

QUANTIFYING THE LEAN VALUE NETWORK SYSTEM; THE LEAN METRICS OF CO-INVESTMENT AND CO-INNOVATION ON ORGANISATION LEVEL

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ABSTRACT

Research about lean has been mainly focused on process or product innovation. Innovation should not only be applied on product level but also on the way the value chain and system are organised. This research takes the lean principles to a higher aggregation; to an organisation level. Adoption of lean principles and the 3C model – value chain innovation process – throughout the whole organisation should improve a company's financial performance. By quantification of the lean enterprise on organisation level it is possible to point out the advantages of a lean organisation to a company's baseline and its lean value network system. Financial data of companies from various industries has been analysed and compared to the configuration of their value chain. As the value chain of a company is more canted this indicates the sophistication of lean within the enterprise. This should show in an improved financial performance of the company.

Keywords:

Lean metrics, Value network system, Co-innovation

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INTRODUCTION

In order to stay afloat in the current dynamic markets it is of utmost importance to anticipate in time on the market developments. The development of appropriate products is the key to ensure continuity of business. The goal of a company is to make money; money is made by simultaneously increasing Throughput, decreasing Inventory and decreasing Operational Expenses (Goldratt, 1986). As the time to market can be minimized by cooperation with other companies, one can see that companies more often work together on the development of new products and even share the investment risk. The process describing this co-innovation throughout the value chain is modelled by Beelaerts (2006) by the 3C model. Beelaerts identified three aspects that drive the innovation process.

These aspects are:

- Continuation: defines the demand where a company can add value.
- Conception: unique technology or smart and original processes, supported by Intellectual Property (IP) in cooperation with co-innovation parties, based upon the customer demand.
- Configuration: formation of a chain, system or network of stakeholders that have interest in bringing the new product to market.

As such this co-innovation and co-investment can be seen as drivers for a sustainable position in the market place.

The traditional value chain is gradually changing under the influence of the growing importance of innovation of products and processes. The value adding activities of many companies, and especially those which introduced lean principles within their organisations, do not include the primary activities as defined by Porter (1985) anymore. These developments should also show in the financial results of a company. Up till now research about lean has been mainly focused on process or product innovation and improvement. This research takes the lean principles to a higher aggregation; on an organisational level. Adoption of lean principles and the 3C model throughout the whole organisation should improve a company's financial performance. This leads to the following research question:

How can the leanness of a company be quantified in the context of the lean value network system?

To answer this question financial data of companies from various industries will be analysed and compared to the configuration of their value chain. The vast majority of companies gauge their

performance using systems that measure internal financial results – systems based on metrics that do not take sufficient notice of the real engines of wealth creation today: the knowledge, relationships, reputations, and other intangibles created by talented people and represented by investments in such activities as R&D, marketing, and training (Bryan, 2007). For companies that have chosen the lean journey, it is important that their accounting, control, and measurement methods change substantially (Maskell & Kennedy, 2007).

The structure of this paper is as follows. First the theoretical framework is presented, followed by case studies of the metrics from industry (car manufactures, aircraft manufactures and airlines), after which the preliminary conclusions will be discussed.

CANTING VALUE CHAIN

Nowadays most advanced industrial companies manufacture and/or supply a wide range of product varieties for ever smaller market segments, because technology enables them to get closer and closer to the needs of their particular clients (Asseldonk, 1998). This is completely in line with the lean philosophy where a company has a strong customer focus and moves more toward the end of the whole value chain in order to meet the (end) customer demand.

The traditional value chain is based upon mass production, focussed on efficiency as the main value generator. In this respect, the value chain as defined by Porter (1985) and its value system are primarily based upon push. However, the lean value chain is build around pull and as can be seen in figure 1 aims to facilitate mass individualization by focussing on differentiation. The evolution matrix is a theoretical approach to the evolution phase of a company.

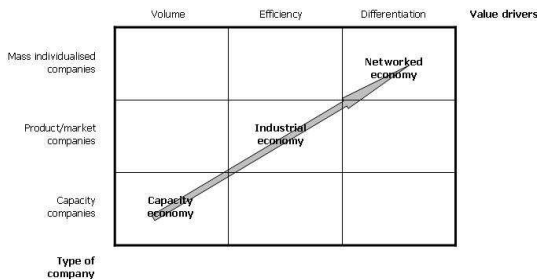


Figure 1 - Business Evolution Matrix, Source - adapted from Asseldonk (1998)

There have been many authors who have studied processes around innovations in value chains. The theory of the concept of co-innovation, devised by Beelaerts (2006), is a perspective on value chain innovation based on a combination of six publications (Chesbrough, Prahalad & Ramaswamy, Leifer, Porter, Von Hippel, Moore) on the relation between the value chain and innovation. Benefits and drawbacks of co-innovation have been explored and supported by qualitative data (Bossink, 2002; Odenthal et al., 2004). However quantifiable research on co-innovation is still under developed. For any business, ‘continuity’ is of primary importance. To achieve continuity a company needs customers who purchase their products or services on a regular basis – Pull. Business starts with customers and it is therefore essential to know your customers and to have a strong focus on customer desire. The customer can be seen as a part of the value chain (Prahalad & Ramaswamy, 2004). The needs and desires of the customer can be used as input for the development of new products or services (Von Hippel, 2005). Supported by the Intellectual Property (IP) shared with partners unique technologies and smart processes can be developed for the development of new products and services or ‘conception’ – Value. The third driver, ‘configuration’, is of organisational nature. Early involvement of suppliers and forging partnerships seems to provide significant reductions in risk, costs and development time (Zsidisin & Smith, 2004, 2005). For partnerships to benefit from the two above mentioned drivers it is necessary to organise the development process well and to collaborate with investment and risk sharing partners in order to create and accelerate added value. In co-innovation investment and risk sharing partners are involved in the development of new products or services from the very start. Prime contractors or integrators are seeking partnerships with their suppliers as they view partnerships as an alternative to “make” in the “make or buy” decision. In addition partnerships can be seen as an alternative for vertical integration (Leenders et al., 2006). Characteristics of these enhanced partnerships are researched by Lamming (1993) and Tidd et al. (2001). They identified that partnerships are developed to reduce the supply base for the main contractor, to involve partners in the development of products, to increase cost transparency and learn together.

The ability of the focal company to multiply the innovation investments and its production share over the partners is expressed by the Innovation Investment Multiplier (IMP) and Production Multiplier (PMP) respectively (Beelaerts, 2006, 2008). They are defined as the total innovation investment or total production divided by the investment or production share of the innovator. The effects thereof result in a change in Market Share (ΔMS) of that product. Lean is the logical next step in already known methods for work process tracking and improvement as Total Quality Management (TQM) and Six Sigma. This process of introducing lean principles can be applied beyond company borders. As such the whole supply chain from supplier to the end customer should be seen as one integrated system. Traditionally lean was only focused on production. However, it does not make sense to only have a lean production when the rest of the organisation is not. Especially when one realises that production is just one link in a company's value chain. Karlsson and Åhlström (1996) state that the lean enterprise consists of the following four elements:

1. Lean development: supplier involvement, cross-functional teams, simultaneous engineering, integration instated of coordination, strategic management and black-box engineering.
2. Lean procurement: supplier hierarchies and larger subsystems from fewer suppliers.

3. Lean manufacturing: elimination of waste, continuous improvement, multifunctional teams, vertical information systems, decentralised responsibilities and pull instead of push.
4. Lean distribution: lean buffers, customer involvement and aggressive marketing.

Lean thinking places 'optimizing the total value' instead of 'minimizing the cost' as the main goal. Within lean cost cutting has to be seen in perspective of eliminating non value adding activities (Womack & Jones, 1996). Within the lean philosophy TQM and Six Sigma are strategies that are frequently applied. Six Sigma has proven to be one of the most emerging business strategies in the 21st Century for accelerating innovation and continuous improvement activities in both manufacturing and service environments for achieving both operational and business excellence (Anthony, 2007). A lean organisation is a more flexible and a more adaptive organisation (Murman et al., 2002) with respect to its environment.

In order to achieve a lean organisation all business processes have to be re-assessed on their value addition and changed if necessary, i.e. the company processes have to be innovated. Application of lean principles and projection of the 3C model onto the value chain redefines the traditional Porter value chain (see figure 2).

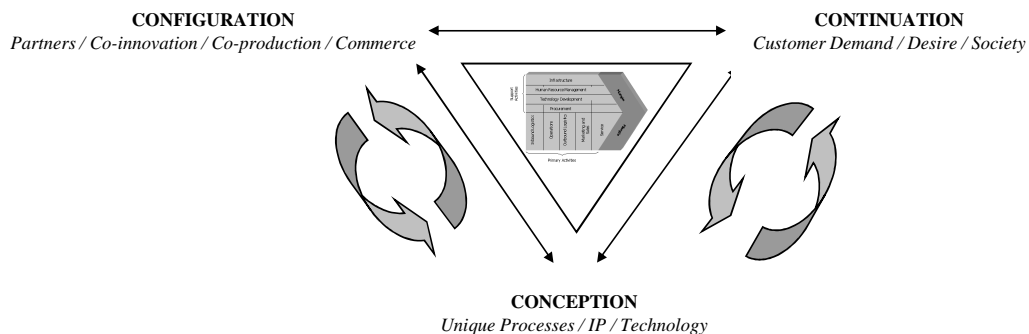


Figure 2 - Value Chain Innovation Processes

Identifying value activities requires the isolation of activities that are technologically and strategically distinct (Porter, 1985). Activities that have strategic implications for a company are classified as primary activities in the value chain. Applying lean principles (Womack & Jones, 1996) – specify value, identify the value stream, product

flow, customer pull, pursue perfection – to the company's primary activities can result in the conclusion that some activities do not add significant value to the chain. They actually become supporting activities or are not being carried out in-house at all anymore. One can also realize that activities that previously have been

termed as supporting activities have become much more important and now do add significant value to the chain. In the past, the time of capacity economy (see figure 1), the ratio of value addition between the primary and supportive activities was generally 80/20 (Pareto). Nowadays however, in the time of a networked economy (see figure 1), it is observed that this is the other way around where especially Procurement and Technology Development are the new value generators.

From case studies performed by the authors it is found that an increasing number of companies do not include the traditional primary activities in their value chain anymore since those activities are no longer the company's value generators. One can now re-arrange the activities into the lean value chain. Re-arranging the activities is a first step in the value chain innovation process.

As one of the aspects upon which the lean philosophy is based is pull and customer focus, every activity upstream the value chain is initiated by downstream demand or derived demand; that is, the demand for products and services is derived from the demand for a customer's products and services (Dwyer, 2002). Therefore, the first activity in a lean value chain should be Marketing – defining the demand – and Sales – facilitating the pull.

Scaling down the number of suppliers is also a consequence of the lean process. The effect of re-designing processes with value added focus is mostly the reduction of own manufacturing activities (Arnold, 2000). There is a shift from many to just a few (strategic) suppliers (Kraljic, 1983). When elaborated and tailored, Kraljic's portfolio approach, allows for sufficient guidance for developing effective purchasing and supplier strategies (Gelderman & Van Weele, 2002). New insights into the relationship between the usage of portfolio models and purchasing sophistication are provided by Gelderman and Van Weele (2005). Purchasing sophistication is defined as the level of professionalism and the position of the purchasing function within companies. The results of the recent studies clearly underline the importance that a purchasing function is urged to possess strategic purchasing skills. (Feisel, Hartman, Schober, 2007). In an increasing number of companies a chief purchasing officer (CPO) is appointed. Purchasing skills and function respectively, have not only been related to purchasing performance,

but also to the firms performance as a whole and have been proven to affect both (Carr & Smeltzer, 2000; Carr & Pearson 2002; Cousins et al., 2006; Eltantawy, 2005; Stolle et al. 2006). The time focus of the purchaser can also be seen as an indicator for the weight of the purchasing function, i.e. short vs. long-term strategic. Adopting a portfolio approach could work as a catalyst for change within the company (Gelderman & Van Weele, 2005). The shift to strategic suppliers/partners involves a much tighter cooperation between the companies (Van Weele, 2005). As such supply management elevates from an operational function to an integral part of business strategy (Niezen & Weller, 2006). The world class purchasing function is represented by developing and implementing commodity strategies and supply management as a core competence. (Burt, Dobler, Starling, 2003). Purchasing and supply management practices can be the source of not only cost savings but also of other competitive advantages (Chapman et. al., 1998), providing the purchasing function with the opportunity to become the next big lever in cost reduction and value creation (Das & Narasimhan, 2000). Therefore the Supply Network Management function has become a primary activity that involves strategic procurement, supply network process integration and intensive relationship management with partnering companies.

Furthermore, it can be observed that currently industries are so strained that real profit can only be made through an innovative approach to products and business processes. Zegveld (2006) argues that although technology is a relevant aspect of corporate change and corporate success, technology itself has no value; it is the context of its application that generates value and competitive advantage. Technology has an extensive impact on the society and economy, and the organisation's ability to continuously innovate its products and business model is essential to the future success (Menzel, Aaltio, Ulijn, 2007). Andrew and Sirkin (2007) state that true innovation must lead directly or indirectly to increased profits. There is a big difference between an idea and an innovation; it is called cash. The ultimate in executive engagement towards innovation is the appointment of a CIO; the chief innovation officer (George, Works, Watson-Hemphill, 2005). The goal of a company is to make money (Goldratt, 1986) and to ensure that it will continue to make money. It is now fair

to say that the process of turning technology into business is a primary activity.

The two primary activities of Operations and Services remain unchanged. As Porter (1985) states, Operations are activities associated with transforming inputs into the final product form and Services are activities associated with providing service to enhance or maintain the value of the product. By definition operations and services are value-adding processes and remain important value generators to a company.

It can be observed that the importance of the traditional primary activities Inbound and Outbound Logistics is growing. However, they are inherently integrated in the expanding importance

and coverage of the activities of Supply Network Management, Technology Development and the application of lean principles through processes such as JIT and build-to-order. Therefore, the stand-alone primary activities Inbound and Outbound Logistics as such are disappearing. This can be seen by the enormous growth of specialised logistics companies like DHL, FedEx and UPS. Cisco Systems is an example of a company that has completely outsourced their logistic activities. Nevertheless, there will always be inbound and outbound operations necessary as a support function to the new primary activities. In figure 3a the re-arranged value chain is presented.

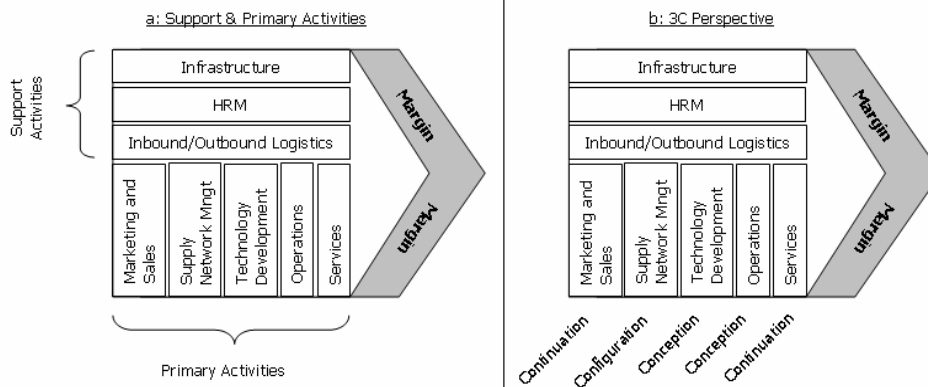


Figure 3 - Canted Value Chain

As one rethinks the new primary activities in the re-arranged canted value chain and reflects on them from a 3C model perspective, the classification as presented in figure 3b can be discerned. Marketing and Sales can be seen as part of the continuation process; defining the demand where value can be added and selling what has been demanded by customers. Supply Network Management is involved with the integration of processes in the value system. It can be seen as an activity part of the configuration process; forming a supply chain or network of business partners. The development of new Technologies and Operations is what is actually defined by the conception process; creating new technologies or smart and unique processes. Services involve after-sales activities that concern retaining and tying in customers. They can be seen as part of the continuation process as they are customer oriented

and thus contribute to ensure continuity of business.

Now regrouping these primary activities leads to the situation presented in figure 4. The authors suggest that the ultimate lean value chain consists of exactly the three innovation drivers, namely continuation, conception and configuration. As such one could argue that a sustainable position in the market can be obtained and maintained by continuous innovation. Prahalad acknowledged already in 1993 that innovation is the fundamental job of a general manager. Changes in the value chain of a company will eventually have an effect on the whole value system. This entails that the way the partners in the value system work will have to change too, which in turn has an effect on the inter-organizational relationships between the partnering companies. Van Weele (2005) says in this respect that the dyadic relationship between

supplier and manufacturer is not only influenced by the characteristics of the product and the involved organisations, but also by the relationship between these organisations and other organisations which are part of the supplier network.

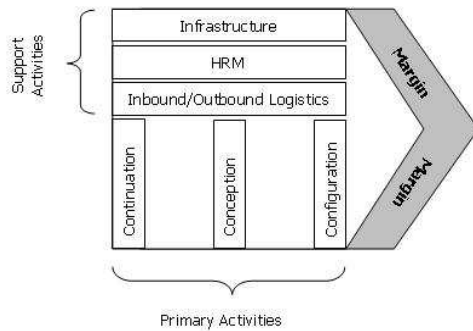


Figure 4 - The Lean Value Chain

The other way around, changes in the value system also influence the value chain. As the value system is dynamic and changes, the value chain is reconfigured in order to anticipate on the developments of the environment. Ideally, this interaction would then have been achieved through cooperation, co-innovation and co-investment. The effects of the changes in the value chain extend further than company borders. Using the traditional position of a company within its value system could be illustrated by figure 5. On the supply side there is a configuration of multiple partners willing to participate with the initiating company. On the demand side the products or services are being distributed ensuring continuation of business.

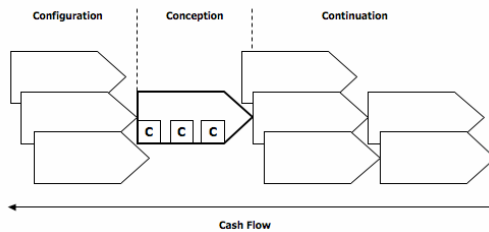


Figure 5 - Lean Value System

In accordance with Zegveld (2006), the authors argue that when the value chain evolves, the value system should also change. In a networked economy (figure 1) the value chain is part of a lean value network system as illustrated in (figure 6).

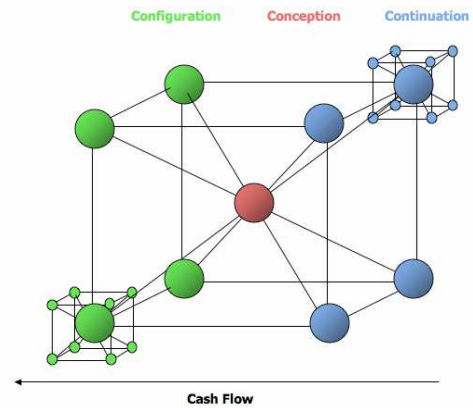


Figure 6 - The Lean Value Network System

Major companies pursuing several, often interrelated, businesses are generally involved in many strategic nets, either in an integrator role (hub firm) or in various partnering roles for other hub firms e.g. technology partner, component supplier, distributor partner (Möller & Svahn, 2003). Analysing a company's lean value network system, one can see that information for *Continuation* can be found together with suppliers, customers, consumers and their interaction. The development of new concepts, the *Conception*, occurs together with partnering companies – both from the supply as from the customer side. The *Configuration* of the network system happens together with all partners involved. Möller and Svahn (2003) argue that by developing specific networking capabilities, firms are able not only to transfer complex knowledge, but also co-create new resources through intentional business nets. From an industrial network perspective, interacting with others is the most fundamental activity of a company. Interaction regards how organizations manage the flow of goods and information between them and influences the development in a network structure (Huemer, 2004). A truly lean enterprise would succeed from the points of view of end users, shareholders, the workforce, suppliers and partners, and society (Murman et. al., 2002). The value is being added by the firm on demand of the end-customer, through interaction with suppliers and the (end)-customers. Hewlett Packard is 'making the computer personal again'. Dell interacts on one side closely with the consumer, facilitating build-to-order sales, with the 'purely you' commercials and on the other side Dell capitalizes on the strength of the supplier-consumer interaction to sell its own product; 'Intel inside'. The joint efforts of the consumer and the firm – the firm's extended network and consumer

communities together – are co-creating value through personalised experiences that are unique to each individual consumer (Prahalad & Ramaswamy, 2004).

LEAN METRICS ON ORGANISATION LEVEL

As mentioned above, the bottom line of the lean philosophy is the optimisation of the whole value chain and system. Lean companies are less concerned about the cost of the individual products within the value streams and are more concerned about the costs of the value streams as a whole (Maskell & Kennedy, 2007). Interim results of the

research of Stolle et. al. (2006) indicate that an evolution from purchasing to supply management correlates significantly with a broad set of performance measures. The authors argue that effects of the value chain innovation can be quantified on three levels; lean perspective, product level and organisation level. The value chain innovation drivers (*Continuation, Conception, Configuration*) are directly linked to the performance indicators on these levels (see figure 7).

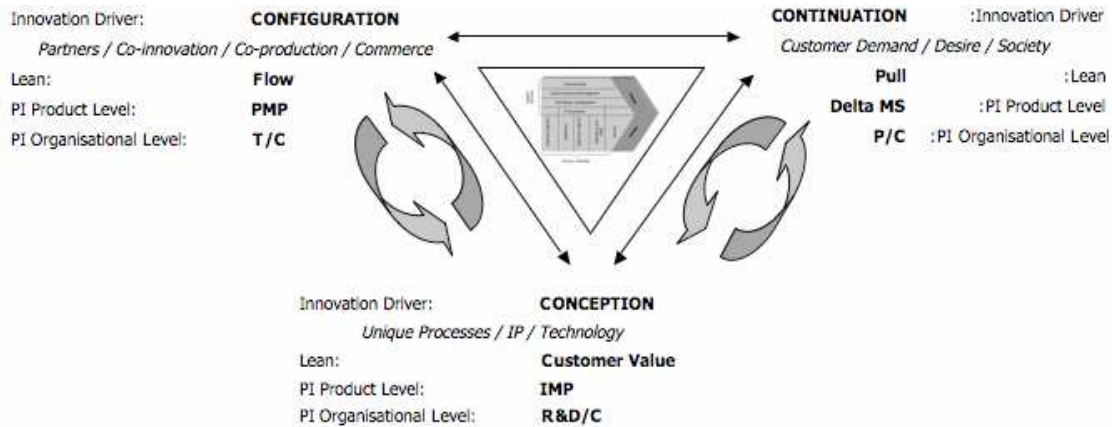


Figure 7 - Lean Metrics of Value Chain Innovation Effects

Lean Perspective

The most important issue with regard to understanding the financial impact of lean transformation is to recognize that lean often does not, in the short term, directly reduce costs very much. However, it eliminates waste and creates additional capacity. The second issue is that there are aspects of lean operations that, in the short term, undermine the company's revenues and profitability (Maskell & Kennedy, 2007). When one looks at the innovation drivers from a lean perspective the following can be discerned:

- Continuation; Customer pull indicates whether the focal firm delivers products or services according to customer demand.
- Conception; Customer value is the degree to which the focal firm, together with co-innovation parties, is able to add value on products or processes. Lean innovation reduces process complexity. Research by Choi (2005)

shows that there is a negative quadratic relationship between complexity and supplier innovation.

- Configuration; Flow indicates the level of sophistication of the value system. The more networked a value system is the faster information and goods can be transferred throughout the system. The concept of JIT can be realised by a decrease in complexity of the system. Choi (2005) has found in this respect that complexity is positively related to the total transaction costs, i.e. if the complexity decreases so do the transaction cost. From a Transaction Cost Economics perspective (Williamson, 1998, 2005) the structure of a firm can be related to the frequency, uncertainty, and asset-specificity of the transactions.

Product Level

The positive results of the formation of a lean value network system on a company's baseline can be quantified by figure 8.

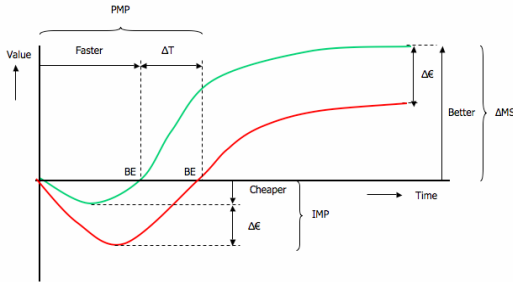


Figure 8 - The Value-Time Curve

Based on quantitative data from the automotive industry, the correlation between the PMP, ΔMS and IMP has been proven by Beelaerts, Verhagen, Santema (2008). They have indeed shown that co-innovation and co-investment on product level have a significant effect on the value-time curve.

- Continuation; Since the product has been co-developed completely according to customer demand, the end product will deliver better value for the end customer. By delivering better customer value an increase in market share can be obtained (ΔMS).
- Conception; Financial leverage is obtained by co-investment in a new or smart product or process; the Investment Multiplier (IMP). The IMP reflects the total amount of innovation investment with respect to the investment of the focal firm. Due to a much lower investment on the side of the focal company, the firm can achieve its breakeven (BE) point much faster than it would in case of financing the innovation by itself; i.e. making the project "cheaper".
- Configuration; Production leverage is gained from the formation of a system of partners; the Production Multiplier (PMP). Leveraging a percentage of the production (PMP) to its partners reduces the complexity of the supply chain.

The innovation investment multiplier (IMP) and the production multiplier (PMP) indeed show that a company can leverage on its value system. The more is leveraged on the value system its own production value declines and so does the organisation around those processes. These developments should also show positive effects in the companies' baselines. In other words: co-

innovation and co-investment effects should also be detectable on organisation level.

Organisation Level

In order to express the gains from organisation improvements and lean efforts on product and process level, the authors have developed suitable financial performance indicators, which in combination with knowledge of that company's value chain can provide insights about the leanness of that company. The authors suggest turnover per capita (T/C), profit per capita (P/C) and R&D budget per capita (R&D/C) as suitable indicators. The metrics T/C, P/C and R&D/C are chosen since they do not require adjustments for accounting conventions. Bryan (2007) states in this respect about profit per employee that since it is based on accounting conventions, companies can easily benchmark it against the comparable results of competitors and other companies.

- Continuation; Profit per capita (P/C); The P/C gives an outlook on a company's ability for business continuity. A high P/C reflects that a company is able to add more customer value. Focusing on creating more value for the customer will, in turn and over time, create even greater value for the owners (Maskell & Kennedy, 2007).
- Conception; The R&D budget per capita (R&D/C) provides information about the importance of technology within an organisation. A high R&D/C indicates the level to which the value chain of the focal firm is canted and a lean value network system is formed. With the formation of a lean network system the R&D/C is an indicator of the ability to leverage on its value system in order to generate innovation.
- Configuration; Turnover per capita (T/C); indicates the ability of a company to leverage its assets and resources on the value system. As such, T/C reflects a company's leanness in relation with the configuration of its value system. The authors argue that the higher the T/C, the more canted the value chain of a company is and the more networked its value system is.

The authors have analysed financial data from car and aircraft manufacturers, and the airline industry. Since there is a relation between the innovation drivers as described by the 3C model, the authors set out to demonstrate that there exists a significant relationship between the proposed

lean metrics at organisation level as well. These are P/C - T/C, R&D/C - T/C and R&D/C - P/C (see figures 9 and 10). Since each industry has its own dynamics and characteristics, it was chosen to analyse the companies by industry segment.

Applying the least squares method it is found that positive and significant correlations exist between the lean performance indicators.

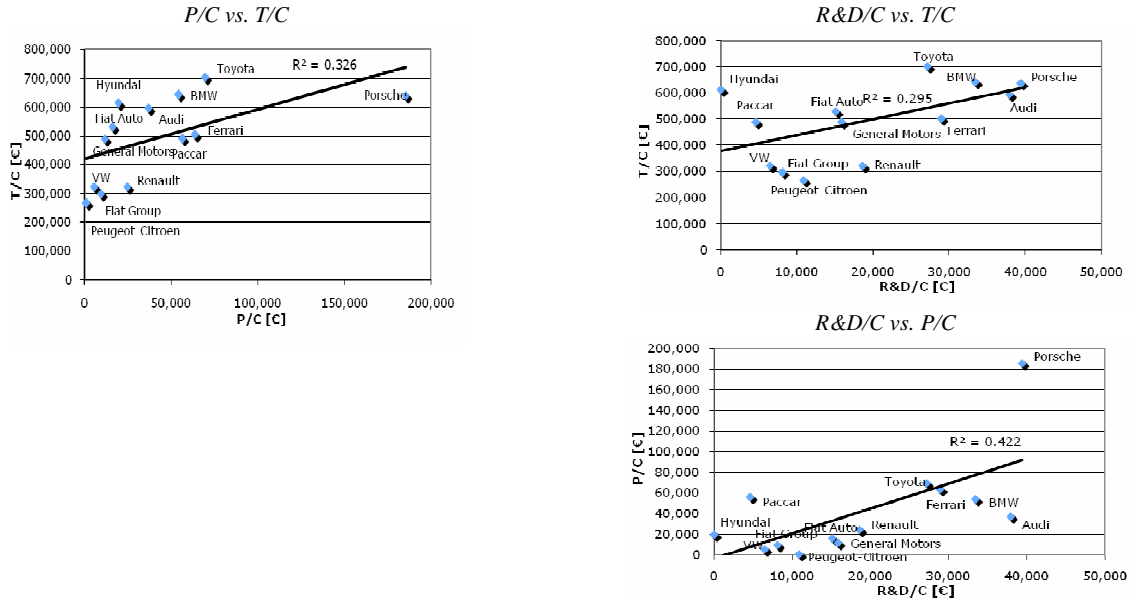


Figure 9 – Lean Metrics for Car Manufacturers based on 2006 Data

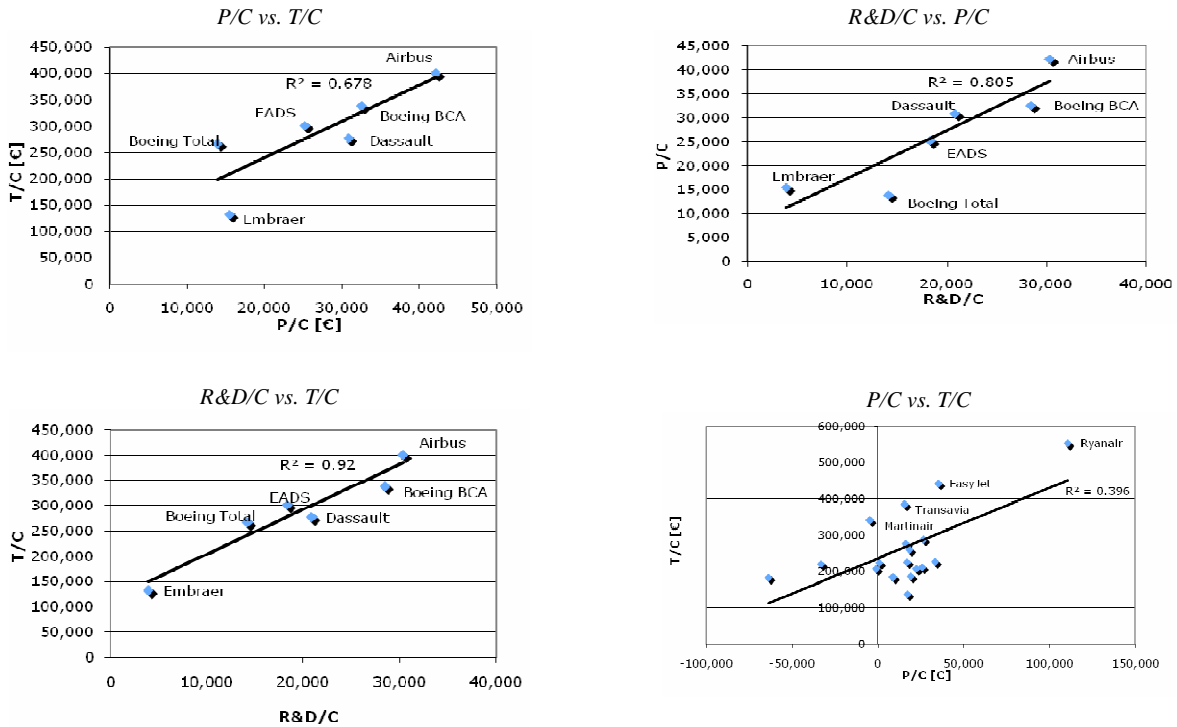


Figure 10 – Lean Metrics for Aircraft Manufacturers and Airlines based on 2006 Data

Tables 1 through 3 show the results of the statistical analysis that has been performed on the values obtained from the plots above. It is found

that the correlation between T/C and R&D/C for the car manufacturers is less strong than for the aircraft manufacturers (see table 2).

Table 1: Statistical Significance Correlation T/C and P/C

Industry	N	R ² -value	R-value	Significance Level	Critical Value	Significant
Car Manufacturers	13	0.3268	0.5717	0.05	0.553	Yes
Aircraft Manufacturers	6	0.6785	0.8237	0.05	0.811	Yes
Airlines	18	0.3968	0.6299	0.05	0.468	Yes

Table 2: Statistical Significance Correlation T/C and R&D/C

Industry	N	R ² -value	R-value	Significance Level	Critical Value	Significant
Car Manufacturers	13	0.2952	0.5433	0.10	0.476	Yes
Aircraft Manufacturers	6	0.92	0.9592	0.05	0.811	Yes

Table 3: Statistical Significance Correlation P/C and R&D/C

Industry	N	R ² -value	R-value	Significance Level	Critical Value	Significant
Car Manufacturers	13	0.4229	0.6503	0.05	0.553	Yes
Aircraft Manufacturers	6	0.805	0.8972	0.05	0.811	Yes

Within the car manufacturers it can be observed that Toyota, as the inventor of lean, manages to leverage a lot on the value system which is reflected by a high T/C. The firm has a relatively high R&D/C within the car manufacturers, which indicates its focus on technology and innovation; the hybrid drive and its premium brand Lexus. Toyota is able to transform this into a high value add to its products that is in turn reflected by a high P/C. It is the most lean organisation of all car manufacturers as it has the highest T/C. Another observation is that the premium brands as Porsche, BMW and Audi have a similar focus on technology reflected by their R&D/C; typical for fast mover companies. Porsche has an exceptionally high P/C combined with the highest R&D/C of all analysed car manufacturers. This firm is able to add a great amount of value to its products and apparently to leverage much of the non-value adding activities to the value system. For example, Porsche decided to outsource production of their US Boxer models completely to a company called Velmet in Finland. Porsche themselves concentrate on engineering, marketing and supplier steering (Arnold, 2000). Hyundai is an exceptional case as it has also a very high T/C, whereas it has nearly no R&D expenses. Therefore, Hyundai does not create any significant technical value, however generates profit with high throughput and a low cost base.

focus has shifted toward supplier relationship management and the organisation of the supplier base. The renaming of its supplier organisation to Global Partners does a far better job at showing the world that Boeing considers its suppliers as an extension of its internal processes (Avery, 2006). Boeing has minimized their supplier base from 3.800 key suppliers to 1.200. With the B787 program the suppliers are involved in the total development and production process. The effects of this leverage on the value system are reflected in a relatively high T/C and R&D/C which in turn pay off in a high P/C. In contrast, Embraer does not leverage development nor production to its value system. To be able to do all these activities in house a big employees base is needed, which results in low lean metrics.

Within the aircraft manufacturers for instance Boeing Commercial Airplanes (BCA) puts much effort in the reorganisation of its value chain. The

In the airline industry it can be observed that Ryanair, Transavia and Easyjet have the highest T/C within the industry. The high T/C value as an indication of a lean company implies that these firms are able to leverage much of their non-value adding activities to the value system in order to focus on core competences. It is known that these low cost airlines have a very agile business model and are able to adapt to a changing business environment very quickly. Ryanair manages to generate the highest P/C of the three, which is probably due to the fact that Ryanair does not fly to the primary hub airports as the others do, and it has developed its ancillary earnings significantly. Ryanair even plans to generate 100% of its profits from non-aviation activities within a few years.

Furthermore it can be observed that traditional carriers show little spread on the P/C vs. T/C plot. This can be explained by their similar business model.

PRELIMINARY CONCLUSIONS

The authors suggest that the 3C model has a broader scope than the product innovation level. When projected onto the traditional value chain, with the adoption of lean principles and re-evaluating all activities, drastic changes in a company's value chain are induced. One can say that a change of importance of business processes can be discerned. Some supporting activities are becoming primary and some primary activities are losing importance and are becoming supportive. Moreover, some activities are leveraged to partners throughout the value system. As such the value chain is canting and drives the configuration of a lean value network system around it. These changes should be recognizable in companies' financial performance. Therefore, this paper set out to answer the following research question:

How can the leanness of a company be quantified in the context of the lean value network system?

In the new business arena where competition is fierce and companies need to stand-out in order to retain customers, continuous innovation is necessary. Industry research has shown that the importance of Supply Network Management and Technology Development are gaining momentum. The use of technology as such has facilitated the evolution of purchasing to procurement to supply network management that now has gained such a prominent role in a company's value chain; configuring the supplier network system to optimise the flow from supplier to the end customer. This also has implications for management. The purchasing function within companies has developed to a function on strategic level. It are not only the changes on organisation level that will transform the corporation to a more agile one. As important as these organisation transformations are, they should spark changes on the functional level as well. Management positions used to reflect a company's organisation. Traditionally companies are organised around functions making managers function owners. However, the lean company is organised around processes, which should be reflected in its management structure. As such managers should

become process owners. Through systems like EDI, ESI, supplier portals, and Track-and-Trace, traditional activities comprising In- and Outbound Logistics are integrated within the Supply Network Management function. The increasing interdependence between partnering companies in the network makes inter-organisational relationships across the value system more important. Through co-operation companies can respond better to the market needs. It has been shown that this co-innovation and co-investment seem to be the drivers of the canting of the value chain. It is also shown that by projecting the 3C model onto the Porter value chain, the ultimate lean value chain can be represented by the three innovation drivers; Continuation, Conception and Configuration.

Achieving and maintaining a sustainable position in the market place, boils down to minimizing the time to market, realising new products or services for less and making sure that your product will outperform the one of the competition. Engaging partnering companies in the development process reduces development time and investment cost. Therefore, time to market can be reduced and the company can sooner break even – faster. Co-investment reduces investment in innovation on the side of the focal firm – cheaper. Finally, due to co-innovation, each partnering company brings its specific knowledge into the project, which the focal firm could not have disposed of otherwise. By moving toward the end of the supply chain and making the customer the driver of the whole process, the focal firm brings in the customers' desires into the development process. The combination of the two results in products augmented to the customer's desires – better.

It has been proven that correlations of the proposed lean performance indicators on organisation level are statistically significant. Linking these performance indicators to the innovation drivers of the 3C model, which are the pillars of the lean value chain, it can be concluded that the lean enterprise can be defined by the performance on these three indicators. The higher the T/C the more a company is able to leverage on its value system and the more networked its value system is – configuration. A firm's technology focus expressed by its R&D/C, provides insight in the canting of its value chain. The higher the R&D/C the more the chain is canted and the more

networked its system is. A high R&D/C indicates that the focal firm is able to leverage innovation investment to its system – conception – and as such co-create added value with partners, for its customers. The application of lean principles – high T/C – and a company’s ability to capitalise on its value creation – high R&D/C – should in their turn pay off by higher profits per capita (P/C) – continuation.

It has been shown that the lean metrics are suitable indicators for the leanness of a company in the context of a faster, cheaper and better lean value network system.

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