffer status"*

Initial results indicate that the new system will further reduce throughput time, lower WIP, reduce costs and improve On-Time-Deliveries in all factories that implement SAP and that in fact it will provide a stronger business case for rolling out SAP faster to more factories currently on other ERP systems.

The latest information (at the time of publication of this paper in May 2009) is that "TOC in SAP" is now live in four factories – one factory in Brno (Czech Republic), two different factories in Vaasa, Finland and one in Baroda, India. There are also deployment variations of the "TOC and SAP" in 2 factories in Cheonan, Korea and another two completing preparations in Przasnysz, Poland. Implementations in their planning phase include factories in Dalmine, Italy, Ratingen, Germany and third factory in Vaasa.

5. RESEARCH CONCLUSIONS

The research objective target of this study was to construct a simple reusable TOC-based production planning, execution and continuous improvement solution into SAP. Based on the evaluation of the first factories, the TOC Experts and the BU representatives and the approval by ABB for a phased roll-out to other sites, the Project team achieved the research objective. One of the interesting unplanned desirable effects was that the process used for implementing "TOC-in-SAP" also enabled new SAP implementations to be done faster and focused on supporting critical business functionality to ensure faster achievement of business results.

In addition, the literature study showed that the development constitutes new knowledge for both academic researchers and industry practitioners. Therefore, the implementation, the blueprint and the experiences of the project team should be of high interest to both practitioners, academic researchers and even ERP companies and researchers, who are seeking ways to assist companies to improve the planning, execution and focused ongoing improvement and scheduling practices in a way that can be supported by standard ERP systems such as SAP.

ACKNOWLEDGEMENTS

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APPENDIX: SAMPLE LIST OF COMBINED TOC AND LEAN APPLICATIONS IN ABB

ABB SITE	Deployment Year	RESULTS ACHIEVED
PPTR, MP Transformers, Bilbao, ES	2006	Productivity +30% Cycle time 50% (from 6 to 3 months) WIP - 35%
PPTR, Small Distribution Transformers, Waterford, IE	2005	TPT (SDT) - 75% TPT (MDT) - 65%
PPTR, Small Distribution Transformers, Zaragoza, ES	2004	TPT - 70% TTPT - 48% OTD from 70 to 96% (while 245% increase in orders)
PPTR, Small Distribution Transformers, Shanghai, CN	2005	TPT > - 50% TTPT > - 25% $1,2M reduction of total inventory while 40% increase in production volume
PPTR, Small Distribution Transformers, Hefei, CN	2006	Capacity +30% TPT - 64% TTPT - 32% Inventories - 44% OTD from 66 to 98%
PPTR, Tap Changers, Ludvika, SE	2005	TPT - 50% TTPT > - 60% ('Green Line')
PPTR, Bushings (GOB), Ludvika, SE	2005	Capacity +30% TPT - 50% OTD from 8 to 93%
PPTR, Micafil HV Bushings, CH	2006	TPT - 50% OTD from 60 to 90%
PPMV, Distribution Automation Tech Center, Vaasa, FI	2005	Project OTD from 45 to 87% with Reduced cycle time and Functional Completion Rate increase to 100%
PPMV, DECMS - CNDMX value chain	2005	Replenishment time - 72% Total inventory turn over rate +100% OTD from 83 to 95-100%
PPMV, Outdoor Breakers, Nashik, IN	2006	Capacity +260% TPT - 60% TTPT - 60% OTD from 77 to 100%
PPHV, Live Tank Breakers, Ludvika, SE	2002	Total productivity +30% Factory productivity +89% TPT - 70% TTPT - 70%
PPHV GIS, Mannheim and Hanau-Grossauheim, DE	2004	Capacity +43%
PPHV, LV Cables, Longford, IE	2004	TPT - 80% WIP - 60%
AP Drives / System AC, Helsinki, FI	2000	Productivity +20 % OTD from 30 to 100% (and sustained) Significant improvement in employee satisfaction
ABB SACE SpA, Italy	1997	TPT reduction 90 % 24 hour deliveries enabled
AP LV Motors, Vaasa, FI	2005	Productivity +38% TPT -17%
AP LV Cewe-Control, Västerås, Sweden	2006	Capacity +25% TTPT - 80% OTD from 23 to 90%

OTD = On Time Delivery (measured against confirmed due date),
TPT = Throughput Time (= manufacturing cycle time)
TTPT = Total Throughput Time (= Cycle time from order confirmation to delivery; in LPT / MPT equal to 'Cycle Time')

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