Multilayered triads in the context of lean management

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Abstract

Purpose – This paper aims to develop the existing theoretical concept of a triad by informing it with the activity-resource-actor (ARA) model in a new empirical context of lean management (LM).
Design/methodology/approach – This conceptual paper draws on the industrial marketing and purchasing (IMP) school of thought and the ARA model as theoretical lenses to inform research on triads in an LM context.
Findings – The authors find that closed buyer-supplier-supplier (BSS) and buyer-supplier-logistics service provider (BSL) triads, which we call "lean triads," had a positive impact on LM. The authors display the drivers for closure – LM improvements (Table 2) and the properties of these "lean triads" (Figure 3).
Research limitations/implications – The paper focuses only on closed triads and is based on previous empirical studies.
Practical implications – The authors demonstrate to lean managers the drivers for connecting their partners in BSS and BSL triads and show the importance of developing relationships on three layers between all three actors in both triads to improve a firm's lean performance.
Originality/value – The authors contribute to the discussion within the IMP school of thought on the value of triads by enriching the understanding of a triad concept with the ARA model, which compounds a concept of a multilayered triad in an LM context.
Keywords – Multilayered triads, Lean management, Actor bonds, Resource ties, Activity links
Paper type – Conceptual paper

1. Introduction

For the last decades, the scholars from the IMP school of thought have focused on understanding the connections between relationships. To study networks and effects of connected relationships, triads have been used as the smallest unit of analysis (Laage-Hellman, 1989). Ritter (2000) distinguishes ten different triadic interconnections and elaborates on the varying effects of positive and negative connections. IMP scholars like Håkansson *et al.* (1999), Dubois and Fredriksson (2008) and Aune *et al.* (2013) demonstrate the value of connections between suppliers in BSS triads for learning and supplier development and Wang *et al.* (2016) and Hedvall *et al.* (2016) on the value of connections between three actors in BSL triads for effective logistics.

IMP studies on triads have been, in particular, focused on understanding **the value of connections for actors in a triad** (Vedel *et al.*, 2016; Vedel, 2016). Vedel (2016, p. 856), in her conceptual work on the triad value function, explains that "actors have an individual perception of the overall value potential of the structural context", such as "connectedness is actor-perceived and actor-interpreted phenomenon". Vedel (2016) shows that the **actors in a triad do not always realize the value to connect**

to each other. Vedel *et al.* (2016, pp. 140-141) also explain that two different triads may have the same shape; for example, both look like a closed triad, but "the properties of the actors' relations differ".

In this study, we intend to understand in more detail the two points mentioned above. We aim to shed more light on 1) the value of connections for actors in a triad and 2) the properties of the actors' relations in a triad which lead to more value. We believe that the IMP theoretical framework ARA model is particularly suitable for studying the properties of the actors' relations, as the framework suggests that the substance of a business relationship consists of three layers – activity links, resource ties, and actor bonds, thus allowing us to study each relationship in detail (Håkansson and Johanson, 1992; Håkansson and Snehota, 1995).

Therefore, in this paper, we infuse the concept of a triad with the ARA model and this compound makes the concept of a multilayered triad.

We examine the concept of a multilayered triad in the LM empirical context. We analyze cases retrieved from the IMP and/or LM literature to test how this conceptual modification, i.e. the *multilayered triad*, may enrich our analytical toolkit for various types of business triadic relationships. For this task, we employ the research design of a conceptual paper called Theory Adaptation (Jaakkola, 2020). Thus, the research question in this paper is:

How can the concept of a multilayered triad be nuanced and developed by applying the concept in an inter-organizational Lean Management context?

We chose LM as an empirical context because this management tradition has been also focused on studying relational advantages in the last decades. The main idea of LM is to create value for the customer, respond to customer demand on the product's quality and time of delivery by reducing waste. A prominent study of Toyota conducted by Dyer and Nobeoka (2000) shows that connected suppliers in the buyer's network learn from each other what results in various lean improvements – e.g. improved changeover time (Heijunka) on the production line of one supplier who learned from the other. Dyer and Nobeoka (2000) claim that the importance of the network of partners for reaching LM goals is overlooked. Furthermore, Netland and Powell (2017, p. 222) suggest that the lean supply chain research could focus on the "triadic buyer-supplier-supplier relationships and how such relationships promote knowledge-sharing and mutual learning among network members". In a similar vein, IMP scholars claim that research on triads should be extended (Ford and Håkansson, 2013; Gadde and Snehota, 2019).

We analyze empirical examples from ten published articles of lean firms engaging in BSS and BSL triads and find that closed BSS and BSL triads, which we call "lean triads" have a positive impact on LM. We display what Vedel (2016) calls "the drivers for closure", such as LM improvements (Table II) and the "properties" of these "lean triads" (Table III).

The paper contributes to this part of the IMP literature dealing with the value potential of triads (Vedel, 2016; Vedel *et al.*, 2016) by introducing the concept of a multilayered triad in an LM context.

2. Theoretical approach and definitions

2.1. ARA-model

According to the IMP school of thought, firms cannot exist in isolation but are embedded in business networks (Håkansson and Snehota, 1995; Ford and Håkansson, 2006). Anderson *et al.* (1994) define business networks as the *sets of connected relationships*. Two directly connected business relationships consist of a minimum of three actors – what constitutes a *triad*.

Håkansson and Snehota (1995) built on the Activity-Resource-Actor model of Håkansson and Johanson (1992). They developed a theoretical framework with activity links, resource ties, and actor bonds to describe a substance of a business relationship, claiming that each business relationship consists of these three layers. Later, Pedersen (1997) studied how the layers of the substance of two connected relationships (relationship A1-A2 is connected to relationship A1-A3) affect each other and graphically presented it in the form of ***a multilayered triad*** (see Figure 1).

2.2. Emphasis on triads

Figure 1 shows an open triad and a closed triad and their various definitions. To be consistent, we follow the definition of Vedel *et al.* (2016). Therefore, when we talk about the setting of three actors and two relationships, we refer to ***an open triad***, the setting when all three actors are directly connected, we refer to ***a closed triad***, or the situation when all three actors directly interact with each other we use the term ***triadic interaction***.

[Figure 1. Triad]

Vedel *et al.* (2016, pp. 142-143) discuss various types of triads depending on two dimensions: "degree of internal cohesiveness and whether or not a triad acts as an entity" and conclude that the degree of internal cohesiveness in a triad is about the connectedness of the actors and "acting as an entity" is when all three actors of a triad "agree upon how to deal with the environment", in other words, form a coalition. Firms can form such triadic coalitions with two different purposes: 1) to maintain existing resources, that is, a protective purpose, and 2) to acquire new resources, that is, a predatory purpose (Vedel *et al.*, 2016, p. 143).

Granovetter (1973, p. 1363) argued that an open triad, which can also be called "a triad with a structural hole", "is most unlikely to occur". Granovetter (1973, p. 1363) called it "a forbidden triad" because, as he argued, the unconnected actors in an open triad would seek to be connected. This point of view was later challenged by Anderson *et al.* (1994) and Holmen and Pedersen (2000). They state that open triads are not forbidden but rather "permitted" in industrial networks, where many suppliers are not connected to each other.

However, in their exploratory analysis of data from the global steel industry, Madhavan *et al.* (2004) elaborate on firms' tendency to form transitive triads (their term for closed triads), thereby supporting Granovetter (1973). Interestingly, Sako (1996) calls the Japanese economy "the network economy" and shows that it is a common practice in Japan when the buyer initiates two or more suppliers to engage in knowledge-sharing and teamwork, therefore, also supporting Granovetter (1973), and showing that closed BSS triads are rather common practice in Japanese supply chains of large automotive manufacturers. Interestingly, opinions about closed and open triads vary among the IMP school of thought, American sociologist Mark Granovetter and Japanese tradition. Significantly, the question of closure is pivotal in BSS and BSL triads. It is frequently discussed whether the buyer should connect its suppliers for learning and whether the buyer, supplier and carrier should connect for more effective logistics. Therefore, despite the existence of a wide variety of triads, we decided to focus on these two types in this article.

2.2.1. Buyer-supplier-supplier triads

In the field of IMP, triads were first discussed by Laage-Hellman (1989). Later, Håkansson *et al.* (1999) wrote about closed BSS triads in the construction industry and discussed the value of connections between suppliers for learning. Choi and Wu (2009) discuss BSS triads and argue that triads provide a rich context to understand relational dynamics better. Using a balance theory, they also identify nine triadic archetypes – from open (with structural holes) to closed, with various combinations of positive and negative relationships between the actors in the triad. Choi and Wu (2009, p. 11) also explain that

"a plus (+) sign represents a cooperative, voice-based relationship between two firms predicated on mutual trust and commitment", while "a minus (-) sign indicates an adversarial, exit-based relationship that arises from inequity and distrust between two firms", but the authors do not go any deeper into what positive (+) or negative (-) relationships in their triadic archetypes imply for triadic dynamics. As an example of a balanced triad with three + signs, Choi and Wu (2009) discuss Japanese firms that help their suppliers to cooperate in BSS triads.

2.2.2. Buyer-supplier-logistics service provider triads

In the field of logistics, triads were first mentioned by Beier (1989), whose ideas were further developed by Larson and Gammelgaard (2001/2002) and also discussed by the IMP scholar Bask (2001), who explains that third-party logistics relationships have been limited either to the dyadic relationship between seller and logistics service provider (LSP) or buyer and LSP. Bask (2001, p. 473) advocates that "all three relationships should be covered" but without specifying the properties of these relationships. More recent publications in the logistics literature also show the value of three-way relationships in BSL triads on logistics efficiency (Hedvall *et al.*, 2016; Hedvall *et al.*, 2019; Andersson *et al.*, 2019). The study of Wang *et al.* (2016, p. 117) shows that, despite that the fundamental logic of LSP is mediation in terms of performing a distributive service, "LSPs create value by taking advantage of being connected and exploring the presence of various forms of interdependence".

2.3. Lean management from a network perspective

The topic of the value of connections for learning and effective logistics is also central in the lean supply chain management literature because learning is at the heart of LM (Powell and Coughlan, 2020). There is a large portion of lean knowledge that is tacit (e.g. Kanban practice) and challenging to transfer; therefore, these practices require more intense interaction and close contact to be understood and conveyed (Herron and Hicks, 2008).

Adhering to the five fundamental lean principles (see the roof of Lean House in Figure 2) requires a firm to synchronize and coordinate work between its customers, suppliers, carriers, and other network actors. Indeed, LM requires firms to streamline and synchronize production with customer demand, for example, through the application of just-in-time scheduling (Shah and Ward, 2003), with suppliers, for example, through the use of Kanban cards (Sugimori *et al.*, 1977), and with carriers for achieving the JIT goals (Larson and Gammelgaard, 2001/2002). Thus, for the successful implementation of LM, lean managers need to pay attention to a ***network approach***.

Based on the Lean House of Liker (2004), we summarized LM tools and principles essential for developing a firm's lean network (Figure 2). *The roof* of Lean House incorporates QCDSM goals of LM - best Quality, lowest Cost, short Delivery time, best Safety, and high Morale, and the five fundamental principles of LM (Womack and Jones, 1996).

[Figure 2: Lean House (based on the lean house of Liker (2004)]

In the foundation of the Lean House, there is Toyota Way Philosophy concept, which emphasizes that LM is not just a set of tools but, as Hines *et al.* (2020) say, "a lifelong journey", for the successful application of which, it is necessary that not only one firm be impregnated with it, but also its network of partners.

Other elements of the foundation are stable and standardized practices. Without standards, it is not easy to know what to improve, and at the core of LM is the idea of Kaizen, small-steps continuous improvements, rather than innovation (Mikvaa *et al.*, 2016). Another element of the foundation is Heijunka - leveling out the production schedule in both volume and variety (Liker, 2004). Heijunka principle enables the organization of supplies in stable way, which is essential for creating a stable and lean business partner network. Coleman and Vaghefi (1994, p. 32) explain that "without quick setups,

the small-lot production sequences often dedicated to Heijunka would be extremely inefficient". Thus, the efficiency of changeover is the fulcrum of Heijunka because narrowing changeover times helps tighten the value stream between supply and demand (Coleman and Vaghefi, 1994).

The bearing structures of the Lean House are two pillars - just-in-time (JIT) and on-time delivery (OTD) (left) and Jidoka (right). Jidoka means "to never let a defect pass into the next station and free people from machines" (Liker, 2004, p. 32). However, the concept of Jidoka is broader than just stopping the machine by pressing the button. Jidoka involves several steps: deviation detection, production pause, adaptations performance, corrections or repair work, and an investigation of the root cause of defects (Bruun and Mefford, 2004). Bruun and Mefford (2004, p. 250) suggest that this last point of Jidoka about solving the root cause of problems can be done by "spreading Jidoka along the supply chain", meaning that firms (together with its business partners) can undertake preventive measures to reach the highest quality of product design before it reaches the robots, thus minimizing the likelihood to need to press the stop button.

Waste (Muda) reduction is another central element of LM. One of the lean practices to eliminate waste is Genchi Genbutsu, which means *going and seeing* with your own eyes to the actual place what happened (Liker, 2004). Netland and Powell (2017) assert that Toyota leaders are obsessed with direct observation, and they distinguish between data (abstractions of reality) and facts (direct observation of reality). Respect for people and emphasis on teamwork is at the heart of LM together with respect for partners and developing lean suppliers and other partners.

There is an apparent consensus in the LM literature that LM studies must pay attention to the network approach. Hence, lean case studies ought to provide a rich empirical source of information for our conceptual paper of a multilayered triad.

3. Research design

We employ the research design of the Theory Adaptation paper (Jaakkola, 2020). Jaakkola (2020, p. 23) argues that "the starting point for the theory adaptation paper is the theory or concept of interest (domain theory), other theories are used as tools, or method theories to provide an alternative frame of reference to adjust or expand its conceptual scope". According to Jaakkola (2020, p. 22) the goal of a Theory Adaptation paper is "changing the scope or perspective of an existing theory by informing it with other theories or perspectives". In this paper, we infuse the concept of a triad (domain theory) with the ARA model (method theory). This compound makes the concept of a multilayered triad, which we study in a new empirical context - LM. We believe it is interesting to do because it broadens the scope of our thinking about triads.

4. Method

Our objective is to understand the phenomenon of a triad, the "drivers for closure" and the "properties" of a triad that lead to achievement of LM goals. Our methodological approach was to examine published articles that provide empirical evidence on the intersection between triads and LM improvements. To do so, we set the boundaries of our literature search within empirical publications within two literature streams - IMP and LM.

We conducted bibliometric searches in Scopus and Web of Science with the keywords "lean" and "business network" and/or "triad" within the fields "Business", "Management" and "Operations research management science". The search in databases using these keywords in various combinations resulted in more than 1000 articles. We examined all titles and other bibliographic information of these items. We discarded those items from unrelated research subjects and ended up with 369 potentially relevant articles. Then, we carefully read the abstracts and, in those cases, when it was not entirely clear from the abstract whether the article was relevant on not, we viewed the internal content of those

articles and ended up with 99 papers that investigate lean cases from a business network or triadic perspective.

Then we have carefully read those 99 articles and selected the ten articles that fulfill all the following criteria:

- articles that analyze connected business-to-business relationships with a minimum of three firms,
- articles that discuss LM performance,
- articles that discuss the evolution of triads (from open to closed) and their impact on lean performance over time,
- to narrow down the scope, we focused on two triadic settings – a buyer managing two suppliers and a buyer managing a supplier and a logistics firm,
- articles based on case studies (some are also supplemented with surveys).

We analyzed the ten selected papers in the following systematic manner, applying to our analysis the ARA model and the Lean House:

- we read the articles using the ARA model as the theoretical lens, which enabled us to analyze BSS and BSL triads meticulously, namely, to understand the role of actors, the bonds, the activity links and the resource ties between the actors;
- we paid attention to the improvements that firms gained due to triadic interaction and made a list of these improvements;
- we matched these improvements with the categories in the Lean House (e.g. improved changeover time – matches Heijunka in Lean House, mutual factory visits - matches Genchi Genbutsu in Lean House, etc.).

In total, we selected eight articles (case studies and surveys) about BSS triads and two articles (one case study and one survey study that covered 75 Danish companies) about BSL triads. Table I provides an overview of these papers, together with a summary of their methodology, sample sizes, the names of companies investigated, etc.

[Table I. The methodology of the articles discussed in section 5 of the paper]

5. Evidence of lean improvements achieved due to triadic interaction in BSS and BSL triads

Based on the ten papers listed in Table I, the first part of this section discusses the effects of triadic interactions on LM in multilayered BSS triads and, in the second part, in multilayered BSL triads. These two different triads describe different parts of the company's context - the supplier side and the logistics side. In the supplier triads, the focus is on supplier development and joint supplier-supplier learning, and in the logistics triads, the main focus is on the efficiency of delivery.

5.1. The effects of triadic interactions in BSS triads on LM

This subsection discusses the effects of triadic interactions on LM in closed BSS triads.

5.1.1. Lean improvements achieved in the Japanese automotive industry by suppliers of Toyota and Honda due to triadic BSS interaction

Sako (1996) conducted a large-scale survey, followed by a case study, of first-tier suppliers of nearly 500 parts to all the 11 Japanese assemblers, Toyota, Nissan, Mitsubishi, Mazda Yokokai, Isuzu, Fuji Heavy Industries, Daihatsu, Suzuki Motors, Hino, Nissan Diesel, and Honda. All these car manufacturers, except Honda, connect their suppliers in supplier associations, creating a supplier-supplier connection

in a BSS triad. Sako (1996) explains that Honda free rides on other manufacturers' efforts to improve their suppliers because Honda's suppliers are members of other car manufacturer's associations. The study shows that supplier-supplier connection enables *mutual inter-supplier learning*. Triadic BSS interaction allows *suppliers to learn in groups from the assembler customer*. This makes suppliers more integrated with the customer and enables them to comply with the first fundamental principle of LM, namely, *to specify a value from the customer's point of view*.

Dyer and Nobeoka (2000) conducted a survey of 97 suppliers in Toyota's U.S. supplier association and 50 of their largest first-tier Japanese suppliers (received surveys from 48 suppliers in the U.S. and 38 in Japan). Along with the survey, the authors also conducted a case study of Toyota and its group of first-tier suppliers in both Japan and the U.S. They interviewed more than 30 Toyota executives in both countries. The research shows that Toyota, both in Japan and the U.S. connected its suppliers in supplier associations, establishing a supplier-supplier connection in a BSS triad. Thanks to established trust in a triad, suppliers visited each other's factories (*Genchi Genbutsu*). L.M. suggests that learning can be more efficient when s*uppliers physically visit each other's factories* because it contributes to more efficient lean tacit knowledge transfer. Dyer and Nobeoka (2000, p. 355) show an example of how such physical supplier-supplier factory visits resulted in supplier learning – Toyota's US supplier visited Toyota's supplier with the same activity in Japan and learned how to *improve changeover time*, which is a *fulcrum of Heijunka*:

> "*Toyota told us to work on cutting our changeover time from 2 hours to 30 minutes. I told them it was impossible. Then they sent me to visit a Japanese supplier in our same business that had changeover time of 15 minutes. I never would have believed it if I hadn't seen it with my own eyes. My boss still does not believe it."*

Another example is when Toyota's US supplier learned Kanban practice after it visited another US supplier who had, among others, "the best Kanban system".

Yet another example of supplier-supplier learning in the BSS triad that resulted in *cost cuts*:

> *"Last year, we were able to reduce our paint costs by 30%. This was possible due to a suggestion* [during group work with another supplier with the painting activity] *to lower the pressure on the paint sprayer and adjust the spray trajectory, thereby wasting less paint."* (Dyer and Nobeoka, 2000, p. 356)

Dyer and Nobeoka (2000) also explain that Toyota's suppliers, members of supplier's association, receive free consulting help, which is available for all suppliers' which are members of Toyota's supplier associations. The visit of Toyota's consultants to suppliers results in *lower costs and higher supplier profits*. For example, TSSC (Toyota's consulting division in the US) has assisted suppliers in achieving an *average inventory reduction of 75%* and an *average increase in productivity or output per labor of 124%* (Dyer and Nobeoka, 2000, p. 354). Also, *suppliers fix quality problems* through problem-solving teams with the other suppliers, which corresponds to *Jidoka* preventive measures to *achieve the best quality at the source, to avoid in the future any need to press the stop bottom*.

Another case study about Toyota that was conducted by MacDuffie and Helper (2007), shows an interesting example when Toyota not only decided to connect its suppliers in a BSS triad with the purpose of one supplier learning from the other but when Toyota *decided to turn more design responsibilities to suppliers*. Such cooperation between two suppliers resulted in *quality and cost improvements*:

> *"An instrumental panel console for a new Lexus model that resulted from the self-initiated collaboration of Sumitomo Denko (an electronics firm) and Toyota Gosei (a plastic firm), which achieved sizeable improvements in terms of lighter weight, lower parts count, and lower overall cost." (MacDuffie and Helper, 2007, p. 437)*

The case study of MacDuffie and Helper (1997) shows how Honda develops lean suppliers by sending one supplier with superior lean knowledge to help another less-experienced and less-knowledgeable supplier to help with equipment installation and product launch. One supplier helps another supplier to achieve a better result without errors (*Jidoka*) and to minimize waste, such as extra processing, motion, waiting, etc.:

> *"When Honda began to build cars in 1982, they asked Capitol to take on some important console parts for the Accord. At first, the tooling was supplied from Japan. Honda also arranged for Capitol to establish "a technical collaboration agreement" with their supplier of the same part in Japan. This firm Marioko began to send technical personnel to Capitol to help with equipment installation and product launch."* MacDuffie and Helper (1997, p. 125)

5.1.2. Lean improvements achieved in the Swedish automotive industry by suppliers of Volvo Cars due to triadic BSS interaction

Dubois and Fredriksson (2008) conducted a case study of a triad of Volvo Cars assembler and its two strategic suppliers, suppliers of front seats and rear seats, that work together to develop and upgrade front and rear seats for Volvo's different car models and platforms. The authors explain that Volvo predetermines many technical characteristics, but several features are decided in the interaction between three parties. Dubois and Fredriksson (2008, p. 171) call this triadic interaction "a triadic sourcing strategy" and describe it as "a dynamic sourcing strategy that *contributes to efficiency and innovation for the buyer and two suppliers*". The authors explain that suppliers regularly meet at each other's factories and work jointly on finding solutions for *overtime work, how to change production volumes, the preordering time, forecast accuracy, temporary labor, etc.* Triadic collaboration between Volvo Cars and its two suppliers enables them to achieve *better quality (Jidoka), better safety, lower costs and to improve continuously (Kaizen).*

5.1.3. Lean improvements achieved in the Norwegian automotive industry by suppliers of Kongsberg Maritime due to triadic BSS interaction

Following the Japanese example and with the help of the lean consultants, Kongsberg Maritime (KM) established in 2014 supplier's association called Network for Supplier Innovation (2014-2017) with the purpose of lean supplier development, where it connected its six strategic suppliers (action learning research for six years at the case company KM conducted by Powell and Coughlan (2020). KM received Lean Award for that supplier development initiative in 2017. Being successful, the company decided to continue this initiative and to develop its suppliers and even sub-suppliers further. After three years of membership in KM's suppliers' association and participating in joint lean learning activities, suppliers showed *26,8% improvement in on-time delivery (OTD) and marginal improvements in quality (Jidoka)*. Also, during Rapid Lean Assessment, suppliers visited each other's factories (*Genchi Genbutsu*). Powell and Coughlan (2020) explain that the opportunity to inspect the actual location allows suppliers *to learn lean transformation progress at the other sites and learn from the others.* The authors highlight that at the end of these three years of tight BSS interactions in KM's supplier association, suppliers *started to speak the same lean language and increased focus on lean thinking, further collaboration, and continuous improvement.* Moreover, after visits to other suppliers, one supplier was inspired *to digitalize its Kaizen boards*, another supplier *confirmed that they learned how operators could proactively identify and eliminate waste ("disturbances and annoyances") in operations*, another supplier *implemented QROC (quick response office cell) software that allows offering quicker confirmations to purchase orders from the customer.* And, finally, all six suppliers confirmed that after three years of KM's supplier initiative, they developed *tighter integration with their customer (KM).*

5.1.4. Lean improvements achieved in the Norwegian subsea industry by suppliers of Sensoil due to triadic BSS interaction

Aune *et al.* (2013) conducted a case study, where they discussed several types of triads. One of such triads was a BSS closed triad. Sensoil, the buyer, the company that develops and produces sensors for production optimization in the oil industry, encouraged its two suppliers to share information and discuss technical issues to enhance knowledge and capability development. The suppliers' products are different and complementary – one supplier is a supplier of hardware products, which combined with the circuit boards by another supplier are vital parts of the final product for their buyer, Sensoil. Aune *et al.* (2013) explain that suppliers regularly meet and visit each other's facilities (*Genchi Genbutsu*). Direct supplier-supplier connection reduces buyer's efforts to transmit information from one supplier to the other. Moreover, due to direct collaboration, suppliers can *directly agree with each other and work on improving the quality of the final product for the buyer, and develop the product faster.* Aune *et al.* (2013) also highlight that suppliers learn from each other and *develop capabilities in some new areas.*

5.1.5. Lean improvements achieved in the Swedish construction industry by suppliers of Swedish construction companies due to triadic BSS interaction

Håkansson et al. (1999) studied how suppliers of one Swedish construction firm learn in networks. The main contractor is a large Swedish construction firm engaged with 16 suppliers and 26 subcontractors. Håkansson et al. (1999) show that joint learning between connected suppliers results in *the better realization of construction projects, e.g., better quality, fewer delays,* etc. Moreover, suppliers learn from each other *and master their capabilities.*

5.2. The substance of business relationships in closed BSS triads

In this subsection, we employ the ARA model to zoom into the role of actors and the substance of relationships in closed BSS triads.

5.2.1. The role of actors and actor bonds

We presented examples showcasing the effects of triadic interactions in BSS closed triads on LM from different industries – the automotive industry in Japan and Sweden, the subsea industry in Norway, and the construction industry in Sweden. In all cases, all three actor bonds are long-term oriented, based on trust and commitment. Long-term orientation is the basis of Toyota's philosophy (see the foundation of Lean House). It takes time to develop trust between the actors, but it enables multilevel collaboration between suppliers in a triad when established. Also, in all the discussed cases/papers, a buyer initiates and then orchestrates the connection between suppliers in a BSS triad. Eleven Japanese assemblers, except Honda, created an infrastructure for supplier-supplier interactions – a suppliers' association. Toyota also established strict rules about knowledge-sharing in its business network to avoid free-riding – suppliers can access Toyota's knowledge only after they explicitly agree to share their expertise with other suppliers in the association openly. Toyota can impose sanctions on those suppliers that violate the rules. Also, KM followed the Japanese example and initiated a supplier association for its strategic suppliers. Talking about actor bonds, firstly, suppliers of KM were skeptical about working together and about engaging in lean learning activities together, but then, Powell and Coughlan (2020, p. 931) explain, happened a shift from "us and them" to "we". According to Vedel *et al.* (2016, p. 143), such conscious triadic collaboration corresponds to a triad acting "as an entity", when actors agree upon how to deal with the environment. To work in harmony with your business partners, it is essential to have a common goal, like Dyer and Nobeoka (2000) say "common identity", and have a good understanding of LM. For example, connected suppliers of KM declared that the result of their joint work was them speaking the same lean language and increased focus on lean thinking. The examples discussed above show that close three-way BSS relationships (close actor bonds) lead to lean operation improvements (e.g. improved changeover time, reduced use of materials, faster communication with

the customer through the installation of special software, etc.), and ultimately to better customer service, which is the main goal of LM.

Moreover, the article of Wu *et al.* (2010) shows that the suppliers need to collaborate more than to compete for the BSS triadic interactions to be fruitful. At least one of the suppliers in a triad should have "good performance". Their survey results, analyzing 43 BSS triads, where the buyer is an aerospace-related manufacturer in the US, show that the more the competing suppliers are forced to cooperate, the more their joint supplier performance would suffer. In all the examined cases showcasing lean improvements, the suppliers were more cooperating than competing.

5.2.2. Resource ties

In terms of resource ties, all three actors in the BSS triad shared knowledge and exchanged technical information in all the discussed cases. Toyota, for example, provided its suppliers with what Dyer and Nobeoka (2000, p. 354) call a "network-level resource" such as free consultants available for suppliers' members of the association. Also, Toyota sends its employees to work at suppliers and vice versa. Japanese automotive firms widely practice this employee exchange (Shukko). In the example of Honda's BSS triad, technical personnel of one supplier was sent to "live" at another supplier. In the case of KM, like in the case of Toyota, the buyer provided suppliers (members of an association) with free lean coaching and individual company consultants. In the case of Volvo Cars, both suppliers have engineers working full-time in the cross-functional development teams of the buyer. In the case of Sensoil, a subsea manufacturer, who connected its two complementary suppliers, like Volvo, Sensoil became highly integrated with one of the suppliers because both have made many technical adaptations to each other during their long-lasting cooperation. In the construction industry in Sweden, the buyer and suppliers share knowledge and exchange technical information. As a result of being connected and working together, they master certain existing and develop new capabilities, which results in the better realization of a construction project.

Discussed examples show that when the buyer connects its suppliers, the buyer with suppliers and suppliers with each other combine their resources and mutually benefit from these resource combinations. According to the assumption of resource heterogeneity in the IMP school of thought, it is crucial which other resources a given resource is combined with. This assumption states that the value of a single resource depends on the combination in which it is used (Holmen and Pedersen, 1998; Baraldi *et al.*, 2012; Prenkert *et al.*, 2019).

In the Volvo case, suppliers work together on product development in joint design teams. Moreover, all three actors are involved in decisions about the technical characteristics of the product. In the case of KM, suppliers work in groups. They are engaged in various lean learning activities (organized by the buyer): co-learning lean basics at Lean Lab in Raufoss, Norway, best practice study visits to exemplary lean enterprises in foreign countries, individual company lean self-assessment, etc.

5.2.3. Activity links

One of the common elements of activity links in all discussed BSS triads cases is that all three actors are involved in the regular meetings (buyer with suppliers, suppliers between each other), suppliers work in groups, and visit each other's factories (*Genchi Genbutsu*). Mutual visits would not be possible without established trust in a triad and, in the case of Toyota, strict management of its network.

In the case of Volvo Cars, suppliers assemble each other's complementary products on behalf of each other in different factories (supplier one assembles front seats for supplier two in Gothenburg, supplier two assembles for supplier one rear seats in Ghent). In the case of KM, suppliers work in groups and perform together extended value stream mapping and rapid lean assessments. In both cases, this is done to better coordinate production and increase production quality between the various members of the triads.

In the case of Swedish construction firms that motivate their suppliers to relate to each other, suppliers are highly involved in the whole construction process and have close contact with each other. Most of them are also involved during the planning stage of the construction project.

5.3. The effects of triadic interactions in BSL triads on LM

Larson and Gammelgaard (2001/2002, p. 72) refer to Gentry (1996), who stated that "closer three-way, buyer-supplier-carrier relationships, such as logistics triads, lead to operating improvements, which in turn, yield better customer service and lower inventory levels". Larson and Gammelgaard (2001/2002) illustrate Harley-Davidson improving on-time-delivery through the logistics triad initiative.

5.3.1. Lean improvements achieved by companies in Denmark due to triadic BSL interaction

Larson and Gammelgaard (2001/2002) conducted a survey of Danish logistics providers and found that Danish firms use logistics triads to reach their JIT objectives. The authors claim that Denmark's distribution system provides a world-class benchmark since Denmark leads on the European Logistics Index, which measures efficiency in terms of lead time, safety stock, and total logistics costs. Thus, it is fair to say that Danish companies provide an excellent example for other firms on organizing logistics through logistics triads efficiently and adequately. The results of their study show that logistics triads offer better transport service through improved *JIT delivery, more on-time pick-up and delivery, greater flexibility, higher inventory availability, and lower (transportation, warehousing, and inventory) costs, and improved packaging.*

5.3.2. Lean improvements achieved by companies in Sweden due to triadic BSL interaction

Andersson *et al.* (2019) conducted a case study of the transport service triad. The study was part of a research project about logistics planning aimed at more energy-efficient freight transports in Sweden. The actors in the case are the supplier of the goods, a large main construction company buying the goods, and the transport service provider. The study results show that BSL triadic interaction results in *improved transport service due to fast, accurate, and scheduled delivery*. By being directly connected with the buyer (having access to the construction site) and supplier, *LSP can plan better their daily work*, which is very important for *LSP's efficiency*. For example, *LSP can fill trucks more efficiently and minimize the number of drives to the construction site.* Close relationships between LSP and the buyer allowed LSP to directly negotiate with the buyer one "aggregated" timeslot to each specific construction site every day, leading to LSP avoiding traffic (from 20 to 180 min per day). The authors conclude that a dialogue between a buyer and LSP can enable LSP to achieve *efficient resource utilization, including what vehicles to use for different transports, how to combine delivery points in an optimal way, how to avoid the worst congestion, etc.*

5.4. The substance of business relationships in closed BSL triads

In this subsection, we use the ARA model to zoom into the role of actors and the substance of relationships between three actors in the closed BSL triad.

5.4.1. The role of actors and actor bonds

The survey shows that firms in Denmark organize their logistics in the form of a BSL triad. In the case of construction firms in Sweden, it was also an initiative of the buyer (construction firm) to improve logistics planning to achieve more energy-efficient transport by directly connecting their suppliers with LSP. In both examples, in Denmark and Sweden, the buyer has primary control of consignments decisions. In the case of Danish firms, the LSP primarily controls the choice of transportation method and the cost of logistics services. The supplier mostly maintains the level of stocks and credit conditions. The buyer shares control with LSP on delivery times, LSP shares with the supplier control over pick-up time. Larson and Gammelgaard (2001/2002) conclude that a key to successful logistics triad relationships is the effective sharing of control over these decisions.

In the case of the construction industry in Sweden, the buyer's goal was to reduce the number of deliveries (by LSP) to the buyer from the supplier from 5 times per week to 2 times per week. However, it was hard for LSP to achieve this goal because LSP needed to have direct communication with the fourth parties, the subcontractors, which, unfortunately, was not initially planned in the project. Therefore, the LSP still had to deliver several times a day to each construction site.

In both Danish and Swedish studies, the authors highlight that, on average, relationships between buyer and supplier tend to be tighter, and the interests of LSP are less considered. Both studies conclude that closer relationships of buyer and supplier with LSP can improve the efficiency and quality of JIT and OTD.

5.4.2. Resource ties

There are knowledge-sharing and information-sharing between all three actors in Danish and Swedish examples of logistics triads. In the case of the construction industry in Sweden, buyer and supplier are connected by a built-in function in the supplier's IT system – the buyer gets a notification from the supplier about the timeslot when LSP will deliver the goods. The delivery takes place the next day after the placed order, supplier's service is characterized as "very good" being at 99%. However, the buyer's order and IT system is an obstacle for LSP to make plans and organize work efficiently because of the automatic function serving the buyer's customer on a "day-after" basis.

5.4.3. Activity links

In the case of firms in Denmark, all three actors in a BSL triad are engaged in coordinating their transport activities, which increases the transport efficiency within the triad. The three actors are also involved in detailed communication, teamwork, continuous improvement, information technology, and frequent meetings. In the case of construction firms in Sweden, LSP has free access to the buyer's construction site and can plan their deliveries according to their logic. Later, the buyer has opened up for the dialogue with the LSP to incorporate the expertise and perspectives of LSP to increase the transport efficiency.

6. Synthesizing on the basis of the evidence

Table II summarizes the analysis above concerning lean improvements that firms achieved due to triadic interactions in BSS and BSL triads.

[Table II. Summary of LM principles and practices achieved due to triadic interactions]

Five studies provide evidence that in a closed BSS triad, suppliers became better integrated with the customer. Seven studies show that closed BSS triadic interactions enabled all three actors to achieve Genchi Genbutsu (i.e. going to see with your own eyes what happened). Only one study discusses how learning between suppliers reduces the changeover time and hence contributes to Heijunka. Heijunka is a principle of LM that tends to be neglected in management studies, therefore, it is not surprising to find only one paper discussing this aspect of lean. Five papers provide examples of improved OTD and JIT thanks to closed BSS triads. Five papers showcase lower costs, seven improved quality (Jidoka), and eight papers present examples of eliminating waste and continuous improvement (Kaizen) that were enabled in the closed BSS triad. Only one paper mentions that better safety was achieved due to the closed BSS triad, probably because safety issues were not in the focus of the research questions in the discussed papers. Table II also provides an overview of LM principles and improvements achieved thanks to the BSL closed triad. These are – first LM principle about value from the customer point of view, improved JIT and OTD, lower costs, and continuous improvement (Kaizen). Both types of studies about suppliers and logistics service providers mentioned that the three actors better understand the Lean Philosophy when they engage in triadic interactions.

Regarding the substance and the multilayered nature of the triadic relationships, Table III summarizes the analysis results and contributes to a synthesis of the findings.

All analyzed empirical cases are narratives that discuss the evolution of triads (from open to closed) and their impact on lean performance over time. The analysis results are organized in Table III in two columns. The left column presents the prior situation of the "open" BSS triad and "weakly closed" BSL triad graphically, which we call "non-lean triad"; it also shows the properties of these triads that lead to "low/average" lean performance. The right column presents the end situation of the "closed" BSS triad and "closed" BSL triad graphically, which we call "lean triad"; it also shows the properties of these triads that lead to "high/optimal" lean performance.

The arrows in Table III depict how the properties of triads change when a "non-lean triad" transforms into a "lean triad".

[Table III. Properties of non-lean and lean triads]

We can summarize our results in four main points. *Firstly*, we observe the tendency of lean firms to create and benefit from two types of closed triads, BSS and BSL. *Secondly*, we show LM improvements as "drivers for closure" in BSS and BSL triads (see Table II). *Thirdly*, we describe different "properties" BSS and BSL triads that lead to different LM outcomes (see Table III). *Fourthly,* we show the importance of developing all three layers between three actors in both BSS and BSL triads for LM.

7. Discussion

According to the analysis above, **multilayered closed triads** contribute to the LM improvements that are more difficult to achieve without a multilayered closed triadic architecture. We believe that is a relevant insight for the strand of IMP literature discussing the value of triads. We think especially of the IMP discussion on the value potential of connected relationships (Vedel *et al.*, 2016; Vedel, 2016), specifically on connections *between suppliers in the BSS triad for learning* (Håkansson *et al.*, 1999; Holmen *et al.*, 2013) and the IMP discussion on third-party logistics on *the value of connections in BSL triad for effective logistics* (Bask, 2001; Wang *et al.*, 2016).

Previous studies have emphasized the role of **actors** in a triad. For example, Vedel and Servais (2017) and Vedel and Servais (2019) discussed the role of a third actor as an intermediary either in the home or host country that allows for a triadic foreign entry mode. Dubois and Fredriksson (2008) advocate for a triadic sourcing strategy, highlighting that role of the buyer to create interdependences between suppliers contributes to efficiency and innovation for both buyer and two connected suppliers.

Concerning the role of actors, our analysis unequivocally shows that the **buyer plays a strategic role in a "lean" multilayered closed triad**. In both types of "lean" triads, BSS and BSL, the buyer initiates the connection between two other actors, orchestrates the relationships, and establishes the rules of interacting so that the actors behave less opportunistically. The buyer's proactive role is pivotal for the actors to develop trust and generate learning synergies.

Our paper also highlights the importance of the role of **suppliers** in a BSS "lean" triad. We agree with Wu *et al.* (2010) that **suppliers need to cooperate more than to compete** and that at least one of the suppliers needs to perform well for both suppliers to effectively learn from each other. In the BSL "lean triad" it is pivotal that the role of LSP changed from being just a supplier of carrier services, as it is in BSL "non-lean triad", into the actor that is actively involved in logistics decisions with both buyer and supplier.

Several studies focused on only one of the layers of the substance of business relationships in a triad. Hartmann and Herb (2015) studied actor bonds, showing how factors related to the quality of social relationships, such as trust, mutual appreciation, and the presence of shared norms, constitute important coordination mechanisms that allow the triad to function toward common goals.

This paper provides evidence that the triad needs to consolidate ***interactions on all three layers and between the three actors***, at least in lean processes. Hence, we reaffirm a longstanding claim made by Håkansson and Johanson (1992) and Håkansson and Snehota (1995) about the significance of all three layers of the substance of a business relationship between business actors, also within triads. Specifically, suppliers in BSS "lean" triad firstly develop actor bonds (e.g. trust, etc.), which allow them to develop activity links further (e.g. conduct mutual visits) and resource ties (e.g. share knowledge). All in all, this results in suppliers learning from each other and achieving such LM goals as improved quality (Jidoka), etc. The buyer also benefits from such a triadic connection because suppliers become closer to each other and the buyer, in a fashion that permits them a deeper understanding of the real customer needs, and hence, to achieve one of the fundamental principles of LM, namely to specify a value from the customer's point of view.

In the "non-lean" BSL triad, an important observation is that LSP needs are underrated in a triad. In contrast, the buyer-supplier relationship dominates the triadic balance of power. Therefore, in the "lean" LSP triad, all three actors are equally involved in the logistics decision-making process. The idea of a balanced BSL triad, where the interests of all three actors are taken equally into account, goes in line with logistics studies on triads (Hedvall *et al.*, 2016; Hedvall *et al.*, 2019), which emphasize the importance of balanced relationships in a BSL triad and with IMP study of Wang *et al.* (2016), who suggest that LSPs take a "collaborative perspective" towards buyer and supplier in their strategy and not just the role of a mediator. By being directly connected to the buyer and supplier, the LSP can plan its deliveries more efficiently. "Lean" BSL triad enables the firms to improve the quality and efficiency of delivery (JIT and OTD), to lower the costs of delivery, and to improve continuously (Kaizen).

8. Conclusion

8.1. Theoretical implications

The aim of the paper was to develop the existing theoretical concept of **a triad** by informing it with the **ARA model**, what compounded a concept of a **multilayered triad,** in a new empirical LM context. We nuanced the concept of a multilayered triad by showcasing that it is a valuable analytical instrument for analyzing how lean firms work with their suppliers and carriers because the concept allows deconstructing the relationships of lean firms in triads into several elements:

- properties of multilayered triads: the role of each actor, actor bonds, resource ties, and activity links,
- the structure of BSS and BSL multilayered triads should be closed on all three layers for such triads to be "lean",
- combining multilayered triad with the elements of LM (Lean House) allows us to understand that LM goals, e.g. Heijunka, are not tied to only one of the properties of the multilayered triad, but the combination of several characteristics, such as the role of actors together with the three layers in three relationships.

8.2. Managerial implications

We show that it is essential to develop relationships on three layers between all three actors in both types of triads (Table III). Paradoxically to LM, such investment into three layers of relationships leads to improved firm lean performance (Table II). We think that the concept of a **multilayered triad** has a practical application and can be used as a tool by lean managers for reflecting on and analyzing their relationships with partners.

8.3. Limitations of the study and future research implications

In the theory part, we discussed that opinions about closed and open triads vary among the IMP school of thought, American sociologist Mark Granovetter and Japanese tradition. Our findings support Granovetter (1973) and Madhavan *et al.* (2004), who discuss the tendency of open triads to close by showing that economic incentives of LM are the driving force behind the closure of triads and by showcasing the advantages of closed triads also in the industrial context.

However, Holmen *et al.* (2007) argue that a supplier network cannot exist of only close connected ties (not always relevant, too costly, etc.), it is somewhat a mix of closed and open triads. Therefore, zooming into the effect of both open and closed triads on LM is an interesting direction for future research. Moreover, it can also be interesting to broaden the perspective and study how triads are embedded in the network with other actors. This can be particularly relevant in the case of logistics triads because the study of Andersson *et al.* (2019) shows that for LSP to make effective planning (time, site, amount of trucks, etc.), LSP's needs not only to establish direct relationships with both buyer and supplier but also directly to relate to the fourth parties like sub-contractors. Future studies can also think about other types of triad configurations, such as *buyer-supplier-customer*, *buyer-customer-customer*, or *buyer-buyer(competitor)-supplier* triads, etc.

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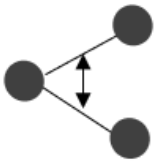
Appendix

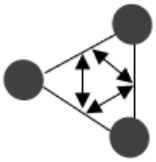
OPEN TRIAD
(Vedel et al., 2016)
One actor is connected to two other actors



Other definitions found in the literature:
The forbidden triad (Granovetter, 1973)
Serial triad (Holmen and Pedersen, 2000)
Triad with a structural hole (Choi and Wu, 2009)
Two dyads - relationships between two pairs of actors (Ford and Håkansson, 2013)
Brokerage (Siltaloppi and Vargo, 2017)

CLOSED TRIAD
(Vedel et al., 2016)
Each of the three actors is connected to the other two actors

TRIADIC INTERACTION
All three actors in a triad directly interact with each other



Other definitions found in the literature:
Unitary triad (Holmen and Pedersen, 2000)
Transitive triad (Madhavan et al., 2004)
A triad - relationships between all the actors (Ford and Håkansson, 2013)
Coalition (Siltaloppi and Vargo, 2017)

MULTILAYERED TRIAD
figure from Pedersen (1987)
two relationships connected on three layers of substance – actor bonds, resource ties and activity links

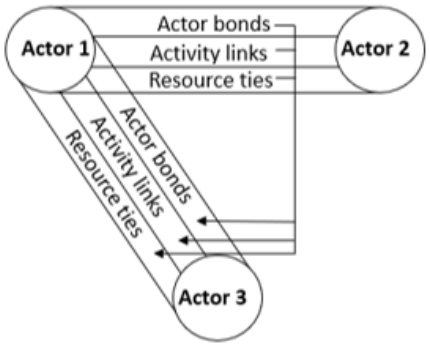


Figure 1. Triad

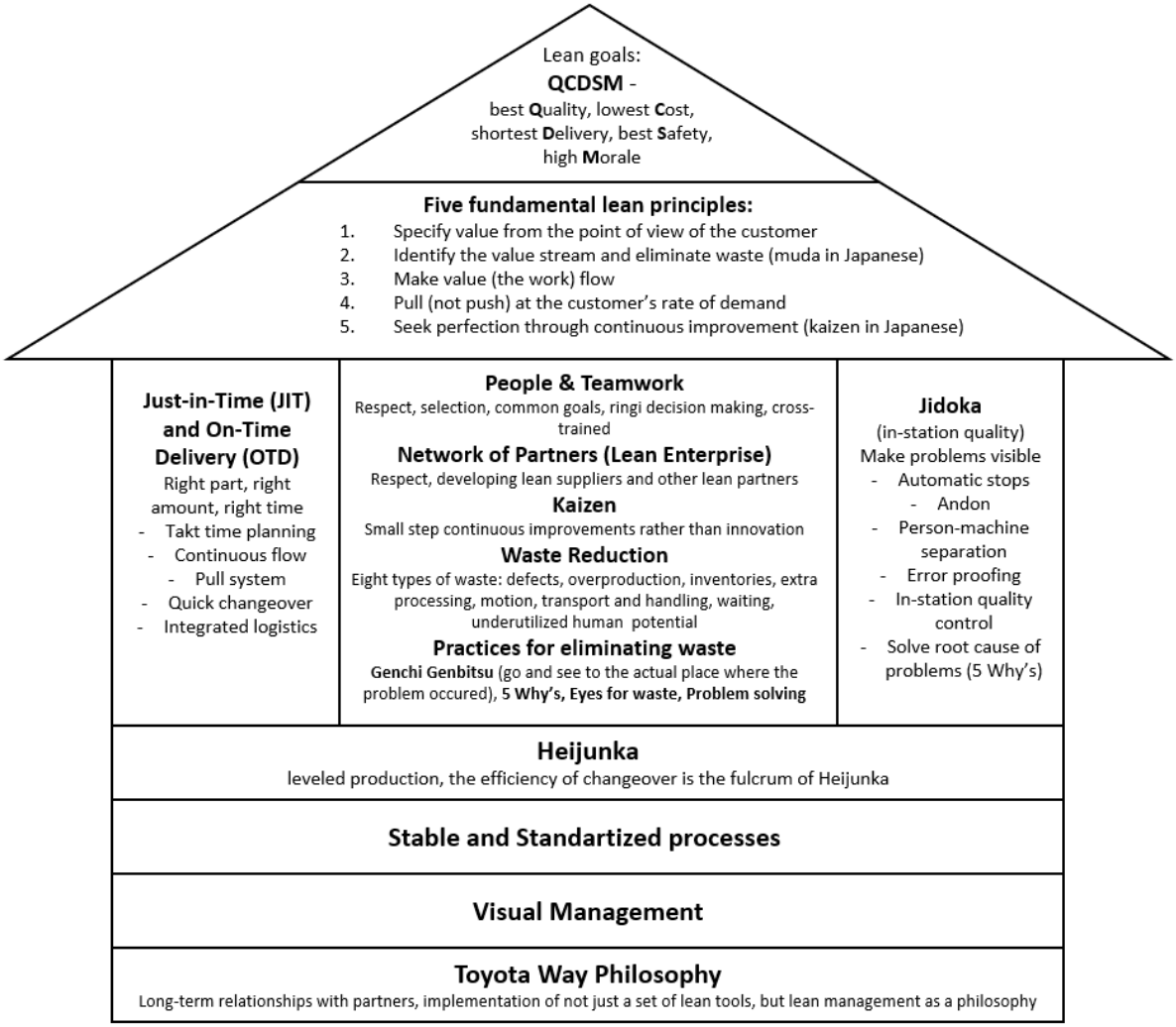


Figure 2: Lean House (based on the lean house of Liker (2004)

Author/year	Domain	Method	Sample type, size, companies
BSS triad			
Sako (1996)	Supply chain management	Case study Survey	Case study - company visits and interviews of purchasing departments and suppliers' association offices of all Japanese assemblers and some first-tier suppliers in 1992-1993. Companies: Toyota, Nissan, Mitsubishi, Mazda Yokokai, Isuzu, Fuji Heavy Industries, Daihatsu, Suzuki Motors, Hino, Nissan Diesel, and Honda Survey – a large-scale survey of first-tier suppliers of nearly 500 parts to all the 11 Japanese assemblers, conducted in July 1993
Dyer and Nobeoka (2000)	Supply chain management	Case study Survey	Case study - Toyota and its first-tier suppliers in both Japan and in the United States, interviewed more than 30 Toyota executives Survey – 97 suppliers in Toyota's U.S. supplier association and 50 of their largest first-tier Japanese suppliers (received surveys from 48 suppliers - 49.5% response rate). The Japanese survey, conducted with the support of the Japanese Auto Manufacturers Association (JAMA), produced 38 responses (a 76% response rate)
MacDuffie and Helper (2007)	Supply chain management	Case study	Three individual case examples: 1) "Collaboration with trust" by Toyota, Honda and Nissan, 2) the small second-tier supplier Stoneridge to Big Three customers, 3) the effort of supplier Delphi (formerly part of GM) to collaborate with trust
MacDuffie and Helper (1997)	Supply chain management	Case study	Case study of Honda and its 3 strategic suppliers
Dubois and Fredriksson (2008)	Supply chain management	Case study	1 triad - Volvo cars and its suppliers of seats. I phase 1998-2001 involved Volvo Cars and all of its module suppliers, more than 200 semi-structured interviews (25 were directly related to the relationships between Volvo and its two suppliers of seats: JCI and Lear). II phase – in 2003-2006, 11 semi-structured interviews with representatives of 3 firms
Powell and Coughlan (2020)	Lean supplier development / supply chain management	Action learning research for 6 years	Kongsberg Maritime and its 6 strategic suppliers
Aune et al. (2013)	Supply chain management	Case study	6 buying companies in subsea industry and their relationships with one common supplier
Håkansson et al. (1999)	B2B relationships	Case study	Swedish construction project: main contractor Swedish construction firm, its 16 suppliers and 26 subcontractors
BSL triad			
Larson and Gammelgaard (2001/2002)	Logistics	Survey and case study	Survey – was sent to 665 firms in the sampling frame, which was made using the Danish database that lists all VAT-registered Danish firms (about 450000) by industry sector. 12 specific logistics industry sectors were selected. Response rate 75/651 or 11.5%. The survey was designed to assess third-party logistics provider involvement in logistics triads Case study – 2 short case studies, based on published reports and interviews with triad participants. Buyer (large retail chains) – supplier (food or electronics firms) - logistics service provider
Andersson et al. (2019)	Logistics	Case study	One case study of transport service triad. Research project about logistics planning aimed at more energy-efficient freight transports in Sweden. Three main actors in the case: the supplier of the goods (Wholesaler), a large main construction company buying the goods (Contractor), transport service provider (Hauler)

Table I. The methodology of the articles discussed in section 5 of the paper

	Valuer from the customer point	Genchi Genbutsu	Heijunka	JIT and OTD	Lower costs	Jidoka	Eliminating waste	Better safety	Kaizen	Lean philosophy
BSS closed triad										
Sako (1996)	•	•							•	
Dyer and Nobeoka (2000) *Example of Toyota*	•	•	•	•	•	•	•		•	•
MacDuffie and Helper (2007) *Example of Toyota*		•			•	•				•
MacDuffie and Helper (1997) *Example of Honda*		•				•	•			
Dubois and Fredriksson (2008)	•	•			•	•		•	•	
Powell and Coughlan (2020)	•	•		•		•	•		•	•
Aune et al. (2013)	•	•				•	•		•	
Håkansson et al. (1999)				•		•			•	
BSL closed triad										
Larson and Gammelgaard (2001/2002)	•			•	•				•	•
Andersson et al. (2019)				•					•	

Table II. Summary of LM principles and practices achieved due to triadic interactions

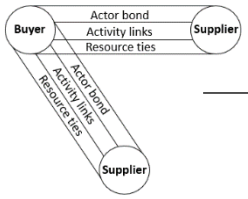
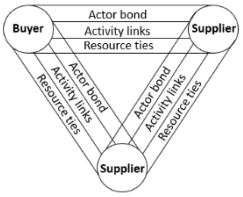
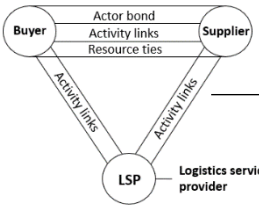
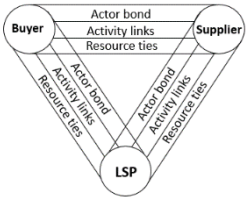
	Non-lean triad	Lean triad
	BSS open triad 	 **BSS closed triad**
Lean performance	Low / average	High / optimal
Structure	Open triad	Closed triad – buyer and two suppliers are all connected to each other **on all three layers**
Layers: **Actor bonds**	No bond between suppliers	Actor bonds between three actors: long-term oriented, based on trust and commitment
Layers: **Resource ties**	No resource ties between suppliers	Resource ties between three actors: knowledge, technical and other information, people - short/long-term employee exchange, employees working together in a team, technical adaptations. Suppliers get access to "free" network resource of the buyer – free lean consultants at the supplier association
Layers: **Activity links**	No activity links between suppliers	Activity links between three actors: regular meetings, group work, visits (Genchi Genbutsu)
Actor toles: **Buyer**	Buyer manages suppliers individually	Buyer initiates the connection between suppliers, engages, controls, establishes rules of interaction to avoid one of the actors to free ride, creates the infrastructure, base for interaction (e.g. supplier association or connects actors via IT tools, e.g. internet, intranet, EDI, consulting groups, learning teams, etc.)
Actor toles: **Supplier(s)**	Suppliers are indifferent to each other or competing	Suppliers should be more cooperating than competing. At least one of the suppliers should perform "good"
	Non-lean triad	**Lean triad**
	BSL weakly closed triad 	 **BSL closed triad**
Lean performance	Low / average	High / optimal
Structure	Weakly closed triad – buyer and supplier are connected to LSP **on one activity layer**	Closed triad – buyer, supplier and LSP are directly connected to each other **on all three layers**
Layers: **Actor bonds**	Actor bond between buyer and supplier, no actor bond with LSP	Actor bonds between three actors: long-term oriented, based on trust and commitment
Layers: **Resource ties**	Resource ties between buyer and supplier, no resource ties with LSP	Resource ties between three actors: knowledge and information sharing, connection through IT system, not only between buyer and supplier, but also with LSP
Layers: **Activity links**	LSP is connected to the buyer and supplier via activity links by performing carrier services	Activity links between three actors: all three are engaged in coordination of transport activities, communication, teamwork, continuous improvement activities, use of IT, frequent meetings. LSP is involved in more activities with buyer and supplier than just carrier services
Actor roles: **Buyer**	Buyer sets the terms for deliveries	Buyer initiates the connection between supplier and LSP, engages, controls, establishes rules of interaction to avoid one of the actors to free ride, creates the infrastructure, base for interaction (connects actors via IT tools, e.g. internet, intranet, EDI, etc.)
Actor roles: **Supplier**	Supplier primarily controls over inventory and supply contract terms	Supplier supports the idea of triadic interaction and engages with both buyer and LSP
Actor roles: **LSP**	LSP primarily controls over transportation mode choice and logistics service rates. LSP is left out of the logistics decisions with buyer and supplier	LSP needs to have a good connection with both buyer and supplier because in the BSL triad the priority is given to the buyer and supplier interests. LSP is actively involved on logistics decisions with buyer and supplier

Table III. Properties of non-lean and lean triads