

Technology and Trust in Global Enterprise Supply-chain

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Abstract

Recent innovations in hardware, software, and Internet groupware technologies have radically transformed supply-chains of global enterprises. In this paper we review how a streamlined supply-chain promises short cycle time from cash-in-resources to cash-in- finished-sales, with minimum investments in inventories. Globalization of enterprises and their supply-chains is imperative for five reasons. In most supply-chains for global enterprises, however, the weak link is people, particularly trust, rather than use of technology. Defining trust has been elusive and a neglected area by researchers. We will develop three key components of trust, trustworthy human capital, trust-building social capital, and trust-driven structural capital, and apply these to supply-chains in global enterprises. In this paper, we postulate that, for the same intensity of technology, a negotiated trust, gradually built over time, will lead to superior performance of supply-chain of a global enterprises over its mistrusting rivals.

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TECHNOLOGY AND TRUST IN SUPPLY-CHAIN

The potential benefits of technology and trust in supply-chain can be summarized in a simple scenario. Imagine that within seconds of a customer buying a plastic toy (such as Mattel's Barbie doll) from the shelves of Wal-Mart or Target in Cleveland, an oil field foreman in Houston, Texas knows when to extract how many more ounces of crude oil from the ground to produce the raw materials required for that toy's replacement [1]. In view of such benefits, rival automakers General Motors, Ford, and Daimler/Chrysler AG recently announced the development of a "superexchange" to conduct nearly all of their supplier business, say with plastics processors and rubber component molders, in the foreseeable future. The objective is to streamline estimated \$123 billion of inventories between customers' driveways and chemical producers' or steel mills' doors.

Technology Driven Globalization of Supply-chain Operations

Recent developments in software, hardware, and groupware technologies, such as SAP R/3, PeopleSoft manufacturing system, Baan E-Enterprise, Oracle ERP and more, have helped supply-chains become faster, more interconnected, and more efficient. These technologies generate significant new economies in costs and delivery times. The new software programs allow supply-chain managers scan from raw materials to finish goods, view past transactions, and project future demands reliably in the near future.

Globalization of operations has ceased to be an option, and has become a strategic imperative for most enterprises because of at least five reasons [2]. These include the (1) growth imperative beyond mature national markets, (2) the globalization of downstream customers forcing globalization of upstream producers and suppliers, and the (3) the globalization of invading competitors forcing domestic companies to counter-attack in their markets. Other reasons favoring globalization include the efficiency imperative when the minimum efficient scale of a value-creating activity (such as high cost of R&D for developing a new polymer, minimum production plant capacity, or risky new product development) that is larger than a nation's potential total demand. And finally, knowledge synergy imperative has benefited global enterprises to transfer innovations developed in one market to markets in other countries.

With the proliferation of computer and communication technologies, and convergence of worldwide customer preferences, the markets in different parts of the world are getting integrated. The current imperfect market information will give way to instant spread of good reputation or bad notoriety. There will be a convergence of tastes in different parts of the world, especially of teenagers and young adults. For instance, teenagers in Malaysia are likely to know instantly that a particular sneaker design was not accepted by their counterpart Bostonians as 'cool.' The lag in international product life cycles is likely to shrink further and disappear. This requires major revamping of supply-chains.

Booz Allen consultants conjectured that with the deployment of available information technologies, the competing interests of economic globalism and cultural nationalism may give birth soon to a trillion dollar enterprise (TDE). These TDEs will be based on globe girdling supply-chain alliances, and operate more like a political federation than a corporation. For example, in telecommunication sector, AT&T may form an alliance with its equally large counterparts and customers in Japan, France, and Germany. Each of the supply-chain allies would manage their local or regional operations and markets, while sharing and coordinating their technological efforts for common innovations, such as building a satellite network, laying intercontinental fiber-optic cable etc. Such global supply-chain alliances would escape local anti-trust regulations, and yet meet local content requirements.

What's the catch? The 20th century history indicates that usually inter-personal politics limits the economic imperatives. Though one must contend that some of the new technological forces available in the New Millennium are unprecedented in their wide-spanning influence. Running a global supply-chain alliance of independent partners would require sophisticated cross-cultural skills. Executive leaders and managers would require the interpersonal skills of diplomat as well as the technical skills of a creative designer. At the other end of the spectrum, technology could give birth to one-person virtual firms that act as bridges to link up other corporations on specific projects.

TECHNOLOGY ENABLING SUPPLY-CHAIN MANAGEMENT

More than 52% of 200 information technology executives polled for 1998 *InformationWeek Research survey* reported that they were planning to use or deploy enterprise resource planning suites (ERP) software systems or other similar technologies to streamline their supply-chains [3]. Technology can help supply-chain managers by providing better business values, with closer real-time collaboration with customers, suppliers, and end users – either locally, or regionally, nationally, and globally. From manufacturing schedules to inventory levels can be coordinated on-line in ERP. The communication problem with retail sellers wanting to know inventory of a particular product, its alternate models, and likely deliveries can be solved by an extranet with access to retail partners via browser-based PCs. Before committing to potential buyers, the company's salespeople can quickly check inventories and place orders directly.

Since rollout in June 1997, GE Polymerland unveiled its recent improvements in e-commerce web site supplying resins from 30 plastics makers, and offering customers detailed real-time data with faster navigation through order-entry screens [4]. The new version offered customer-specific end-use pricing (say, for an injection molder's client with pre-approved materials with Polymerland). Building the supply-chain web site cost tens of millions of dollars, but it is the price for staying in the highly competitive polymer business. The Polymerland web site had sales of less than \$1 million in 1998, which increased to cross over \$100 million mark in 1999.

Strategic Benefits of Technology in Supply-chain Management

The information technology executives say that their most strategic advantages for using supply-chain technology systems are lower operational costs, better collaboration with partners, and reduced cycle times [5]. A recent study by Weston, Massachusetts based consulting firm Pittiglio Rabin Todd & McGrath (PRTM) found that companies best at streamlining supply-chain management hold a 40%-65% advantage in their cash-to-cash cycle time working capital, and 50% - 80% less inventory over competing average supply-chain companies [6].

Technology can help producers flex their production capacities to meet changing customer demands without blocking excessive capital in inventory. For example, roller bearing and steel producer Timken installed Rhythm Factory Planner application from i2 Technologies Inc. to anticipate and avoid flooding or starvation bottlenecks of operations at its four plants as a result of 8,000 – 15,000 steel orders it receives every year. The Rhythm software modeled Timken's process path, including output constraining resources, to synchronize its steel-production process with real-time visibility. Software technology helped reduce Timken's steel manufacturing cycle times by 30% to 40%, and reduce inventories by 25% [7].

New Technological Developments

Recent developments in ERP technology are enabling cross-enterprise collaborations, connecting the indigenous ERP supply-chain systems of different enterprises to those of their extended supply-chain partners [8]. By connecting ERP technology systems to Internet allows the supply-chain participants conduct business globally, generating greater returns on investments.

New technology systems offer demand-planning and forecasting applications. This helps companies like U.S. food packager Nabisco accurately gauge product demand and forecasts to reduce unsold inventories, and coordinate increases in production capacities when demand grows. Nabisco uses software technology from supply-chain vendor Manugistics Inc. to connect with its large retailers such as Wal-Mart and Wegmans. This enables Nabisco to do collaborative forecasting and coordinate its business plans with those of its retailers (such as synchronizing their advertising campaigns) so that the final customer never leaves empty-handed [9]. Leading software enterprises such as Microsoft Corporation are working on converging Internet-based electronic commerce with supply-chain platforms and customer-driven demand-chains to create real-time value-chain management systems [10]. Technology is fast merging the boundaries between the supply-chains, demand-chains, and value-chains of different participants into an extended enterprise value-creation network.

Techno-Laggards

Some global enterprises have been still waiting on the sidelines to use technology in streamlining their extended enterprise supply-chains. The first reason often is their cultural inability to trust their supply-chain partners [11]. These enterprises fear that sharing their strategic information with supply-chain partners can turn into a competitive disadvantage. They fear that if their customers know of their excessive inventories, they will negotiate for price reductions. Or, if customers know that the production of a product is behind planned schedule, they may switch to rival producers. Another reason for using technology is the fear of security leakage of trade secrets and lack of control of strategic data regarding manufacturing schedules on the Internet. Encryption technology may help in this regard.

People: Weak Nodes in Supply-Chain Network

The weakest link in the streamlining of supply-chain management, however, is not hardware, software, or groupware Internet technology, but the level of trust between people who must coordinate, cooperate, and collaborate to get high performance results [12] from their supply-chains. Often supply-chain evolves as a nonlinear network of flows of information, materials, and transactions across links between nodes. The efficiency of supply-chain network depends on the weakest link: people at the nodes directing and sharing the flow of goods and information. Usually, the problems in the performance of a supply-chain can be often traced to a lack of trust

between interacting people. Such mistrust may arise from insecurity, fear of untrustworthy participants, or from past problems. Some suppliers can not forget and forgive their past mistreatments by buyers. Some purchasing managers can vividly remember the time their vendors let them down with poor quality goods or late deliveries [13]. These events may be caused by structural deficiencies, including poor untrustworthy leadership, untrusting internal environments, and inefficient modes of communication in organizations participating in an extended enterprise supply-chain. Across mistrusting organizations, blame game takes precedence over finding and resolving root causes behind supply-chain challenges.

TRUST AS THE KEY TO GLOBAL SUPPLY NETWORK

In the Age of economic globalization of production and operations, where supply-chain collaborations and strategic alliances are in a dynamic flux, trust rather than technology would be the critical determinant. Trustworthiness would become the more important testimonial demanded by potential supply-chain partners. People or firms who earn the notoriety of seeking short-term profits by abusing their partners' trust are likely to be shunned away from future opportunities.

There is a growing consensus that understanding trust is essential and sometimes indispensable for understanding group and team behavior, interpersonal interactions, managerial effectiveness, organizational performance, and even economic or political stability of highly interdependent global supply-chains. Trust is vital for the maintenance of cooperation in society and necessary for even the most routine, everyday interactions and social relationships.

The exchange of goods, according to Max Weber [14], "is possible only on the basis of ...personal confidence and trust." Weber pointed out that formal social mechanisms and economic institutions, such as the Western legal system, were designed and developed to "guarantee or secure trustworthy conduct." With increasing economic development, Weber conjectured that the focus of trust will shift from a discretionary, and sometimes arbitrary, individual behavior in relationships, to a more dependable social institution. Trust of the citizens of a society, members of an organization, or partners in a supply-chain, are the foundations to the functioning of such social mechanisms and economic institutions. As interdependent building blocks of an economic value-adding supply network, these members trust in their social mechanisms and economic institutions.

Trust was not a favorite topic of most Western moral or normative philosophers. The classical ethicists, such as Socrates, Plato, Aristotle, St. Augustine, Hobbes, Locke and others are strangely silent about this topic dealing with human behavior. They instead focused their efforts on their search for the golden decision rules of morality for the ultimate good of the society. The economists, particularly institutional economists tend to focus their efforts and investigations on 'distrust' in principal/agent relationships, game theoretic economic transactions, and the personal characteristics of very generalized economic 'others' [15].

To discover what we need to know to win the coming struggle for global economic competitiveness, Francis Fukuyama, the author of The End of History, and Trust: The New Foundation of Global Prosperity draws attention to the social principals of economic life [16]. Fukuyama argues that only those economies with a high degree of social trust will be able to create flexible large transnational enterprises needed to gain competitiveness in the new Age of global economic operations. American enterprises are discovering the significance of trust late in the 20th Century, because, so far there were new neighboring (westward) frontiers to grow into. When an American enterprise did not like its neighborhood, it moved its operations to South or the frontier further West. Once America urbanized and industrialized to the end of the Oregon Trail, the enterprises had to grow into global markets abroad - further west deeper into Asia/Pacific. This globalized their supply-chains. Thus it is anticipated that the importance of trust is likely to increase in the United States during the coming years.

Role of Trust in Enterprise Supply-chain

Many researchers and practitioners believe that trust can not be easily identified or measured [17]. Trust between transacting partners does not happen accidentally. It is built by specific qualities/attributes of the partners, and the quality of interactions. These are critical especially in the early stages of a supply chain alliance between a

producer and its supplier, and therefore they are governed by structural attributes of the institutions involved. There are other important questions. Is trust in an alliance absolute, or is it driven by loyalty. Is trust contingent on certain environmental context? Trust is a dynamic construct that evolves and develops over time, in short term and long term. Trust has been often neglected in supply-chain management [18]. A clear understanding of trust, therefore, can help develop 'best practices' for streamlining supply-chain alliances.

Why should managers trust their partners in a supply-chain alliance? Trust represents the non-rational choice, loaded with risk and vulnerability. Trust-based choices may be very different from the alternate economic rational choices for survival? Does a purchasing manager exercise a dichotomous choice in his or her individual buying decision to trust or not to trust? Or is trust a dynamic continuum as a degree of trust, implying a continuous variation in the confidence or reliance in the amount of hope for the positive outcome from a supply-chain transaction, the purchasing process or the persons involved? Is trust anchored in the competence and role performance [19] of the trusted – trustee pair?

DEFINING KEY COMPONENTS OF TRUST

Barber (1992) provided an excellent summary of some of the earlier research on the subject of trust [20]. Trust is a set of commonly shared social expectations emerging from multiple sources [21]. Different researchers have identified from four to nine different elements underlying trust [22]. A taxonomy of trust can be proposed based on the types of actions (and attributes) that lead to trusting relationships.

1. Trustworthy Human Capital Partners

The early understanding of trust was based on persons involved, and on an individual's 'personal expectations.' Trust involves dyadic relationships between trustors and trusted persons. A purchasing manager is presumed to promote excellence and reward reliable delivery of quality goods by a supplier. Their common cultural backgrounds lead to higher congruence of shared expectations. In the case of members of dissimilar cultures in different supply-chain organizations, such congruence needs to be consciously nurtured and developed.

Mayer, Davis, and Schoorman (1995) distinguish between trust and cooperation. Individuals may be coerced into cooperation, without much trust [23]. And, that risk of trustor is an essential component of a psychological model of trust. These researchers considered integrity, benevolence, and ability as the basic additive antecedent components of trust. The first two components are different from the last one, in that they are ethical in nature, and may be combined with other ethical components [24], to develop into an ethics based factor of trust.

The third component of ability or personal competence can be integrated into a concept of capabilities. This is recognized as an important characteristic in learning knowledge-driven organizations. This includes factors such as (1) innate personal abilities, and (2) developed capabilities, such as expertise and judgement [25]. Trust and abilities are related, but not necessarily always interchangeable. People with high capabilities may not be trustworthy. And trustworthy members of an organization may not be capable. Capabilities can be measured relatively more easily than trustworthiness.

The personal and perceptual attributes of a partner in a trusting interaction can be clustered as the trustworthy human capital. Three individual attributes define the trustworthiness of a person. These are: (A) integrity, or the reputation for honesty and truthfulness of trusted and trustee person, but particularly of trusted person; (B) competence, or the ability, technical knowledge and interpersonal skills needed to perform the job; and (C) credibility, or the confidence of trustor in the trustee, that he or she may act with confidence and capability.

Trust and capabilities can be linked together into the concept of source credibility [26]. Credibility is the key to the trust stakeholders put in their agents' trustworthiness and competence. Stakeholders seek confidence that some or many members of a group or an entire organization will act creatively and competently to fulfill their expectations (or stakes) under different contextual circumstances. Of course this depends on the organization's sociology - which people get to participate in setting the performance goals and processes to achieve the same.

2. Trustbuilding Social Capital and Supply-chain Interactions

Later researchers expanded the person-centered understanding of trust to include the interpersonal interactions and the processes used [27]. Trust developed into a dyadic interaction between a trustor person who trusted, and another trustee person who was trustworthy. This could be a pattern of interactions between a purchasing manager and small business suppliers, or vice versa. Trust emerges from a respectable historical record of past operations.

Trust is an evolutionary phenomenon. It can be studied only from a longitudinal study of evolving interpersonal and sociological relationships between the trustors and trustees. As a sociological relational process, trust is a belief that diverse participants in a group or team share and participate in setting common goals for a superior performance, and developing processes to achieve these collective goals [28]. It was pointed out that trust operates in an organization at at least 5 sociological levels : (1) at individual level, (2) at group level, (3) as broad social entities, (4) in relationships between individuals, and (5) in relationships between individuals and groups.

Trustbuilding social dimension of trust can be therefore clustered as consisting of two components: (A) consistent relationships, and the reliable and predictable good judgement in handling and responding fairly to diverse situations; and (B) open-benevolence or the willingness to share, and support, encourage, and protect others.

Researchers have postulated that the degree of each key component of trust would vary depending on the role one plays in the superior/subordinate dyad.

3. Institutional Frameworks and Structural Capital

The human capital and social capital based definition of trust does not sufficiently take into account the institutional influences by other sociological aspects of the organization. Many researchers have agreed that the model of trust needs to be extended to the group and organization levels of analysis [29]. Workgroups and teams, as well as suppliers and customers developing trust in each other, are critical requirements for organizations competing in the Age of Economic Globalization.

Trust is based on evolving formal mechanisms and institutions that guarantee trustworthy behavior and performance. We have professional ethics codes for public accountants, lobbyists, and lawyers. Every person in a police uniform is trusted to protect the citizens, and maintain law and order. A lawyer or a journalist is by law permitted to keep the words of their clients or sources confidential. The judicial system allows an individual not to incriminate herself or himself in a court of law. But still many researchers considers trust as 'the optimistic expectations of a single individual relative to the eventual outcome of an uncertain event' [30]. But a nagging question that often emerges is: who guarantees the actions and policies of the guarantors? Perhaps a continual, open and critical public scrutiny would keep them away from non-trustworthy temptations.

In a similar manner, over time a professional code may evolve for the purchasing managers, suppliers, and intermediaries in a supply-chain.

Trust should also include characteristics of the trustor, such as propensity to trust, and take risk, which operates through vulnerability. Trust may involve reliance upon ethical behavior of others. We should, however, consider the possibility of trust between thieves, where benevolence and ability, rather than integrity, are the critical antecedents of trust. In the dyadic model of trust, normative ethical rules, commonly accepted by society, are not essential.

Elusive Definition of Trust

Some researchers [31] have integrated past research and theoretical developments of organizational trust in a game-theoretic dyadic mode. In this model trust is a transaction activity between trustor and trustee. They define trust as "the willingness of a party to be vulnerable to actions to another party based on the expectations that the

other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party."

From the organizational theory literature and related disciplines [32], a broader definition of trust could be defined as the reliance (and willingness) by one (Trustor) person, group or an organization upon a voluntarily accepted duty on the part of another (Trustee) person, group or organization, to recognize and protect the rights and interests of all others engaged in a joint (interdependent) endeavor or economic exchange. This definition of trust, appropriate for supply-chain relationships, includes the elements of integrity, competence, credibility, open-benevolence, and consistency. It also reflects the vulnerability of the trustor on the trusted person.

TRUST AS A NEEDED RISK IN SUPPLY-CHAIN ALLIANCES

Trust in enterprise supply-chain is based on a trustor manager taking risk and exposing his or her vulnerability and dependence on the trusted supplier, and vice versa. This risk assumes the trustworthy person's fiduciary duty, of placing the interests of others, including the trustor's optimistic expectations, before the trustworthy person's own selfish interests. This is a radical new approach to managing supply-chain for global enterprises. Trust is needed for working together in supply-chain networks that involve interdependence, dependence of people on others in various ways to accomplish their personal and organizational goals.

Trust involves mutual cooperative interactions and behaviors. These behaviors were observed to be skewed when the cooperating members were unequal as in a superior/subordinate relationship in a supply-chain. In studies of role of trust in the career paths of executives, it was observed that trust by their superior was a critical essential requirement for the promotion of the subordinate [33]. A study of behavior of newly appointed presidents in underperforming companies showed that effective action by the superior depended on trust by the subordinates. Similar hierarchical effects may influence the relationships between the purchasing manager of a commodity product and its multiple suppliers.

Trust and Supply-chain Performance

In conclusion, though concept of trust is widely considered to be the keystone to interpersonal and social interactions, few studies have focused on its role in supply-chains of global enterprises. Practitioners have frequently acknowledged the role of trust in streamlining supply-chains using advanced information technologies. They propose that cultivating trust in supply-chain of a global enterprise will enhance its performance significantly. Most recognize that pervasive mistrust of supply-chain partners have added wasteful costs to excessive inventories, and protective control of information. Some fear that a pervasive reliance on trust may be abused by their supply-chain partners, and result in leakage of their competitive trade secrets. In this paper, we postulate that, for the same intensity of technology, a negotiated trust, gradually built over time, will lead to superior performance of supply-chains of global enterprises over mistrusting rivals.

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SELECTED REFERENCES

- [1] Grace, Robert. 2000. Doing business on the Net sparking rapid 'e-volution,' Plastics News March, 20: 1, 21
- [2] Gupta, Anil K. and Vijay Govindarajan. 2000. Managing global expansion: A conceptual framework, Business Horizon, March/April:45-54.
- [3] Stein, Tom. 1998. Extending ERP, Informationweek, June 15: 75-82.

- [4] Esposito, Frank. 2000. GE Polymerland's e-business is booming, PlasticsNews, March 20: 25
- [5] See Stein, 1998.
- [6] Sheridan, John H. 1998. The supply-chain paradox, IndustryWeek, February 2: 20-28.
- [7] Sheridan, 1998, p 26.
- [8] See Stein, 1998.
- [9] Stein, 1998.
- [10] Sheridan, 1998.
- [11] Marriotti, John. 1999. Plenty of technology, but a shortage of trust, Industryweek, June 7: 128; and see Sheridan, 1998.
- [12] Marriotti, 1999 .
- [13] Sheridan, 1998.
- [14] Einstadt, S. N. 1968. Max Weber on charisma and institution building, Chicago: Chicago University Press.
- [15] Hosmer, Laurie Tone. 1995. Trust: The Connecting Link between organizational theory and philosophical ethics, Academy of Management Review, 20(2): 379-403.
- [16] Fukuyama, F. 1992. The end of history and the last man, New York: Avon Books; and Fukuyama, Francis. 1995. Trust: The New Foundation of Global Prosperity. Free Press/Simon & Schuster.
- [17] Handfield, Robert B. and Ernest L. Nichols, Jr. 1999. Introduction to Supply Chain Management, Upper Saddle River, New Jersey: Prentice-Hall.
- [18] See Sheridan, 1998, and Stein, 1998.
- [19] Gabarro, J. J. 1978. The development of trust, influence and expectations. In A.G. Athos and J.J. Gabarro (Eds.), Interpersonal Behaviors: Communication and Understanding in Relationships, Englewood Cliffs, NJ: Prentice Hall. pp 290-303.
- [20] Barber, B. J. 1992. Jihad vs. McWorld. Atlantic Monthly, 269(3): 53-63.
- [21] Zucker, L.G..1986. Production of trust: Institutional sources of economic structure, 1840-1920. In B.M. Staw and L.L. Cummings (Eds.), Research in Organizational Behavior, 8, pp 53-111.
- [22] Butler, J.K. 1991, Toward understanding and measuring conditions of trust: Evolution of conditions for a trust inventory, Journal of Management, 17, pp 643-663; and Butler J.K. and R.S. Cantrell. 1984. A behavioral decision theory approach to modeling dyadic trust in superiors and subordinates, Psychological Reports, 55, pp 19-28. Also see Gabarro, 1978.
- [23] Mayer, R.C., J.H. Davis, and F.D. Schoorman. 1995. An Integrative Model of Organizational Trust, Academy of Management Review, 1995, 20, pp 709-734
- [24] See Hosmer, 1995, and Jones, T.M. 1995. Instrumental stakeholder theory: A synthesis of ethics and economics, Academy of Management Review, 20 pp 404-437.
- [25] Tinsley, Dillard B. 1996. Trust plus capabilities, Academy Management Review, Apr, Dialogue, pp 335-337.

- [26] See Tinsley, 1996.
- [27] See Barber, 1993; and Hosmer, 1995.
- [28] Wekselberg, Victor. 1996. Reduced "Social" in a New Model of Organizational Trust," Academy of Management Review April, pp 333-335
- [29] See Tinsky, 1996.
- [30] See Barber, 1983; and Hosmer, 1995.
- [31] See Mayer, Davis, and Schoorman, 1995.
- [32] See Hosmer, 1995, p 393.
- [33] See Butler and Cantrell, 1984.