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Participatory Demand-Supply Systems

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Abstract

Introducing the notion of Participatory Demand-Supply (PDS) systems as socio-technical systems, this paper focuses on a new approach to coordinating demand and supply in dynamic environments. A participatory approach to demand and supply provides a new frame of reference for system design, for which the engagement of all stakeholders plays an important role, as does distributed ICT. This approach has been applied to an industrial case to explore new opportunities enabled by distributed ICT for communication, negotiation, joint decision-making, and collective learning required for coordinating demand and supply. The application results in a platform as a test-bed for collecting relevant information to study the participation of stakeholders (actors) in coordinating a PDS system.

Keywords: Demand-Supply Systems; Participatory systems; Participatory Demand-Supply Systems; Coordination

1. Introduction

Managing demand and supply in today's dynamic environment is an enormous challenge. Most operational approaches focus on coordinating demand and supply from the supply chains perspective to couple supply to demand. This paper proposes a participatory systems approach to coordinating the intertwined nature of demand and supply of

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a product [1]. In this approach, all stakeholders (actors) participate in a Demand-Supply (DS) system. They contribute and take responsibility for their accepted role in the system. The reason for the existence of such systems is coordinating demand and supply, supported by appropriate coordination mechanisms and technologies, to creating positive stakeholders' experience.

Coordinating demand and supply of products has economic impact. From a micro-level point of view, on the one hand, shortage of a product results in stock-out and lost sales. This situation creates negative end-customer experience and causes negative impacts on profitability of the involved businesses. On the other hand, excess of a product results in higher inventory level and causes productivity problems. From a macro-level point of view, on the one side, the shortage results in higher prices and causes social welfare problems, which is crucial especially for fundamental products. On the other side, excess of products is an indication of resource utilization problems.

This paper defines a DS system as a multi-layer socio-technical system of social and technical entities (actors and man-made components respectively) to fulfil demands by supplying one or more products. In this context, a product is a good, a service, or a combination of the two. Coordinating demand and supply of products refers to the process of delivering one or more required products according to specified qualities, appropriate price, in the right quantity, at the right moment, and at the right place.

Coordinating demand and supply of a product is complex. First, DS systems themselves are complicated. The many actors involved in a DS system are inter-dependent, self-interested, autonomous, each with their individual goals and in most cases unaligned [2]. Furthermore, many technical components (often locally optimized) such as factories, warehouses, transportation systems, and infrastructure systems are involved in coordinating demand and supply of a product. Second, the situation is dynamic and changes over time. Actors enter and exit. New technical components replace obsolete ones. The complicated, dynamic nature of coordinating demand and supply of a product results in complexity, making thorough understanding and prediction of behaviours almost impossible.

The DS systems concept adheres to a systems point of view and demonstrates interrelations among actors, technical components, and between the two in both the business and operations layers. The concept provides a frame of reference to study the complexity of coordinating demand and supply. A DS system consists of two layers (Figure 1)

- *Business layer* contains three networks. A *demand network* including actors such as end-customers and/or end-users; A *distribution network* including wholesalers and retailers; A *supply network* including a producer/manufacturer, suppliers, and contractors. The business layer represents the social aspects of a system, including organisational aspects.
- *Operations layer* contains a network of activities required for transforming raw materials into the final product. This layer also includes conventional Information and Communication Technology (ICT) systems such as Enterprise Resource Planning (ERP) systems, Advanced Planning Systems (APS), Workflow Management Systems (WMS), etc. The operations layer represents the technical aspects of a DS system.

Considering both the business and operations layers, the DS systems concept makes it possible to study the complexity of coordinating demand and supply of a product from soft and hard systems approaches. Soft systems approaches relate to the behaviours of actors, such as the Soft Systems Methodology (SSM) concept [3]. Hard systems approaches relate to how technical components interact with one another, such as the System of Systems concept [4, 5].

The Participatory DS (PDS) system concept introduced in this paper is a broader concept than the concept of a supply chain. Although a network approach to supply has been extensively acknowledged in supply chain literature [6-14], the supply chain concept focuses on supply and considers the effects of demand to be an exogenous factor. Such an approach misses the intertwined nature of demand and supply. Moreover, instead of viewing DS systems as a chain (linear structure), the PDS system concept focuses on dynamic non-linear relations among actors, among the technical components, and between the two. Finally, the PDS system concept adheres to the systems thinking paradigm and considers a PDS system to be an open system in a dynamic environment.

Actors in a PDS system behave strategically to achieve their individual goals. In most cases, the strategic behaviours of actors bring about local optimization and individual actions [14, 15]. Shortage and excess of products are results of local optimization that ultimately results in demand and supply incoordination and performance decrease. For example, the Bullwhip effect is an instance of incoordination and low performance [16]. Actors are inter-dependent, and usually no single actor has the resources required to balance demand and supply in complex environments in which they act. Therefore, actors need to work together for coordinating demand and supply and improving system performance [17, 18]. Hence, the participation of all actors in a PDS system is required to coordinate demand and supply.

Approaching the coordination of demand and supply from a participatory perspective and introducing the PDS systems concept has been structured as follows. Section 2 elaborates on strategic behaviours of actors in a PDS system. Section 3 introduces the participatory systems concept, in the context of relations between participants, accomplishing the mission of a system, and coordination. Section 4 applies the participatory systems concept to DS systems and introduces a model of PDS systems. Section 5 illustrates the potential of the model for the design of a dyadic PDS system in practice, for a real industrial case. Section 6 discusses the paper and suggests directions for future research. Section 7 concludes the paper.

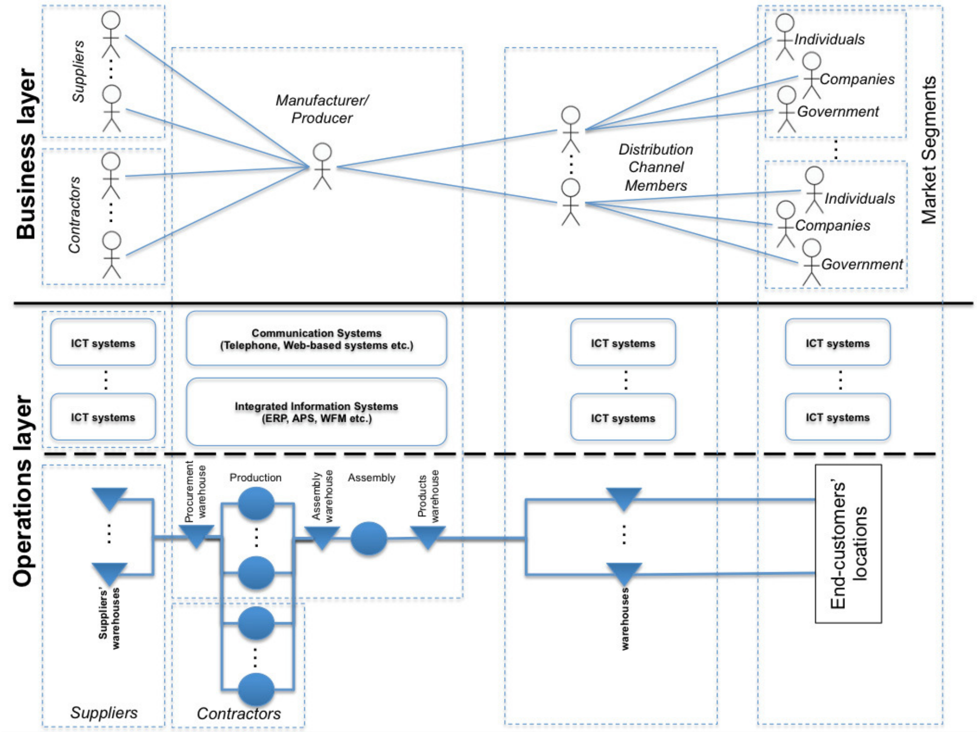

Figure 1. An example of a DS system
(Lines represent business relations at the business layer and materials flow at the operations layer.)

2. Strategic Behaviours in DS Systems

Actors involved in the business layer of a PDS system (Figure 1) behave strategically to achieve their individual goals:

- *End-customers* in the market segments, such as, individuals, companies, and the government, most often follow a last moment purchasing strategy, maximizing possible benefits and minimizing possible risks [16].
- *Distribution channel members* such as wholesalers, distribution centres, and retailers most often follow a local inventory policy. They do not order in time and at the optimal quantity needed for coordinating demand and supply [14].
- *Manufacturer/producer* has two different behaviours. On the one hand, manufacturers/producers operate according to economies of scale and scope principles to decrease the total costs by increasing the

production[19-21]. On the other hand, manufacturers/producers double marginalize prices in relations with their suppliers and contractors [22].

- *Suppliers* providing raw materials, standard industrial components, and parts, behave similar to a manufacturer/producer.
- *Contractors* providing production and support services behave similar to a manufacturer/producer.

The above behaviours are individual actions aimed for local optimization. Such behaviours result in system incoordination and cause performance issues. Collective actions are needed for improving the system performance. Participation shows a solution direction for collective actions required for improving the system performance.

3. The Participatory Systems Approach

Socio-technical systems are purposeful systems. The mission of a socio-technical system is the reason of its existence, and (usually) addresses a societal need [23]. In this context, *a participatory system is a socio-technical system in which actors participate to accomplish the system's mission*. Participation is related to a larger whole and participants are empowered to act accordingly [23]. Participants engage in a participatory system. They contribute to a system mission and take responsibility according to their accepted roles in the system. Participatory systems values (trust/integrity, empowerment/autonomy, and engagement) are essential for accomplishing the mission [24]. Coordination, managing relations [25, 26], is crucial to participatory systems (Figure 2).

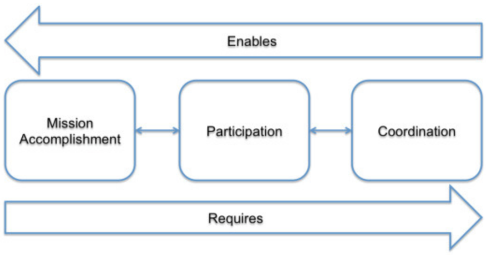

Figure 2. Participatory systems concept

The participatory systems approach is a value-based approach:

- Participants need to be able to *trust* the *integrity* of a system. A well-designed governance structure within a participatory system should be designed to this purpose.
- Participants are *autonomous*, and a participatory system should *empower* participants by providing them the freedom of choice within the boundaries of the governance structure, to act and take responsibility.
- A participatory system *engages* actors by (social) connectedness, which means being connected, interact and possibly perform collective actions [27, 28]. The ability to communicate, negotiate, joint decision-making, and collective learning; to interact, work together, and contribute to accomplishing a mission.

Well-designed coordination (including coordination mechanisms and technologies [25, 26]) enables participants to engage in a participation process. Value sensitive design based on these core values is essential.

One single actor is most often not capable of improving the performance of a socio-technical system on his/her own as the resources required for improving the performance are distributed among actors. The participatory systems approach promotes the idea of improving system performance by individual and joint actions, sharing possible benefits, and possibly taking less risk both collectively and individually.

4. Participatory DS Systems (PDS)

The participatory system concept shows a solution direction for coordinating demand and supply. The goal of a PDS system is to create an environment in which all actors actively engage to coordinate demand and supply of one or more products, to improve system performance, to share benefits proportionately, and to take less risk both collectively and individually. In a PDS system, actions of participants are coordinated: synchronized, harmonious, and in time.

4.1. The mission of a PDS system

The mission of a participatory system is the reason for its existence. A PDS system exists to create a positive experience for all actors involved as a result of coordinating demand and supply of one or more products. Therefore, *the mission of a PDS system is to coordinate demand and supply by stakeholder (actor) engagement for the purpose of creating a positive experience for all actors involved in the system.* Participatory systems values are essential for accomplishing this mission, which distinguishes a PDS system from a DS system.

4.2. The participation process in a PDS system

The PDS system proposed in this paper involves end-customers, distribution channel members, manufacturers/producers, and their suppliers and contractors. They participate in coordinating the system using the following process:

- *End-customers* share their needs including information on quality, quantity, time, and place, i.e. demand information, and order products on time. Demand information represents end-customers' expectations, while orders are end-customers' commitments.
- *Distribution channel members* most often perform Just In Time (JIT) purchasing, smaller orders and more frequent deliveries. Distribution channel members purchase products as needed to meet end-customer demands, and manage the purchasing process carefully to keep inventory as small as possible, whilst preventing stock-outs [29, 30].
- *Manufacturers/producers*, *suppliers,* and *contractors* reduce production lead-time, improve quality, eliminate non-value-added activities to reduce costs, and provide better and faster services to customers. Implementing the Quick Response Manufacturing (QRM) strategy, for example, results in these objectives [31, 32].

Such a participation process makes it possible to work with actual demand information and real orders, assures shortest technically feasible supply lead-time, and results in coordinating demand and supply of products.

4.3. Coordination in a PDS system

Participation necessitates managing relations among participants (the system actors). Following coordination theory [25, 26], coordinating a participation process requires identification of relations among participants, defining coordination mechanisms(s) for each relation, and implementing these mechanisms using suitable technologies.

From a relational point of view, relations among actors involved in a DS system form dyad, chain, and network structures [8, 13]. Dyadic relations involve two participants, chain relations involve a linear structure with three or more participants, and network relations involve participants in a non-linear structure. Addressing dyad, chain, and network relations separately is crucial because of the synergy phenomenon in systems [33]: the behaviour of a chain is not the same as the sum of the behaviour of its constituent dyads, and the behaviour of a network differ from the sum of its constituent chains.

From a coordination mechanism’s point of view, institutions coordinate actors' behaviours and form their relations [34-36]. Adhering to Koppenjan and Groenewegen’s model of socio-technical systems [37] adopted from Williamson’s work [38], Figure 3 describes how institutions coordinate a PDS system. Layer 1 relates to actors and their interactions (i.e., communications and exchanging products, money, and information) and does not include institutions. Layer 2 relates to formal and informal institutions in the system (i.e., arrangements defined by the actors involved: contracts and agreements). Layer 3 relates to formal institutions in the system environment (i.e., regulations such as rules, laws etc.). Layer 4 relates to informal institutional in the environment of the system (e.g., cultural elements such as norms, values etc.). In short, layer 1 represents actors' interactions, and the other three layers represent coordinating institutions. In a PDS system, participants interact with one another in a participation process according to the defined and agreed arrangements (layer 2). Regulations and cultural elements (layers 3 and 4) enforce these arrangements.

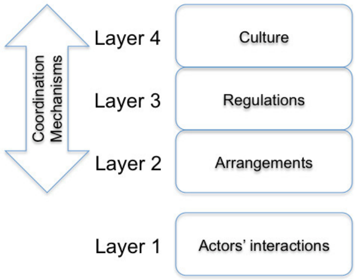

Figure 3. The four-layer describing coordination mechanisms of a PDS system

From a coordination technology point of view, participants are connected, information is distributed, and flows are coordinated in a PDS system. Distributed ICT is the enabler of a PDS system (Figure 4) that makes coordination between distributed decentralized actors and technical components possible. Distributed ICT is a decentralized network of autonomous ICT components. Each ICT component refers to an individual technical component such as hardware and software designed for facilitating communication and information exchange. Distributed ICT in a PDS system enables distributed communication, clustering and networking (for example, social networking for the business layer) in contrast to the more conventional computer systems in the operations layer that are mainly concerned with processing and storage of transactions involving flows of products, finances, and related information (see Figure 2).

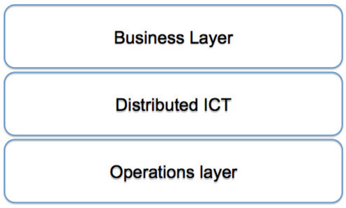

Figure 4. Distributed ICT in a PDS

Figure 5 illustrates the coordination design space in a PDS system. First, regulations and cultural elements are (most often) taken as a given for design purposes because, layers 3 and 4 change in the long term, but most often not in the short-term [38]. As a result, PDS systems design focuses on arrangements such as contracts, information sharing protocols, joint decision-making procedures, and market mechanisms (layer 2) to form participation at layer 1. Second, these arrangements are designed for dyad, chain, and network levels.

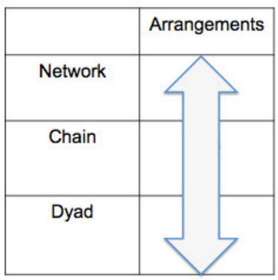

Figure 5. Coordination design of a participatory demand-supply system

5. Industrial Case: The Design of a PDS System

This section illustrates the potential of the PDS system concept for the design of a platform to facilitate coordinating demand and supply of a group of products. The platform connects a manufacturer and its sales agents (a Persian water pumps manufacturer and its independent sales agent companies (comparable to dealers)). The platform is a means of communication, capable of implementing information sharing and joint decision-making mechanisms required for coordinating business relations. The goal is to enable actors to participate in coordinating demand and supply of products to improve the performance of the current DS system.

The platform provides the ability to define private groups using web-based communication. Each group includes sales agent's personnel and the area manager from the manufacturer. The platform facilitates communication within a group and supports the following activities (Figure 6):

- '*Segment 1*' where *marketing intelligence* according to Porters' five forces model [39, 40] takes place, where participants communicate and share information about the market,
- '*Segment 2*' where participants share relevant *strategic information* concerning political, economic, social, and technological subjects from the Internet (sharing links),
- '*Segment 3*' where communications and *joint decision-making* with regard to logistics operations take place.
- '*Segment 4*' where communications and technical discussions about *sales engineering* and technical topics happen.

The platform also captures all activities and enables further analysis and synthesis required for the purpose of future analysis and learning. Documentation capability provides the chance to use the platform as a test-bed for future business research.

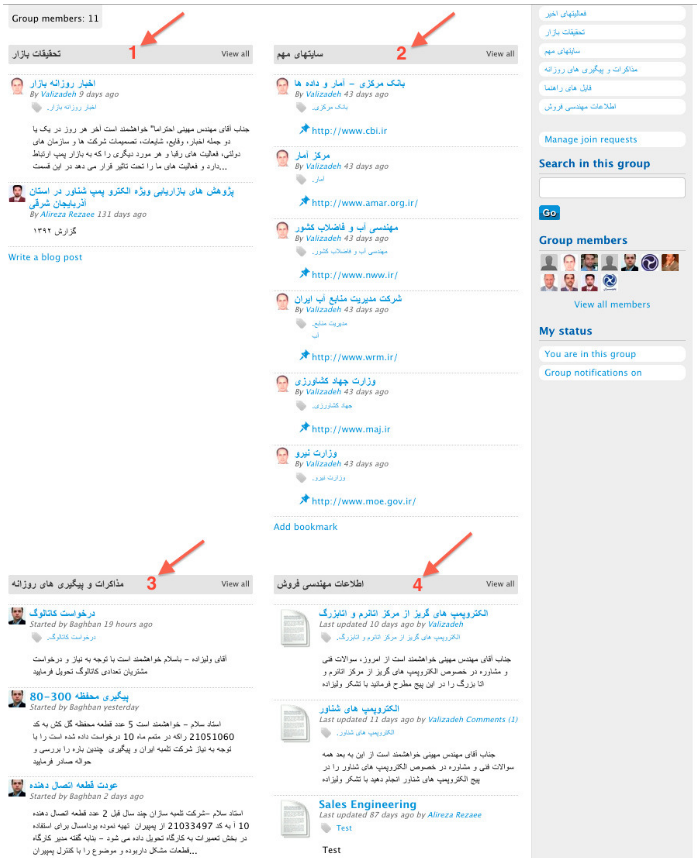

Figure 6. A screenshot of the webpage giving access to the platform

This environment supports participants' business relations and enables them to improve their operations performance (layer 1), because participants are connected, share marketing and business environment information, and jointly decide on logistics activities. The current situation is the implementation of information sharing and joint decision-making mechanisms (layer 2) in a dyadic level. However, the platform is extensible and has the potential to coordinate chains and networks by defining relevant groups. Although the platform is in the initial test period, participants have reported positive experiences on coordinating their business relations (research is continuing) and changing roles.

6. Discussion and Future Research

The paper focuses on coordinating demand and supply of products using a participatory approach. The paper first introduces the DS systems concept and then applies the participatory systems approach to introduce a PDS system model. Finally, the paper shows the potential of designing such systems including a distributed ICT layer in a platform designed to coordinate demand and supply of a product in an industrial setting. This section discusses the PDS systems model, the industrial case, and proposes future research directions.

6.1. PDS systems model

Implementing the concept of participatory PDS systems requires well-designed coordination mechanisms and technologies. Cultural elements such as norms and values used by the New Institutional Economics, and cultural dimensions such as those proposed by Hofstede [41] can be defined using qualitative research. Regulations play a crucial role in designing the coordination especially in international contexts. Understanding the implications of contracts to motivate participation in coordinating demand and supply is essential and contract theory provides a theoretical foundation for the design of contracts [42]. Current research focuses on these topics in a number of domains.

6.2. Industrial case

Interaction within the experimental groups is an indication of the participants' willingness to coordinate demand and supply of products and to improve business performance. The platform enables participants to implement the CPFR (Collaborative Planning, Forecasting, and Replenishment) [43] method by providing them the opportunity to implement relevant information sharing and joint decision-making arrangements (layer 2). Although the platform implements dyadic groups, the platform supports a one manufacturer-many wholesalers network in which wholesalers operate in different market segments. In practice, as a result of working with the platform, wholesalers have initiated new coalitions and operate together, for example by exchanging products. As a result the function to define groups to support such collective actions has been added to this platform. Finally, the impact of regulations (layer 3) e.g., security and privacy, and cultural elements (layer 4), especially organisational cultures, will be taken into account in current research.

6.3. Future research

PDS system design requires further research. Future research includes (1) a model for identifying participation requirements and classifying them into functional, structural, behavioural, and experiential requirements. Requirements analysis is an essential part of designing such systems, focusing on all stakeholders (actors) involved. (2) Investigating the behaviours of participants within such systems. The test-bed introduced in Section 5 is an initial step in this direction. (3) In addition to understanding the behaviours of participants, a hybrid simulation environment is required to test and evaluate a variety of possible scenarios in such systems.

7. Conclusion

This paper proposes a Participatory Demand-Supply model for coordinating demand and supply of products engaging all stakeholders (actors) involved. The model extends the supply chain concept integrating the demand network into the scope of study for the purpose of tackling complicatedness, dynamism, and consequently complexity of coordinating demand and supply. The model provides a means to coordinating demand and supply by supporting actors' active participation - to act, share benefits, and take less risk in a trusted system. Distributed ICT facilitates communication and provides new opportunities for information sharing, joint decision-making, and market mechanisms required for a participation process to accomplish the system mission to which trust/integrity, autonomy/empowerment, and engagement are core.

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References

1. Rezaee, S.A., Oey, M., Verbraeck, A., Brazier, F., *Participatory Demand-Suppy Networks.* CESUN 2014, 2014.
2. Li, X. and Q. Wang, *Coordination mechanisms of supply chain systems* European Journal of Operational Research 2007. **179**(1): p. 1 - 16.
3. Checkland, P., *Systems thinking, systems practice: includes a 30-year retrospective.* 1999.
4. Ackoff, R.L., *Towards a system of systems concepts.* Management Science, 1971. **17**(11): p. 661-671.
5. Jamshidi, M., *System of systems engineering: innovations for the twenty-first century*. Vol. 58. 2011: John Wiley & Sons.
6. Egri, P. and J. Váncza, *A distributed coordination mechanism for supply networks with asymmetric information.* European Journal of Operational Research, 2013. **226**(3): p. 452-460.
7. Kim, Y., et al., *Structural investigation of supply networks: A social network analysis approach.* Journal of Operations Management, 2011. **29**(3): p. 194-211.
8. Miemczyk, J., T.E. Johnsen, and M. Macquet, *Sustainable purchasing and supply management: a structured literature review of definitions and measures at the dyad, chain and network levels.* Supply Chain Management: An International Journal, 2012. **17**(5): p. 478-496.
9. Kaipia, R., H. Korhonen, and H. Hartiala, *Planning nervousness in a demand supply network: an empirical study.* International Journal of Logistics Management, The, 2006. **17**(1): p. 95-113.
10. Luh, P.B., et al., *Price-based approach for activity coordination in a supply network.* Robotics and Automation, IEEE Transactions on, 2003. **19**(2): p. 335-346.
11. Choi, T.Y., K.J. Dooley, and M. Rungtusanatham, *Supply networks and complex adaptive systems: control versus emergence* Journal of Operations Management 2001. **19**(3): p. 351 - 366.
12. Tsiakis, P., N. Shah, and C.C. Pantelides, *Design of multi-echelon supply chain networks under demand uncertainty.* Industrial & Engineering Chemistry Research, 2001. **40**(16): p. 3585-3604.
13. Harland, C.M., *Supply chain management: relationships, chains and networks.* British Journal of management, 1996. **7**(s1): p. S63-S80.
14. Fugate, B., F. Sahin, and J.T. Mentzer, *Supply chain management coordination mechanisms.* Journal of Business Logistics, 2006. **27**(2): p. 129-161.
15. Sahin, F. and E.P. Robinson, *Flow coordination and information sharing in supply chains: review, implications, and directions for future research.* Decision sciences, 2002. **33**(4): p. 505-536.
16. Lee, H.L., V. Padmanabhan, and S.a.s. Whang, *The bullwhip effect in supply Chains.* Sloan management review, 1997. **38**(3): p. 93-102.
17. Kanda, A., S. Deshmukh, and others, *Supply chain coordination: perspectives, empirical studies and research directions.* International journal of production Economics, 2008. **115**(2): p. 316-335.
18. Simatupang, T.M., A.C. Wright, and R. Sridharan, *The knowledge of coordination for supply chain integration.* Business process management journal, 2002. **8**(3): p. 289-308.
19. Panzar, J.C. and R.D. Willig, *Economies of scope.* The American Economic Review, 1981: p. 268-272.
20. Teece, D.J., *Economies of scope and the scope of the enterprise.* Journal of economic behavior & organization, 1980. **1**(3): p. 223-247.
21. Krugman, P., *Scale economies, product differentiation, and the pattern of trade.* The American Economic Review, 1980: p. 950-959.
22. Gaudet, G. and N. Long, *Vertical integration, foreclosure, and profits in the presence of double marginalization.* Journal of Economics & Management Strategy, 1996. **5**(3): p. 409-432.
23. Nevejan, C. and F. Brazier, *Granularity in reciprocity.* AI & society, 2012. **27**(1): p. 129-147.
24. Brazier, F. and C. Nevejan, *Vision for Participatory Systems Design.* CESUN 2014, 2014.
25. Crowston, K., *A coordination theory approach to organizational process design.* Organization Science, 1997. **8**(2): p. 157-175.
26. Malone, T.W. and K. Crowston, *The interdisciplinary study of coordination.* ACM Computing Surveys (CSUR), 1994. **26**(1): p. 87-119.
27. Köbler, F., et al., *Social Connectedness on Facebook-An Explorative Study on Status Message Usage.*, in *AMCIS*2010. p. 247.
28. Wei, R. and V.-H. Lo, *Staying connected while on the move Cell phone use and social connectedness.* New Media & Society, 2006. **8**(1): p. 53-72.
29. Dong, Y., C.R. Carter, and M.E. Dresner, *JIT purchasing and performance: an exploratory analysis of buyer and supplier perspectives.* Journal of Operations Management, 2001. **19**(4): p. 471-483.
30. Ha, D. and S.-L.i.k. Kim, *Implementation of JIT purchasing: an integrated approach.* Production Planning & Control, 1997. **8**(2): p. 152-157.
31. Johnson, D.J., *A framework for reducing manufacturing throughput time.* Journal of Manufacturing Systems, 2003. **22**(4): p. 283-298.

32. Tubino, F. and R. Suri, *What kind of numbers can a company expect after implementing quick response manufacturing*, in *Empirical data from several projects on lead time reduction.* Quick Response Manufacturing 2000 Conference Proceedings, Society of Manufacturing Engineers Press, Dearborn, MI2000. p. 943-972.
33. Ackoff, R.L., *Systems thinking and thinking systems.* System Dynamics Review, 1994. **10**(2-3): p. 175-188.
34. North, D.C., *Institutions, transaction costs and economic growth.* Economic Inquiry, 1987. **25**(3): p. 419-428.
35. North, D.C., *Institutions and economic growth: an historical introduction.* World development, 1989. **17**(9): p. 1319-1332.
36. North, D.C., *Institutions, institutional change and economic performance*1990: Cambridge university press.
37. Koppenjan, J. and J. Groenewegen, *Institutional design for complex technological systems.* International Journal of Technology, Policy and Management, 2005. **5**(3): p. 240-257.
38. Williamson, O.E., *Transaction cost economics: how it works; where it is headed.* De economist, 1998. **146**(1): p. 23-58.
39. Porter, M.E., *How competitive forces shape strategy*1979: Harvard Business Review Boston.
40. Porter, M.E., *The five competitive forces that shape strategy.* Harvard Business Review, 2008. **86**(1): p. 25-40.
41. Hofstede, G., *Cultural Dimensions In Management And Planning* Asia Pacific Journal of Managemen, January 1984.
42. Hart, O.M., John, *Incomplete Contracts and Renegotiation.* Econometrica, 1998. **56**(4).
43. Williams, S.H., *Collaborative planning, forecasting, and replenishment.* Hospital Materiel Management Quarterly, 1999. **21**(2): p. 44-51.