

# DEMAND-DRIVEN INNOVATION IN MATERIAL PLANNING AND CONTROL: A REVIEW OF EARLY IMPLEMENTATIONS

*Peter McCullen<sup>1</sup> and Simon Eagle<sup>2</sup>*

<sup>1</sup>Brighton Business School, University Of Brighton

<sup>2</sup>Simon Eagle, SmartChain International

## INTRODUCTION

Demand-driven materials planning and control represents a significant and well-developed alternative to the traditional approach to MRP/DRP that is embedded within today's leading ERP systems. The term 'Demand-driven' emerged from the ERP company PeopleSoft in 2002 (Ptak and Smith, 2011). It has been developed upon principles to be found in other supply chain approaches, including Lean/JIT, the Theory of Constraints (TOC) and Factory Physics, and is now promoted by the Demand Driven Institute (DDI). The rationale and principles of Demand-driven have been thoroughly articulated by Ptak and Smith (2011) in a book which positions the approach in the context of MRP evolution, drawing heavily on the concepts established by the American Production and Inventory Control Society (APICS). The approach is rapidly gaining ground as a result of dissemination via professional bodies, including the UK's Institute of Operations Management (see Harding and Ptak, 2012), and via the qualification 'Certified Demand-driven Planner', accredited by the International Supply Chain Educational Alliance (ISCEA).

Although the concept of the 'demand driven supply chain' has been explored by academics (see for example Mendes, 2011), the DDI's approach has not, so far, been covered within the academic literature. There are currently around 50 implementations of Demand-driven worldwide (that can be identified from public domain sources), and that number is rapidly growing. In order to understand the likely trajectory of Demand-driven and, to help inform practitioners of its potential benefits and likely implementation challenges, this paper will report on qualitative research into Demand-driven adoption and implementation.

## DEMAND-DRIVEN VERSUS TRADITIONAL MATERIAL PLANNING AND CONTROL

To understand the difference between Demand-driven and mainstream MRP/DRP, it is necessary to consider the *planning*, *execution* and *control* functions of MRP/DRP. Whereas mainstream MRP communicates detailed planning and execution information via a mixture of 'planned' and 'released' orders across a dependent demand network, Demand-driven dispenses with planned orders (and the associated order maintenance) in favour of kanban-like inter-work centre/inter-echelon replenishment signals; combined with a system of graduated buffer status alerts to help control day-to-day operations. This approach is underpinned by careful positioning, sizing and maintenance of buffers: typically inventory in the case of make-to-stock, but also including the novel innovation of 'time buffers' for make-to-order and non-stocked SKUs.

## THE DIFFUSION OF INNOVATIONS

The Operations Management that underpins Demand-driven has already been clearly explained by its main proponents Ptak and Smith (2011). This research therefore focuses on the factors affecting its diffusion. The initial motivation for Rogers' (2003) innovation research was to understand the pattern of adoption of new farming methods in America's mid-West in the post-World War II period. Rogers was trying to understand why some farmers would rapidly adopt new methods, like pesticides and seed drills, while others would 'stick' with tried and

tested approaches, despite the seemingly obvious benefits of the new techniques. Rogers developed a general model to explain the innovation-decision process, considering factors including: prior conditions, innovativeness of the host company, and the complexity, observability and trialability of the innovation, as shown in Figure 1.

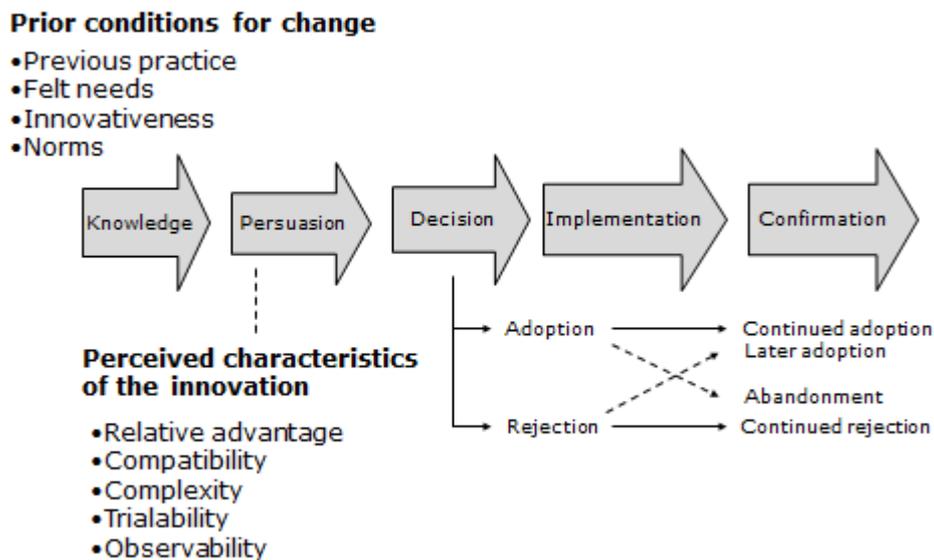


Figure 1. The innovation-decision process, adapted from Rogers (2003)

The great strength of this model is that it allows the researcher to consider contextual factors alongside the technological characteristics, business requirements, and organisational implications of the innovation. In this way, it is possible to explain the factors affecting the adoption of a new technology and potential for its further diffusion.

## RESEARCH METHODOLOGY

The current population of Demand-driven implementations has been estimated by searching for customer lists and testimonials on the web pages of the Demand-driven software providers that are currently accredited by the Demand Driven Institute (DDIa, 2015). Other sources include case studies provided by the DDI, and case studies from their 2015 conference (DDIb, 2015). These sources accounted for 51 implementations, and a further 10 were known to one of the authors through his network of consulting colleagues.

In order to achieve a broad understanding of factors affecting the adoption of Demand-driven, the authors attended an IOM course on Demand-driven held at the Chartered Institute of Logistics and Transportation's (CILT) headquarters in Corby, UK. Research has focused initially on the experiences of experts: consultants who have delivered courses on Demand-driven to supply chain professionals, and, who have worked with clients to implement Demand-driven across a range of organisations globally. A more in-depth understanding of the adoption and implementation issues has been obtained through a case study (Yin, 2003) based on the experience of one of the authors who, in consultant role, has participated in the adoption and implementation of Demand-driven within a European pharmaceutical supply chain.

The focus group was undertaken immediately after a 2 day Demand-driven course (CDDP) with three experienced consultants in April 2015. The researcher

employed a series of open-ended questions developed from Rogers' (2004) framework, to stimulate a discussion on the factors affecting adoption. The focus group was recorded and transcribed. Some initial qualitative analysis is presented here, structured around stages in the diffusion of innovations (Rogers, 2004). The same framework has been employed to structure the case study data.

### ESTIMATED POPULATION OF DEMAND DRIVEN IMPLEMENTATIONS

The population of Demand-driven implementations has been estimated, as shown in Table 1, but this only serves as a rough indication as it is biased towards the more longstanding users.

Sector	Number
Apparel	12
Food	10
Industrial	9
Engineering	9
Household products	5
Pharmaceuticals	3
Electronics	2
Business Services	2
Cosmetics	1
Automotive	1
Aerospace	1
Packaging	1
Other	5
Total	61

Table 1. Estimated population of Demand-driven implementations by sector

Demand-driven is generally supported by proprietary software which interfaces with an ERP system. The DDI exert close control over the terminology and algorithms employed within Demand-driven applications, and publish a list of 'compliant software'. The packages that currently carry DDI approval are Replenishment+, Flowsoft and Orchestr8. The current distribution of software applications is shown in Table 2.

Software	Number of implementations	DDI compliant?
Replenishment+	11	Yes
Flowsoft	31	Yes
Orchestr8	13	Yes
Other	3	No
Spread sheet	3	No
Total	61	

Table 2. Estimated population of Demand-driven by software application

The largest proportion of our estimated implementations are in South America (31), using Flowsoft, and predominantly in Columbia, a country with a history of TOC drum-buffer-rope applications. There are 12 applications in North America and 1 in Canada, mainly using Replenishment+. There are 14 implementations in the UK, mainly using Orchestr8, with 2 in France and 1 in Germany. However, these mainland Europe figures seem understated.

## FINDINGS FROM FOCUS GROUP

### Characteristics of adopting companies

The facilitator asked whether many companies used Demand-driven across echelons, as in retail. Consultant 1 replied “a lot, it makes distribution easier. Considering the operating characteristics of adopting companies, Consultant 1, said that it worked for make-to-stock (MTS) and engineer-to-order (MTO), but that “MTS companies tend to think it’s for MTO, and the MTO companies tend to think it’s for MTS.. MTO uses control points with capacity buffers whereas MTS uses control points with inventory buffers.” Consultant 1 recounted the case of an MTO electronics company in Canada that had seen their supply chain as a competitive weapon and had adopted Demand-driven with remarkable results; cutting their backlog and lead times, and reducing inventory turns. Demand-driven allowed them to achieve market leading responsiveness, for which they charged premium prices, leading to quite remarkable growth in sales revenue and profitability. Consultant 1 reflected that “customer value comes from product features, or, delivery”, and recounted the case of a US Forgings manufacturer, situated in the upstream end of engineering supply chains, “they are the buffer in their supply chain, that was their strategy”. Demand-driven had enabled them to provide that buffer cost effectively, and without excessive inventory holdings. In response, Consultant 3 recounted the cautionary tale of a company that had, after implementing Demand-driven, offered too much to the market. The marketing department had seen the benefits of Demand-driven and offered 2 week lead times to customers, which was less than half the market norm, while promising 100% on-time-in-full. The company quickly became inundated with orders and overwhelmed, leading to customer service failures and a cash flow crisis. Consultant 1 reflected that they should have segmented the market and understood the [price] elasticity, employing demand shaping to harvest the benefits of Demand-driven. Consultant 2 commented that there is “an equilibrium of forces in the supply chain between Sales and Supply Chain, normally Sales have the power”. Consultant 1 reflected that “DDMRP (the term preferred by the DDI) is all about: ‘How do I strategically leverage my supply chain to provide value to my customer and profit to myself?’. it’s not an inventory reduction platform.”

### Prior conditions for change and acquisition of knowledge

The facilitator sought to discover which *previous practices* for planning and control would typically be in place prior to adoption of Demand-driven? Consultant 1 explained that many would be disappointed users of SAP’s Advanced Planning and Optimisation (APO) package. She outlined a typical trajectory involving Class A [APICS definition] but legacy MRP, followed by a costly ERP implementation with disappointing results, leading to APO, also with disappointing results. Companies would go on to implement “some fancy forecasting software in the belief: ‘If only I could do a better forecast, then my life would be complete’. And, what they are finding, is that none of it works”.

In relation to the *felt needs*, Consultant 1 reflected on the corporate environment inhabited by Materials Managers. “Companies have the wrong inventory, they’ve got too much of the wrong stuff..[and] too little of the right stuff. Overall we’ve got too much stuff, and senior management are looking at this inventory number and saying: ‘Why can’t we deliver products? Why do we have shortages? What is the matter with you people?’ Look at your Materials Managers, they have breakdowns because the stress is incredible. Consultant 2 commented: “And that is why there will be a massive wave of implementation, because the [Demand-driven] pioneers have done all that [implemented ERP, APO and forecasting software], and they fail. You can tell the story ‘skip all that.. just go to the right answer.’”

The group's reflection on the influence of firm size and ownership helped to explain the *innovativeness* of the early adopters. Consultant 1 explained that Large companies have 'process owners', the 'brightest and the finest' who are on the lookout for new ideas, and who have time to attend conferences etc. Consultant 1 reflected that she would initially meet someone from corporate, and later see the supply chain team booked onto a course. "These are the typical early adopters.. they will try anything." Consultant 2 commented "but also for mid-market, APO is prohibitive". Consultant 1 added: "the privately held mid-market company is the other one that we tend to get". These companies, it emerged, have the same issues with customer service and inventory as the larger companies, less resources to invest in planning and control systems, but more freedom to act. Consultant 3 identified another innovation-driver which he called the "burning platform". He recounted the case of a pharmaceutical company facing an unwanted takeover that decided to quickly implement Demand-driven in order to achieve a step-change in performance. The Supply Chain Manager's rationale was that he would have to improve performance either before or after the possible takeover, so he may as well take the plunge and "do it now." Consultant 1 added that there is also the lean group that had [misunderstood] what Ohno said, and believe that all inventory is evil. Those supply chains have now been extended globally and are incredibly fragile with all the inventory driven out.. and supply chains are breaking.

In order to explore the *norms* that increase the propensity to adopt, the facilitator asked the consultants to identify any existing practices that made a company more likely to consider Demand-driven. Consultant 1 identified two groups, those that had "done lean" and the Theory of Constraints (TOC) people who had implemented drum-buffer-rope. Companies using lean were "still tripping over the fact that they are short of material, and are so frustrated with those MRP people [in their own organisations] because they were constantly in their way." For the TOC people "the problem is, as in any pull system, that you can only pull if there is material there. But the raw material is ordered by a two level process via a forecast driven Master Production Schedule (MPS) and MRP." These companies are already familiar with the principles of flow, and want to make it work better.

### **Perceived characteristics of Demand-driven and persuasion**

To explore the *relative advantage* of Demand-driven, the facilitator asked what specific problems motivated companies to consider Demand-driven. Consultant 1 replied that it was: "One, cash flow. Two, customer service is terrible, even with high inventories. And Three, revenues are declining. Consultant 3 added that "you sometimes get people in the business who just want to do things better." Reflecting on the motivation of the Retail Vice President who had sent three people on the course, Consultant 1 commented: "He sees the pain that his planners are going through, and the company he came from did things differently".

Concerning *compatibility*, Consultant 1 was very clear that ERP cannot deliver Demand-driven by itself. "I don't care how good you are at flipping switches.. it does not work. One, because the planning equation is different. Two, management of the stock buffers is different. Three, replenishment of the stock buffers is different. Four, we do not use a master schedule, we do not forward-do a planning calculation. Five, everything is based on our available inventory today." The facilitator noted some similarities between MRP and Demand-driven, in the need for accurate bills of materials (BOM) and an inventory management and accounting system. Consultant 3 added that: "You need to have a transaction management system [in Demand-driven]" Consultant 3 agreed: "It hasn't changed. Item master hasn't changed. BOM hasn't changed. What you do with it has changed."

Regarding *complexity and trialability*, the consultants agreed that Demand-driven can be piloted for a small number of SKUs using spread sheets. Consultant 1 said that she encouraged clients to run a pilot with their six worst items. It became clear that extending this approach across the range of SKUs would become unfeasibly complex. In response to a question about trials, Consultant 1 explained that “a lot of simulation work is done, especially in big companies.” It is possible to “look at what [inventory] we had. To run the transaction file against Demand-driven buffers [appropriately sized according to variability and lead time etc.], and to find: ‘What would my customer service level and inventory have been [with Demand-driven]?’” The facilitator commented that these findings could be used to make the business case for Demand-driven, and the other consultants agreed. In response to a question concerning the number of companies implementing Demand-driven, Consultant 1 replied that she “had no idea how many” and drew an analogy with Goldratt’s influential book *The Goal*, “it made sense to people and they just did it.. like in this class, we have a pilot running”. Consultant 1 was referring to three participants in the IOM/CDDP course from a high fashion retail organisation who were already piloting Demand-driven using spreadsheets for a small range of Stock Keeping Units (SKUs).

Concerning *observability*, the consultants reflected on the prime mover’s need to see results before committing to ‘roll out’, and that people tended to trust what they knew from their own experience, and this tended to underline the requirement to run a pilot, and/or the importance of previous experience with flow-oriented approaches.

### **Decision and adoption**

Concerning the decision to *adopt*, the facilitator asked whether people decided to adopt because of the success of their own trials, or because they have seen Demand-driven working somewhere else. Consultant 1 replied that “Usually it’s their own pain. ‘Is it going to solve my problem?’” She also reflected on a barrier affecting APO users, because to adopt Demand-driven after implementing APO may be to admit that millions [of dollars] has been wasted. The facilitator went on to ask whether any companies had adopted and then abandoned Demand-driven. The consultants could identify a small number of cases, but these were all associated with buy-outs, where the acquiring company had insisted on implementing their own systems and approaches. The facilitator also asked whether any companies had rejected Demand-driven and later adopted it. Consultant 3 recounted the experience of a senior manager who had been intellectually interested in Demand-driven, and then promoted. Once in a position to go ahead, he sensed a lack of support from IT, who preferred to use more famous proprietary software. He decided to ‘wait and see’ how the standard approach would work. Five years later, in the light of disappointing results, he is now feeling more empowered to adopt Demand-driven.

### **FINDINGS FROM A EUROPEAN LIFE SCIENCE CASE STUDY**

Company A is a large life science company with a factory in Europe and global distribution. The factory handles a wide variety of products in make-to-stock batch mode supplying a warehouse in Europe, which operates as a hub supplying markets in Europe, Russia and the Middle East, and trunking directly to regional distribution centres in the USA and AsiaPacific. Company A’s Supply Chain Manager had met the consultant at a conference and had been impressed by the Demand-driven rationale and reported results achieved by example companies. The company faced the possibility of an unwanted takeover (mentioned above by Consultant 3) and, in this business environment, he was able to persuade the Marketing and Operations VP to authorise a trial of Demand-driven.

### **Prior conditions for change and acquisition of knowledge**

Company A had previously implemented Sales and Operations Planning and its planning and control system was pure 'forecast push', using proprietary software for forecasting and DRP/MRP. Its planning and control system could not be described as 'best in class', and it had no particularly strong track record of adopting innovative approaches (e.g. lean or TOC) to improve material flow. However, its Supply Chain Director had previously worked in the automotive industry, and had experience of running Just in Time (JIT) and was aware of more advanced ways of working. She had a good understanding of queuing theory and Hopp and Spearman's (2000) approach to improving material flow and was very supportive. Company A's existing customer service levels was in the early 90s (line-fill percentage)

### **Perceived characteristics of Demand-driven and persuasion**

To improve its competitive position, the company needed to improve its customer service levels and increase its inventory turn. Company A also recognised the negative impact of schedule instability on factory capacity and costs. It needed to get more output from the factory, and schedule stability was therefore an important objective.

In order to understand the potential contribution of Demand-driven, the company engaged a TSP to simulate the potential impact of Demand-driven for a representative group of products, looking at the DC and hub echelons. Using six months of actual demand history, the simulation used lead-times, batch sizes (equal to shipping quantity), supply constraints and Demand-driven control points and buffer sizes to estimate service levels and requisite inventory levels. The simulation showed that service levels could be raised to 99% with an accompanying 35% reduction in inventory. This stage of the project took 3 weeks to complete.

### **Decision and adoption**

Company A understood that Demand-driven would be a completely different way of working and recognised the need for additional software. The company undertook a pilot (trial) of Demand-driven for a range of SKUs, using proprietary cloud-based Demand-driven software. The company retained its ERP system for transaction management purposes only, with requirements planning functions 'switched off'. The proprietary Software as a Service (SAAS) package employed FTP file transfers for functions including inventory status capture, and, to input Demand-driven orders into the system. MRP was retained within the factory. Distribution Planners used the Demand-driven software planner screens to monitor the inventory buffer status at control points in the warehouses and, to manage order release. The pilot, affecting a small range of SKUs was run for 3 months and evaluated. As a result of its success, the pilot was extended to cover all SKUs handled in the European market, and is expected to last for six months.

### **Learning from the pilot**

Demand-driven has improved the general level of predictability within the supply chain. As a result of 'right-sizing' the distribution inventories, the supply chain is de-stocking, which is causing anxiety in the factory and requests for more orders. The existing management accounting system indicates that the factory is failing to recover overheads. What these difficulties suggest are incompatibilities between the Key Performance Indicators (KPIs) and the Demand-driven approach. The existing performance management system encourages Operations Managers to make product that is not actually needed. Company A's manufacturing operation therefore needs to change mode from 'can and will build' to 'can build and sell'. There are clearly significant change management implications involved in Demand-driven implementation.

The nature of the company's S and OP process has changed from one pre-occupied with shortages, to a more measured focus on reviewing buffer inventory

targets in relation to underlying changes in demand. The unexpected reduction in factory output also points to a need for new approaches to managing capacity. Overall, the unnecessary variability, and system induced bullwhip, has been taken out of supply chain operations, leading to a sense of greater control and the opportunity to make more deliberate choices.

The role of the planner has completely changed and the European planner 'loves it'. With far fewer shortages and schedule changes to manage, it would be possible to have global planning done by one person, instead of splitting it amongst 3 in regional locations, thereby enabling a more efficient 1:1 relationship with the factory. Territory forecasts by SKU are still needed to review buffer inventory targets and to forecast capacity.

## **CONCLUSIONS**

The trialability of Demand-driven through low cost simulations and pilots will aid diffusion, as will the low cost 'pay as you go' SAAS model (i.e. with no high cost capital expenditure barrier). Adoption seems likely to proceed through a standard diffusion process, with the defining characteristics being urgency (burning platform) and supply chain education at high seniority levels. It seems likely that there will be a tipping point as the performance of the innovators begins to significantly outstrip that of others, who may later have to play 'catch up'. The approach of the five leading consultancy organisations (thought leaders) and ERP providers, that do not currently support Demand-driven, is bound to significantly affect the rate of diffusion. In the meantime, the rate of diffusion will depend upon the ability of pioneering change agents to network and publicise the process to gain opinion leader support.

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