Benefits; drawbacks and boundaries to deliver JIT

Re-thinking the UK automotive industry operations supply strategy

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Abstract

Purpose – The purpose of this paper is to carry out case study research to analyse the current situation at a world class vehicle manufacturer (VM), the main case organisation. This paper aims to conclude whether there is scope for further inbound JIT supply focus to the case study organisations within this research.

Design/methodology/approach – The data and vision for this paper comes from a literature review and practitioner papers and case studies to survey inbound supply of JIT theory and practice in a UK automotive supply network. Primary data are collected through case study research and site visits.

Findings – This paper presents the findings of recent research into a UK automotive industry supply network and identifies the benefits, drawbacks and boundaries of delivering JIT. The sub-element of this paper identifies whether there is scope to make a more focus inbound supply JIT into the main VM case study organisation.

Research limitations/implications – This research looks at one network over three tiers of a supply chain. However this research creates a case study hub and looks at whether there is potential to increase the level on inbound and outbound JIT supply to and from the main case organisation.

Practical implications – This case study research directly gains primary research form operational supply organisations working in a supply hub network in the UK automotive industry.

Social implications – Social implications here allow an improved understanding of efficient JIT and supply chain issues.

Originality/value – This research considers the enhanced relationship amongst automotive supply chain members to ensure a clear understanding and position the importance of a JIT; lean and agile approach in practice.

Keywords Lean production, Just-in-time

Paper type Research paper

1. Introduction and literary background

1.1 Supply chain management

Over two decades ago, Langley (1985) explained how the effective management of logistics activities helps towards overall cost efficiency. This is still the situation today; Shapiro and Wagner (2009) give a useful insight into how organisation's get effective supply chain performance through minimising a wide range of costs and taking a holistic approach, involving suppliers and customers when making decisions. Previously, Thomas and Griffin (1999) and Silver *et al.* (1998), agreed on the fact that procurement, production and distribution work together to create a better supply chain. Managing a supply chain helps work towards improving the long-term performance of

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individual companies and the supply chain as a whole (Mentzer *et al.*, 2001). It is about the organisation of business processes to enable the transformation of raw materials into finished goods and their timely distribution to meet customer demand.

Cohen and Roussel (2005) have shown that many industry leaders build supply chain efficiencies in order to develop an industry leading performance and long-term sustainable competitive advantage. In agreement, Sotelo explains that the interest of the customer should be at the heart of all decisions and core competencies, aims and objectives should be developed around them. If organisations use resources available in the most efficient way, that will help create wealth (Wall, 2007). Moreover, if businesses minimise costs then they will generate more revenue, and therefore be more successful.

1.2 The automotive industry

Manufacturer F, the main case study organisation hub which this research is based upon, is a tier one supplier in the UK automotive industry. This is part of a very large, competitive and pressurised industry which can act as a barometer and flagship for today's environment and economy (Mason-Jones *et al.*, 2003). Schmitz and Platts (2003) suggest that logistics operations in the automotive industry make supply chain tasks difficult to manage, where Hannon (2003) considers the pace that a vehicle manufacturer (VM) builds its products requires a constant stream of JIT supply required to keep production lines rolling. Donnelly *et al.* (2004) advise us that the influences of globalisation, implementation of lean production and the development of modularisation have had reflective influences on the relationships between VM's and their suppliers, particularly those in the first tier. Modular manufacturing and JIT delivery have enabled companies in the automotive industry to be more efficient while simultaneously allowing them to take advantage of the supplier's specialised expertise in their respective component groups (Morcott, 2000).

Ford gives an example of a company in the automotive industry which experienced a supply chain failure as an effect of moving towards leaner processes. They cut costs too heavily which lead to them having to shut down one of their plants for two days due to a lack of parts (Hickey, 2004). Doran (2001) shows that Nissan (UK) expects its suppliers to embrace continuous improvement as part of a responsible attitude towards a zero defect philosophy. In addition, the VM expectation is that suppliers manage their product design, material specification and manufacturing processes in co-operation with the VM. The basis to a lot of competition within manufacturing industry is time-based (Pragman, 1996) and automotive companies continue to put more and more emphasis on trying to cut lead times and waste costs to a minimum. Kaizen (continuous improvement) in automotive logistics is an important philosophy, and JIT is one of the ways VM suppliers are trying to reach a goal of minimised costs and competitive advantage (Bennett and Klug, 2012).

Goyal and Deshmukh (1992) described how JIT considerations focus on waste reduction and that it is alternatively defined as the co-ordination of finished work from upstream to downstream operations. At a similar time, Brown and Mitchell (1991) described JIT as primarily reducing and eliminating all wasteful operations. Germain *et al.* (1994) described JIT as a time-based strategic pull strategy which focuses on minimum process operation. The intense competition in the current market place has forced firms to re-examine these methods of doing business. More recently,

Farahani and Elahipanah (2008, p. 229) state that JIT is where all suppliers give a full delivery focus. Similarly, Boysen and Bock (2011, p. 15) describes how it is necessary to co-operate to win business from a VM.

1.3 JIT today

Sower *et al.* (2010) found that JIT positively and directly impacts total quality management (TQM) which in turn positively and directly impacts agile manufacturing. Amasaka (2002, p. 135) identified a new term for JIT, calling it "New JIT", justifying that it would be a good terminology to describe how hardware and software systems have developed over time.

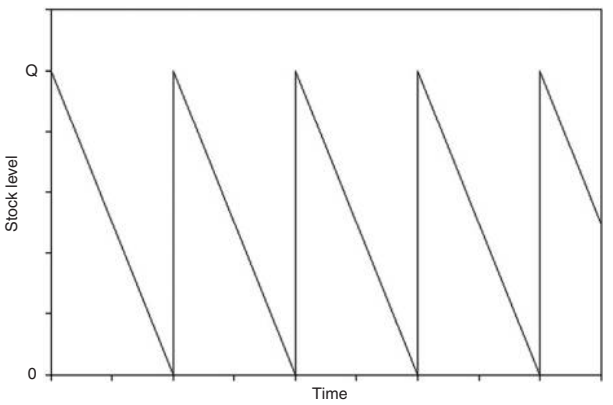
JIT offers many advantages, beginning with reduced inventory and administrative costs, and increased opportunities to reallocate valuable capital (Orton and Sowinski, 2001; Fullerton and McWatters, 2000). Kim and Ha (2003) note that material flows with synchronized production, would improve customer service and limit inventories. Beasley (2013) demonstrates this within Figure 1.

Carleton (2011) supports the diagram by explaining that by using JIT, companies can cut the costs of inventory holding. In eliminating as much waste costs as possible and holding as little stock on site as feasible, this results in minimising inventory costs as a whole. Davy *et al.* (1992) had previously considered that reducing inventory costs are all possible outcomes of meeting those goals. Clear and realistic objectives need to be supported by business processes underpinning the cost-effectiveness of the value chain (McGuffog, 2011).

Natarajan and Goyal (1994) considered that lot sizes are reduced through JIT implementation. This means that companies need to ensure they are always prepared to absorb any last minute fluctuations in demand.

Alternburg *et al.* (1999) advised us that a very small holdup in the supply chain can bring production facilities to a halt. This is still a disadvantage today, as Zandieh *et al.* (2010) advises us that with JIT, due to the specific delivery slots at the customer, any glitch that would lead to an early or late delivery, would lead to "tardiness costs" or an "earliness penalty".

Gonzalez-Benito (2002) explains that JIT purchasing is not applicable in just any circumstances; its implementation responds to particular factors. Mishra (2009, p. 173)



Note: Allow stock to fall to zero as no time needed to replenish stock

Figure 1.

agrees with this and explains that "no two JIT are the same – they vary according to the places and conditions in which they are being applied". For instance, JIT may not be suitable for a company who delivers a small quantity of orders to a customer who is located in a different country. Yasin *et al.* (2004) consider that some companies are resisting the adoption of JIT within their operations because they simply feel it would not suit their business environment. It is not sufficient just to make the decision to implement JIT and then let events run their course (Kazazi, 1994). Fitzgerald (1999) argued that far too many companies begin to introduce JIT without a comprehensive plan that includes all affected links of the supply chain. These factors include "length of set-up time, the physical size of the parts and, in the case of suppliers, the distance involved" (Hill, 2000).

Supply chain JIT integration between VM's and their suppliers is crucial in eliminating waste and improving efficiency (Gourley, 1998). Moreover, JIT can help to enhance the relationship with the customer, as they work more closely together (Parvatiyar and Sheth, 2001).

Once companies have adopted and mastered JIT, there are several ways they can measure their performance and maximise efficiency. They may find it helpful to analysis their "takt" times during the planning process; takt time being the planned time between completion of units in a production system (Sheridan, 1999). Measuring this would help to increase the rate of movement and speed up flows of material.

Linked with the JIT philosophy is the concept of lean manufacturing. Davidson informs us that lean-manufacturing techniques were pioneered by Toyota in the late 1980s as a reduction of waste and elimination of steps that do not provide customers value. According to Hassler (2008) being lean aims for the complete elimination of waste and mistakes with continual enhancement of the process. There is also more emphasis in recent years on company's becoming agile. Pullin (2001) advises us that the original concept of agility was perceived to be the need to introduce multi-task processes. More recently however, Ramesh and Devadasan (2007) describe being agility as being capable within the manufacturing operation to respond rapidly to the market demands. Mason-Jones *et al.* (2000) identified leanness as a means of developing the value stream to remove all waste and ineffective time to achieve a level schedule.

JIT II, conceived and implemented by the Bose Corporation in 1987 (Dixon, 1999), is a customer-supplier partnership concept that is practiced by many companies and their suppliers. It helps with cutting both design and response lead time to a minimum. The JIT II concept has only emerged over the last two decades where Pragman (1996) described JIT II as a supply chain partnership that reduces lead times in time-based situations. More recently, Green *et al.* explain that JIT II gives empowerment to on site supplier employees to fully integrate into the purchasing decision process. With JIT II there is an employee from the supplier in-house with the customer. It is a deviation to the regular JIT, where there is much more emphasis on the relationship between the supplier and the customer. This employee keeps a record on stock and orders supplier deliveries when necessary thus allowing sequential and synchronous delivery to be effective.

1.4 Synchronous and sequence supply

With the "Just in Sequence" method, components and parts arrive at the customer's production line exactly at the time scheduled before they are assembled. This method

allows organisations to eliminate buffer stocks to a minimum, therefore reducing waste costs. By delivering in sequence, Werner *et al.* (2003) suggest that it adds further efficiency to JIT delivery.

Synchronous supply is also used by organisations as part of the JIT philosophy. Doran (2001) suggest that whilst synchronous supply results in notable benefits for both buyer and supplier, the journey to achieving synchronicity is difficult and such a supply system may be limited to the supply of a small number of key components or high value component systems. Doran (2002) further explains that synchronous supply matches components and assemblies exactly to the production requirements and location for the buyer. Using the automotive industry as the example, a supplier would deliver the exact variation of product matching each individual car on the customer's production line. Synchronous supply therefore necessitates superior planning and control to enforce 100 per cent customer requirements (Bennett and O'Kane, 2006; Bennett and Klug, 2012).

2. Research method

An exploratory research design was adopted which comprised of a multi-method approach to understand the different forms of associated supply (Yin, 2003). The data and insight for this multiple case approach comes in part from the literature review of research and practitioner papers. In addition, studies to survey logistics integration models and practice have been used. To undertake an in-depth study the sample size was restricted to seven information rich cases. A case approach requires a combination of rigour, relevance and pragmatism (Darke *et al.*, 1998). The choice for the seven interviewed cases was opportunistic and determined by access to the respective facilities as one of the authors had spent 12 months working within a supplier directly connected to the network under study. The primary study comprises of seven site-specific surveys of logistics and operations executives within the said network of UK automotive suppliers, and a UK VM. The intention here was to gain a reality understanding as to what is actually happening within the case study network investigated.

This research considers a deductive approach via a route of theory, method, data and findings. Saunders *et al.* (2009) explains how practical considerations such as access to data, resources and the time available impact upon the research methods chosen, however, case studies are desired by researchers who need to define broad research topics (Yin, 2003). This applies to this research because JIT is a well-known term that is adopted by many organisations in many industries, so it is appropriate to narrow the focus to a case study perspective.

The author acts as an interpretive independent researcher for this paper as they worked within the case study organisation full time for one year. Therefore the data collection is judged as ethnography, as the researcher is participating through having worked with the subjects and within the automotive culture, watching what happens at the OEM (Hammersley, 2007).

Interviews were selected as the method for gathering primary data and a semi-structured guide of questions was produced from a detailed literature review to allow for a degree of comparability but also allowing for opportunities for a flow of narration. The interviews lasted between 1 and 2.5 hours and were conducted face-to-face and were taped and transcribed to ensure reliability and traceability of the data. The transcriptions were later validated by the interviewee's and confirmed as a true record. This ensured that an accurate record was kept. The questions were derived

from common themes born from the literature review. To complement the interviews, the respondents were contacted via telephone and e-mail to follow up for clarity any issues ambiguities and anomalies that arose from the interviews. Focus groups were considered but were not chosen because it was felt that if all participants were gathered together, their answers may not have been as open in front of others. At the interviews, the author had in front of them a copy of the template of questions that were going to be asked along with an interview guide. This ensured the researcher covered and focused on all relevant questions.

3. Research boundaries and constraints

3.1 Introduction to the main case study organisation: Manufacturer F

This company will be referred to in the paper as Manufacturer F.

Manufacturer F is a global automotive Tier 1 supplier that provides engineering solutions and automotive components. It has approximately 62,000 employees in 32 countries with 200 production sites and 32 research and development centres. Three of the production sites are in the UK, including the plant this study is focused on.

Manufacturer F is the fifth-largest automotive supplier and partners with the majority of the world's automakers. They manufacture for four business groups; automotive seating, emissions control technologies, interior systems and automotive exteriors. As a company they are recognised for their efficient programme management and they try to draw on innovation and technology to optimise performance.

This research discusses JIT management at Manufacturer F where they become the hub of this research regarding their outbound supply to their main VM customer, considering the possibility of making more inbound supply JIT. Manufacturer F supplies to three VMs, with the main customer VM1 (considered in this research) accounting for 80 per cent of F's overall business. This VM is 5.6 km away from the manufacturing facility at F. For this reason, Manufacturer F is able to synchronously deliver to the point of VM fit, up to 48 times per day. They can do this within 30 minute time slots, operating on a JIT basis. Moreover, they deliver parts in the right quantity, at the expected time, to the exact fit point on this customer's production line.

Manufacturer F is required to hold adequate stock levels in order to avoid risk of stopping the customer's production line. It is a key aim for F to never stop the line because not only does it have a substantial financial penalty of £20,000 per minute of down-time, but it severely damages customer relationships, thus jeopardising future chances of business opportunities.

Due to customer needs and the aim to maintain a strong relationship with them, along with Manufacturer F's group expectation for each plant to drive down costs, Manufacturer F have many pressures encouraging them to control their logistics activities effectively. Quality is one of the most critical aspects for the strategic management of service firms such as transport and logistics companies (Zunder, 2010, p. 30), and the link between supply chain and customer relationship management is critical.

3.2 Data collection

When selecting people to be interviewed, the selection process for any research project can be a complex issue in qualitative research (Coyne, 2008). Seven respondents were

chosen due to their position in the industry and their relation to the VM case study organisation and their socioeconomic status.

The first interviewee was the Logistics Controller at Manufacturer F and referred to in this research as F1. They are responsible for organising all inbound logistics and transport for inbound supply.

The next subject is a Production Supervisor at Manufacturer F and referred to as F2. They have management responsibilities for overseeing and organising the production of all products at the plant.

The third person interviewed was the Autonomous Logistics Unit Supervisor at Manufacturer F, referred to as F3. This person is in control of the transport of finished goods between the plant and the customers. They are responsible for daily sequence operations and dispatch.

The next three subjects represent three different suppliers to Manufacturer F. These respondents are referred to as S1, S2 and S3. They were chosen as a sample of the suppliers that deliver to Manufacturer F. They currently deliver to F in different ways.

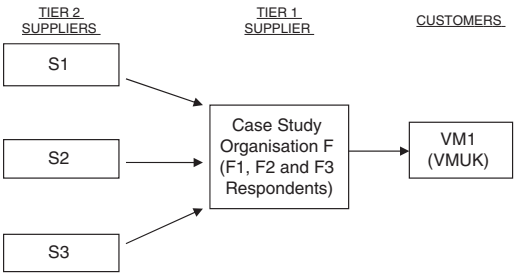
The final subject, F's main VM customer, is referred to as VM1. Their plant is within close proximity to F and requires all deliveries to be received on a JIT basis. The diagram below shows a brief outline of the area of the supply chain the interviewees come from in relation to the case study organisation (Figure 2).

4. Findings from the supply chain

The findings for this research were born from application of the research method that was explained in the previous section. As identified, interviews were carried out as a method of primary data collection. Three of the interviews, F1; F2 and F3 were carried out in person during March 2011 through visit's to the location of the case study organisation. All of these interviews were recorded using a Dictaphone. The remaining four interviews were sent and returned electronically via e-mail.

Themes/codes were chosen by the authors' as main topics identified from the literature review. For example, different author's advised their definition of JIT II, and the interviewees gave their interpretation, so now all data can be compared to see whether there is a relationship between the definitions.

These quotes had to be linked to the theme/code. Some themes/codes, such as "Use JIT with F?" only applied to certain people. In this example only the interviewees from outside F, including suppliers and VMUK applied.



Source: Author

Figure 2. Positions in the supply chain

4.1 Critical analysis

An analysis was conducted to identify any patterns across the data. The search was set for any similar answers or answers that contradicted one another and aimed to establish whether what the interviewees were saying corresponded to what the literature review stated, and whether the respondents were up to date with their definitions. Key words used across the answers were identified. This helped show a level of common knowledge. For example, in relation to the theme on lean interpretation, there was a common thread of terms used relating to reducing waste. These terms included: "minimal", "eliminate", "lowest" and "constrained" in relation to "waste", "resources" and "inventory"; showing a common understanding of the term lean.

Another example, "Advantages of JIT", the authors' looked for common words used and found that every data source referred to the advantage of waste and inventory reduction. Out of the data sources (including the seven interviewees), 90 per cent referred in some way to the advantage of reduced inventories. The following words and synonyms that were used are shown in Table I.

This shows a common interpretation of the advantages that can be gained from JIT, and it shows that the interviewees are up to date with the literature.

After studying the analysis, comparisons can be made across the answers each person and author provided and collated findings to highlight any links. In relation to the general interpretation of the term "JIT", all interviewees have the same basic idea on the topic. They all know what the acronym represents and across the answers there was frequent mention of waste elimination and getting supply in the right place at the right time. Due to the nature of this theme/code, it only applied to F1, F2 and F3 respondents, and the VMUK respondent. An important finding showed that F does deliver JIT to VMUK, and two of the suppliers, S2 and S3 deliver JIT, whilst S1 does not. Due to the differing answers, the questions were re-emphasised so that the authors' could find out the reasons for their reply. With this information, along with other findings from F1's interview the authors' started to consider why only some suppliers deliver JIT, and relate back to the initial focus, to see if there is scope to increase the current level. When asked why S1 (see Figure 1) does not deliver JIT, they explained that it is due to the nature and configuration of the product.

4.1.1 Advantages of JIT. As mentioned in the critical analysis, every interviewee and all three selected respondents made reference in some respect to the fact JIT lowers inventory/stock levels. This shows a common knowledge on how JIT affects inventory.

4.1.2 Disadvantages of JIT. The respondents consider that there is a level of risk associated with JIT in the sense that if there are any slight errors in schedule or delivery, internally or externally within a supply chain, it can lead to difficulties in timely supply. Although it may be argued that these types of difficulties would be present in any form of supply, it is more of a risk with JIT due to the shorter lead times available to react to the issue.

Table I.
Term frequency

Term	Frequency used
Reduced	2
Less/lower	3
Minimum/minimised	2
Cut/decreased	2

4.1.3 Interpretation of lean and agile. The next consideration was the respondents' interpretation of the terms "lean" and "agile". The authors' chose to look at these concepts because they are both qualities that businesses strive for in order to be efficient in production, particularly with JIT. The literature review informed us that although the two terms are similar in nature, and can be used together; there is a distinct difference between their definitions. However, this concept did not seem clear in reality with some of the interviewees. For instance, F1 answered the question on lean and agile as a whole, and did not refer to the two topics individually.

In relation to other respondents' answers, F3, S2 and S3 all referred in some respect to the need with agile to react quickly to customer needs and demand changes. This was also identified by Pullin (2001), Ramesh and Devadasan (2007) and Bennett and Klug (2009). Controversially, other interviewees such as F2 did not have an understanding of the term agile.

In relation to lean, there was a clear link across all of the answers given. Terms were used such as "minimal", "eliminate", "lowest" and "constrained" in relation to "waste", "resources" and "inventory", showing a common understanding of the term lean. The consideration is whether this tied up with the definitions the literature was providing. Phrases found in definitions by Mason-Jones, Hassler (2008) and Davidson also used common terms such as "reduce" and "eliminate" in relation to waste. This is a positive finding as it shows that all interviewees are up to date in relation to the term lean.

4.1.4 Interpretation of JIT II. The literature informed us that JIT II is a relatively new concept that has been developed in recent decades (Bennett and Klug, 2012). Referring to the primary research analysis, it seems that there is a clear lack of knowledge of this terminology. Although it was found earlier that each person had a sound level of knowledge on JIT, it seems that JIT II is something that has not fully been recognised. Three of the interviewees, including the contact from VMUK, showed limited, if any, understanding of the term. However, the other four respondents showed recognition that the term involved an employee of the supplier being in-house with the customer. This concurred with what Green *et al.* identified.

The majority of interviewees, in comparison with the literature review, answered that they feel JIT is a customer relationship enhancing activity. Conflicting with this, S1 did not feel the same. They felt that it does not always enhance the relationship, especially if the demand time becomes greater than the best production time.

4.1.5 Synchronous and sequence supply. The authors' chose to ask about synchronous and sequence supply because they are both delivery methods that can be adopted for JIT supply. There seemed to be a lack of clarity across some interview answers in relation to distinct definitions of the terms. However, there was a clear link between the answers and the literature in the sense that there was frequent mention of delivering to exact requirements, in a certain order, to point of fit.

5. Conclusions

Some of the generic findings are summarised in Table II.

From the interviews it was found that Manufacturer F does use JIT II in a minor respect, as they have team members on the VM's site taking final parts to the point of fit at the customer. Moreover, Manufacturer F could take this a step further and consider suggesting the placement of a member of staff at the customer full-time,

helping the integration of synchronous parts ordering. This would improve the relationship with the customer, as more direct contact and interaction would be made.

It must be concluded as to whether there is scope for an increase of inbound JIT supply to F. It was found from the interview with F1 that currently only 17 per cent of inbound supply is JIT (Figure 3).

From questions asked to other interviewees, it seems that there are several factors stopping more companies from delivering JIT; whilst there are also a few findings indicating that the level of JIT could be increased, such as it helps to enhance the customer relationship.

From an unfavourable perspective, although in the literature the concept of JIT is very significant and it seems to be looked upon as something all firms should consider adopting, it is not always the ideal solution. The VMUK plant is seen as one of the most efficient vehicle manufacturing plants in Europe and also a world class manufacturer comparable with manufacturing facilities in Japan (Bennett and O'Kane, 2006). After interviewing the respondent at VMUK the authors' feel their standards could be seen as a benchmark for their suppliers to work towards; Manufacturer F being one of them.

However, having found from the interview with VMUK that only 12 out of their 302 suppliers within the UK and Europe deliver JIT, it puts this into perspective. The VMUK respondent advised that they used JIT only for this number of suppliers due to the commodities they supply, and all of the JIT suppliers are typically located within a 12 mile radius of the VMUK manufacturing site. This informs the authors' that from a perspective of VMUK, F's main customer, there is not necessarily a required need to increase JIT supply; it is just something that should be done if the environment of an individual supplier is suitable. Moreover, for suppliers such as S1 who do not deliver JIT due to the nature of what they supply, there is not a necessity for it to become JIT.

Table II.
Summary of key findings

Item	Finding
JIT	Common understanding of terminology
Advantage of JIT	Reduction in operational costs
Disadvantage of JIT	Risk to production
JIT II	Lack of understanding of concept

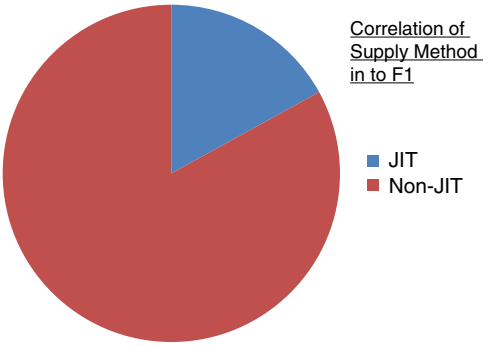


Figure 3.
Comparison of supply method in to F1

Source: Author

To conclude, although authors such as Hannon (2003) claimed that due to the pace that a vehicle manufacture builds its products, a constant stream of JIT supply is required to keep production lines running, this is not necessarily the case identified in this research where the requirement of JIT is based on many factors. As identified from this research, it seems that the opposing views to Hannon (2003), such as those given by Gonzalez-Benito (2002) and Mishra (2009), suggesting that JIT is dependent on the circumstances, are more logical. Therefore, Manufacturer F should not feel the need to increase JIT inbound supply unless the factors are suitable.

Relating back to the initial aim of this research, the authors' have found that there is scope to increase the level of inbound JIT supply to Manufacturer F, yet it is not necessary and it is dependent on numerous factors. Manufacturer F informed the authors' that they have ten suppliers throughout the UK that deliver either once a week or once a month (six weekly, four monthly). Referring back to the initial research objectives, the level of inbound JIT could potentially be increased with these suppliers. There are several options that could be considered.

First, for those suppliers who currently only deliver to F once or twice a week and are located within the UK, such as S3, F should look at the cost effects of daily delivery to those companies. From one of the authors' knowledge gained from working at the firm F, one supplier that is located in France delivers daily to F, so there is an identified scope to look at UK suppliers, within closer proximity to F, to match this delivery frequency. This would add value to F's supply network because more frequent deliveries would translate to fewer inventories on site at any one time.

A second option would also involve those UK suppliers who currently only deliver once or twice per week. A milk run could be developed across these suppliers. This would help reduce the level of inventories coming in at one time, and would help maximise the truck fulfilment. However, a limitation here is that it would depend again on the type of product being delivered. Moreover, it would be difficult to deliver pallets of material on the same load as a flammable liquid.

A third option to increase JIT supply would be to create synergies with other VMUK Tier One suppliers in the area, who have the same Tier Two suppliers as F. This may be a reliable option because you would have the comfort of knowing that these potential partners would have the same level of urgency with deliveries and would know exactly what service level VMUK expect. Another advantage here is that the suppliers involved could share each other's best practises and learn from each other as an association. Controversially, a risk may be that it would involve a higher level of management, and if a mistake was made by one of the other companies, they would feel the effect, and vice versa.

Another option could be considered in relation to the six UK suppliers who currently deliver weekly to F. They could potentially implement a cross-stock facility shared by these six suppliers, so that mixed, more frequent deliveries could take place. This has the potential to increase the current JIT percentage into F from 17 per cent to above 35 per cent. Overall, it would also reduce inventory levels and consequently save costs. The drawback with this option would be the initial start-up and organising costs of the cross-stock facility.

Finally, similar to the above option, there would be the consideration to create a platform for monthly suppliers, so that a bulk amount of stock from each one could be stored in a facility and called off as and when needed. Again, this would dramatically reduce the level of inventory, as previously it would be delivered in larger amounts, 12 times per year, yet it would have the potential to be delivered multiple times.

Ultimately, the decision of whether to implement any of the above options is in the hands of managers at Manufacturer F. From a literature review consideration it is clear that Manufacturer F is a successful organisation, so it raises the question of why such recommendations have not previously been implemented, perhaps because this research uncovers the possibilities first. However, the decision should be made in order to get the cost balance right.

It would not be a simple decision, as it was found from this research that delivering JIT is a dependable concept based on many factors. VMUK highlighted that their JIT suppliers are JIT due to the commodity they supply and their location proximity to VMUK, so Manufacturer F would need to consider this in their calculations.

This research has been successful in addressing the initial aims and objectives, but some limitations need to be considered. First, the size constraint of the work which must be considered as a case study focusing on the theory and practice interface into UK automotive industry JIT practice. This limited the research to certain boundaries, only allowing a certain level of depth and might be considered as an initial study. Effectively, the sample of participants and the focus centred on one network hub supplier location was limited which shows the future requirement for further exploration over an expanded selection of suppliers.

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