Chapter 2
Related Works

2.1 Collaboration

Collaboration literally means working together (Bititci, Martinez, Albores and Parung, 2004). Additionally, organizations can usefully collaborate in situations in which working alone is not sufficient to achieve the desired ends (Huxham, 1996).

Due to lack of consensus about definitions of the collaboration, Hartono and Holsapple (2004) developed a framework to give the comprehensive picture about collaboration, and the research processed via three stages: (1) draws from a broad review of literature to identify various collaboration, (2) extracts key and common facets of definition of collaboration from first stage, (3) synthesizes these facets to develop the unified, relatively comprehensive framework. The synthesized facet of definition of collaboration was described as:

"Collaboration is an interactive, constructive, and knowledge-based process, involving multiple autonomous and voluntary participants employing complementary skills and assets, with a collective objective of achieving an outcome beyond what the participants' capacity and willingness would allow them individually accomplish."

The axioms of definitions of the collaboration were:

- Collaboration is episodic, involving episodes of varying durations that maybe linked in varying patterns.
- Collaboration requires an internal governance structure, which can range from rudimentary to complex and can have formal and informal aspects.
- The internal governance structure of a collaboration episode includes both infrastructure and culture.
- The process and outcome of a collaboration episode is influenced by the environment within which it occurs.

The aspect of collaboration has to be differentiated from working together with organizations and from cooperation between organizations.

The definition of collaboration in Merriam-Webster was “actors (humans or organization) work together by extensive information exchange largely supported by information technology, and this may happen even under conditions of different goals of actors and does not need a strong existing relationship between actors”. Furthermore, compared to the definitions of cooperation, they entail the idea of working together, but collaboration might be possible in short phases, without strong relationships and without common interests.

To construct collaboration between participants within the communities has to follow specific steps. Hartono (2004) synthesized definitions, coupled with attendant axioms, then succinctly summarized important elements or ingredients of collaboration, and proposed five common phases (see Fig. 2.1), to construct collaboration episode.

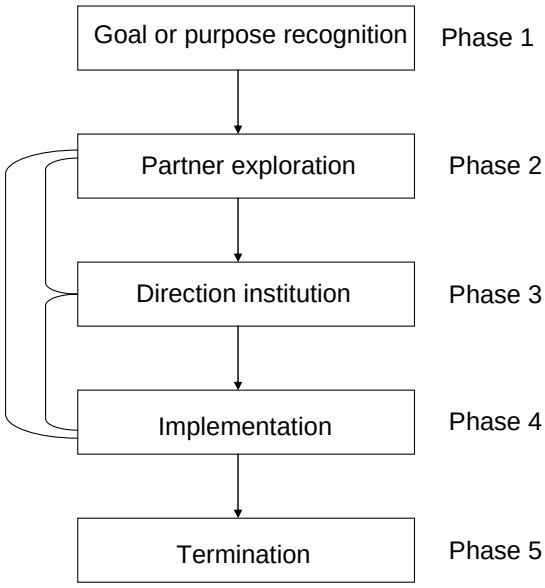

Fig. 2.1 The collaboration phases

The collaboration phases were briefly described as follows:

- Goal or purpose recognition: The phase takes place when a candidate participant found new business opportunities that he can not explore it individually but can achieve it by collaborating with other parties.

- Partner exploration: After recognizing a business opportunity for collaboration, the candidate participant searches for right partner, with compatibility and complementary skills between them, to take advantage of the opportunity.
- Direction institution: After determination of right partners, collaborating participants negotiate to agree upon collective culture, infrastructure, and objectives.
- Implementation: The participants perform their tasks based on the agreed infrastructure and culture to realize the agreed collective objective. Within a collaboration episode, participants retain their autonomy.
- Termination: When collaborative participants attain their collective objective or with intolerable conflicts they can not resolve, the collaborative episode terminate.

The concept of virtual enterprise (VE) was one of the latest organizational strategies in the manufacturing. Each member of the VE brings to the collaboration his core competencies relevant to the mission and concentrates on those areas where it may have a unique competitive advantage. In other words, the success of the objective depends on all participants collaborating as a synergetic unit; due to each one contributes his strengths or core competence to the VE (Mikhailov, 2002).

The lifecycle of new VE, similar with the collaboration phases previously mentioned, was identified by Kanet, Faisst and Mertens (1999) such as: (1) identification phase, (2) formation phase, (3) design phase, (4) operation phase, and (5) dissolution phase. First, during the identification phase, an intelligent agent might search and recognize the market opportunities, planning a formation of a new VE. Second, the main objective during formation phases is to identify suitable partners to perform these tasks; accordingly, the agent could search in his internal database or to perform an Internet search into public databases and on-line catalogues. Third, the tasks during design phase include the design of new products, development of all material and information flows etc. Fourth, during the operation phases, the agents execute the

partner's operational plans. Finally, when the mission of opportunities was achieved, then the VE smoothly dissolves.

2.2 Collaborative Supply Chain

2.2.1 The Evolution of Supply Chain

The rapid evolution of conventional supply chain and outsourcing practice means that tasks are increasingly performed by autonomous teams of a few people or small and medium enterprises (SMEs) that are set up as independent contractors or small firms and linked by a network. Moreover, the emerging paradigm of collaborative networked organization (CNO), as virtual enterprise/organization (VE/VO), fundamentally alters the organization of commercial industry, culture and social activities (Camarinha-Matos and Torre, 2004). Such organizations are generally temporary and project-based, and are most common in manufacturing design, in software development and the film industry. These networks of organizations can support SMEs to identify and explore new business potentials, in order to boost innovation and raise their knowledge.

Three distinguished types of CNO were identified and gains more attention (Camarinha-Matos and Torre, 2004) as:

- Type A: It's based on a long-term partnership of SMEs with one dominant partner. Further, the dominant partner owns the core knowledge, trademark, and logo etc., and plays a decisive role in defining the cooperation rules.
- Type B: It is oriented towards a dynamic project-based partnership, such network of organizations do not have a dominant element. Negotiation represents the main principle of decision-making in this type of CNO.
- Type C: It is base on temporary partnerships aimed by one organization to explore short-term market opportunities among SMEs. In other words, SMEs in such networks usually joint temporarily and very often occasionally, to meet a certain

short-term goal.

The background and scenario of the RBPS model in this study was based on the type C of CNO previously mentioned that the enterprise has to identify the partners with high level of initial trust for exploring new business opportunity in the temporary partnerships and project-based manner; additionally, the RBPS model provided an effective way to assist the enterprise to select a partner with excellent competence, predictability and goodwill in a multi-industries and distributed environment.

As in a new business era, supply chain management (SCM) is considered as a medium for achieving short-term economic benefits and gaining long-term competitive advantages. Therefore, Folinas et al. (2004) developed a framework for identifying and analyzing the various types of SCM ranging from the initial efforts towards optimizing isolated business functions internally to the creation of virtual enterprise network. The framework includes four types: (1) core logistics activities efficiency, (2) coordination of internal organizational process, (3) inter-enterprises of business exchanges, (4) establishment of dynamic networks between organizations (see Fig. 2.2).

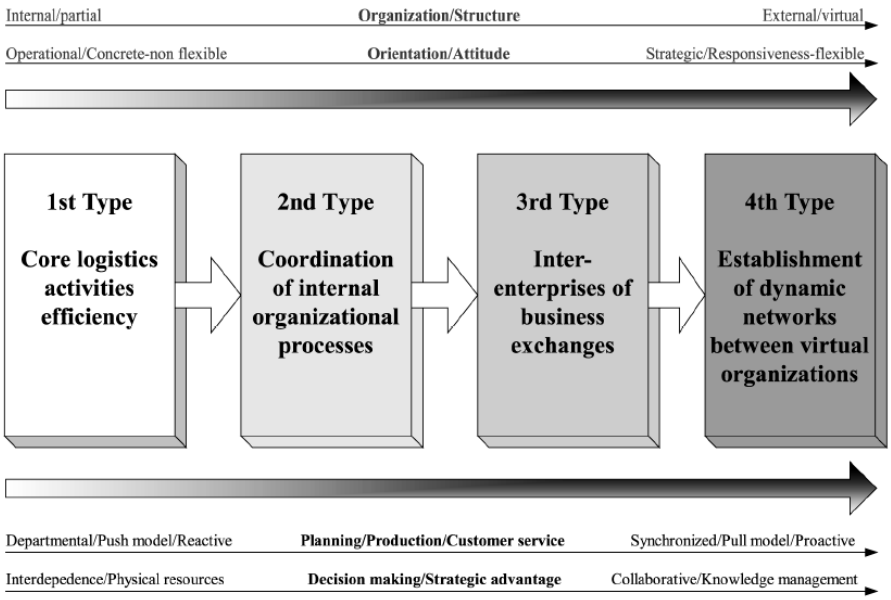

Fig. 2.2 The evolution of supply chain

The first two types (as 1_{st} and 2_{nd} types) relate to a single enterprise (internal). While the last two types (as 3_{rd} and 4_{th} types) relate to a cluster of enterprises (external), and they both focus on key factors like data and information exchange, high inter-enterprise transparency, and integrated demand forecasting, planning and scheduling. But key factors such as broad-based collaboration, dynamic network of organizations, high trust, and long-range relationships are limited in the third type but are important in the fourth type.

American Manufacturing Research (AMR) Inc. divided SCM into two parts: (1) supply chain planning (SCP), and (2) supply chain execution (SCE); in addition, the former being more strategic and tactical, and the latter being more tactical and operational (AMR, 2000a, 2000b, 2000c). As noted by the Supply Chain Operations Reference (SCOR) model, the excellent model to provide the necessary overview and classification of collaborative arrangements, the planning process includes sales and operations planning, demand forecasting, supply planning, production scheduling etc., spans all other processes, making it the fundamental linkage of loaning, sourcing, monitoring, and control. Besides, Rudberg, Klingenberg and Kronhamn (2002) introduced collaborative performance management as the elements into the collaborative planning, for examining performance metrics was regarded as crucial in collaborative settings to get feedback on performance from both individual members and the supply chain as a whole.

Bititci et al. (2004) developed a framework to describe different stages of maturity of collaboration in supply chain and categorized as:

1. Ad hoc: Collaboration does not go beyond the traditional customer supplier relationship.
2. Defined and linked: Collaboration focuses on operational issues and limited to collaborative planning, forecasting, and replenishment (CPFR) of materials and capacities.
3. Integrated and extended: Collaboration at a strategic level where integrated and coordinated strategies lead to strategic synergy.

The relationships between supply chain members are categorized by AMR (1998), and they have been identified as Table 2.1.

Table 2.1 The supply network relationships

Partner Relationship	Description	Supply Chain Integration Support	Types of Electronic Information Included
Transactional	Computer-to-computer transmission of fixed structure transactional information.	● No support of synchronized planning. ● Supports synchronized execution.	● Purchase orders. ● Invoices. ● Order acknowledgement. ● Shipment notices. ● Load tendering.
Information Sharing	Trading partner information-sharing and exchange.	● Supports synchronized, but independent planning. ● Minimum support of integrated execution.	● Order status. ● Shipment tracking. ● Sales forecasts. ● Production schedules. ● Inventories.
Collaborative	Trading partner joint development of plans.	● Supports joint synchronized planning. ● Minimum support of integrated execution.	● New product plans. ● Product design and technical specs. ● Product packaging. ● Demand plans. ● Replenishment plans.

The partner relationships were described as follows:

1. Transactional relationship: Transactions within a buyer-seller relationship involve the activities conducted to execute the buyer's purchase of a commodity. Thus, the information transmitted among supply chain members just for executing a purchase, it includes purchase orders, invoices, and transfer funds etc.
2. Information sharing relationships: In this relationship, partners are given access to a system that has shared information in it, or partners transmitted information to another partners, additionally, since partners receives the information as-is and are not providing feedback. This type of relationship only supports independent planning done by each participant, rather than joint-planning.
3. Collaborative relationships: Collaborative efforts enable trading partners to work together to better understand future demand and to put plans in place to satisfy it profitably. Furthermore, in this type of relationships, information is not just exchanged and transmitted, but is also jointly developed by the buyer and with the seller.

2.2.2 CPFR

In 1995, the concept of Collaborative Planning, Forecasting, and replenishment (CPFR) was introduced in connection with a pilot project includes firms like Wal-Mart, SAP etc.; subsequently, the organization Voluntary Inter-Industry Commerce Standards (VICS) developed a nine-step processes model as a guideline for CPFR collaboration (VICS, 2002). VICS defines CPFR as:

A collection of new business practices that leverage the Internet and electronic data interchange in order to radically reduce inventories and expenses while improving customer service.

Skjoett-Larsen, Thernoe and Andresen (2003) defined CPFR or collaborative relationships as:

Collaboration where two or more parties in the supply chain jointly plan a number of promotional activities and work out synchronized forecasts , on the basis of which the production and replenishment processes are determined.

ECR Europe (2002) defined CPFR as:

A cross-industry initiative designed to improve the supplier/manufacturer/retailer relationship through co-managed planning processes and shared information.

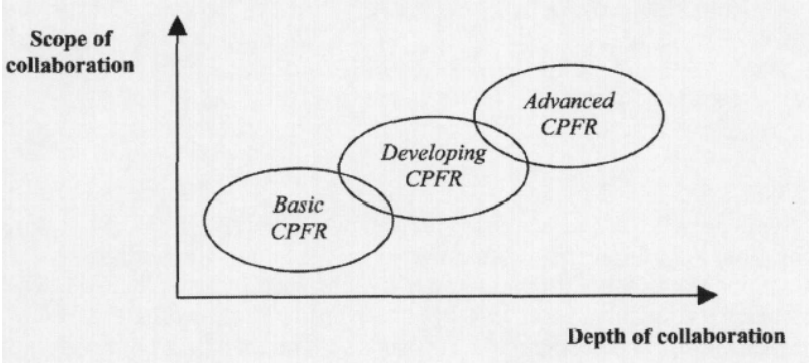

Fig. 2.3 Three levels of CPFR

Noekkentved (2000) argued that the SCOR model tells us what processes include in collaboration, and the VICS's guide on CPFR tells us how to do it. Furthermore, Skjoett-Larsen et al. (2003) developed a

framework that CPFR was divided into three levels based on the scope and depth of collaboration (see Fig. 2.3).

First, the basic CPFR collaboration, the starting point of all collaborative initiatives, only involves few business processes and a limited integration among trading partners; therefore, the parties with this type of collaboration neither coordinate nor synchronized the process. Second, the developed CPFR collaboration is characterized by increased integration in several collaboration domains. Moreover, the supply chains actors enter into this type of collaboration have a network approach; focus on frequent exchange of information and generation of trust in the relationships. Finally, the advanced CPFR collaboration not only focuses on the information exchange, but also deals with synchronizing the dialogue among the parties. In addition, this type of collaboration has been expanded to coordinate processes with forecasting, replenishment, and planning.

The benefits of adopting CPFR are considered as strong incentives for organizations to implement the concept; moreover, these benefits include more predictable order cycles, reduced costs, smaller shipments, more frequent deliveries, accuracy of information, fewer stock outs, improved reliability of deliveries, increased customer service etc. (Barratt and Oliveira, 2001). While individual enterprise, such as Walt-Mart, successful implementations of CPFR has been reported, there are not yet been the widespread adoption that was originally hoped for.

The challenges of collaboration implementation have been extensively discussed in literatures. Fliedner (2003) summarized several anticipated and actual obstacles to implement CPFR, they are: (1) lack of trust in sharing sensitive information, (2) lack of internal forecast collaboration, (3) availability and cost of technology/expertise, (4) lack of information sharing standards, etc. McCarthy and Golicic (2002) pointed out the factors, like substantial cost of investment, lack of adequate technology and software etc., are barriers that have prohibited its anticipated widespread adoption. Additionally, besides the factors of IT, Skjoett-Larsen et al. (2003) indicated the barriers of a more organizational nature, such as issues of trust, lack of discipline and

collaborative goals in relation to the partners. Barratt and Oliveira (2001) summarized literature reviews, and denoted “trust and sharing by adversaries is one of the notable barriers to implement CPFR”. Likewise, Folinas et al. (2004) emphasized that “high trust” is an important factor between customer and partner relationships. To summarize the concepts aforementioned, “trust” among collaborative partners is a critical factor to successfully implement collaborative supply chain, but this issue in commerce of B2B relationships remains under-explored (Saunders, et al., 2004). For this reason, the RBPS model of this study focuses on the B2B commerce environment that the enterprise may identify trusted partners with excellent behavior to collaborate with.

2.3 Partner Selection in Supply Chain

Partner selection is crucial in supply chains, just as it is important as selecting a suitable partner for marriage (Ireland, 2005). To select partners in CPFR, Ireland also reminded us: “Not all of our trading partners are very collaborative, and you have to pick your collaborative trading partners wisely and ensure that you minimize your risks of failure”. Based on this notice, some keys about picking collaborative trading partners are:

- To pick a strategic partner: collaborate with the 20 percent of your trading partners, with which you do 80 percent of your business.
- To pick a trading partner that has already executed successful supply chain collaboration programs: if the trading partner has already done collaboration before, your chance of success is fairly high.
- To pick a trading partner that believes in a win/win relationship: if both trading partners see the need to support and measure joint performance goals and scorecards, it may have the potential for a winning combination.

The issues about trusted partner selection were discussed in the Collaborative Network Organization (CNO) environment; accordingly, Camarinha-Matos and Afsarmanesh (2003) proposed a VE breeding

environment (VBE) to overcome the problem that select trusted partners to form a VE in a temporary relationship. Namely, for each business opportunity found by one of the VBE members, a subset of the VBE enterprises, or find external partners in case some skill or capacities are not available internally, maybe chosen to form a VE for that specific business opportunity (see Fig. 2.4). The VBE provide the centralized management functions such as access rights management, performance history of service provider, service assessment/certification function, and intelligent search/selection/filtering lookup function etc.

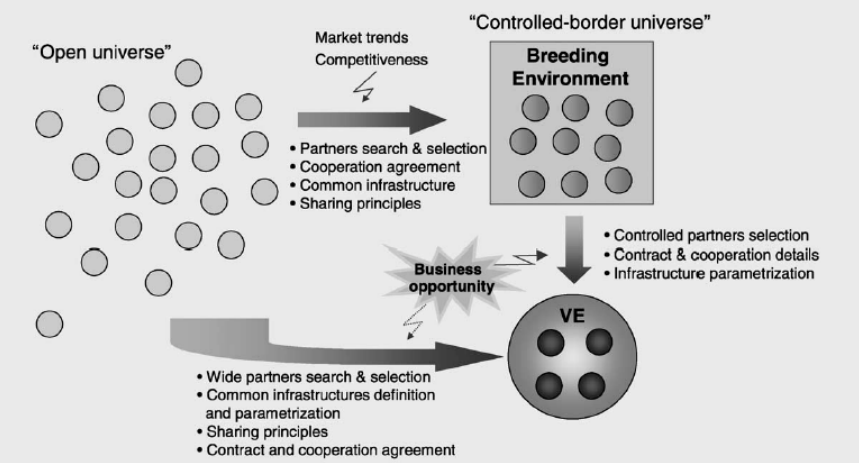

Fig. 2.4 VE breeding environment (VBE)

There are extensive literatures on partner selection in the supply chain or VE/VO fields. Summarizing these literatures, the research issues related to suitable partner selection can be divided into two categories: selection methods and selection criteria. The partner selection methods include qualitative, quantitative, optimization methods and Multi-Agents Systems (MAS), the fuzzy preference programming method, integer programming, integrated analytic hierarchy process (AHP), the voting AHP, colony optimization, agent-based Contract Net Protocol (CNP) etc. (Mikhailov, 2002; Wu and Su, 2005; Liu and Hai, 2005; Fischer, Jahn and Teich, 2004; Jiao, You and Kumar, 2006). Meanwhile, the selection

criteria used in partner selection can refer to the 23 criteria of Dickson, including net price, delivery, quality etc. (Dickson, 1996).

However, in traditional buyer-seller relationships, the selection methods aforementioned deal with the information elements, used to evaluate the candidates, were provided by the suppliers and seems to address the weights of criteria, neglect to the source of testimonies for evaluating the candidates. Additionally, the selection criteria primarily focus on the capabilities and core competence of supplier candidates. Research issues related to inter-organizational trust are important to collaboration fields, but are overlooked in traditional studies of supply chains.

2.4 Inter-Organizational Trust

Trust is an important factor in collaborative supply chain and virtual organization/enterprise (VO/VE); similarly, trust is a critical factor in fostering commitment among supply chain partners. Lack of trust among supply chain, partners frequently leads to inefficient performance owing to increasing transaction costs associated with the verification, inspection and certification of trading partners (Kwon and Suh, 2004). However, trust is not a simple phenomenon and encompasses constructs as diverse as ethics, morals, emotions, values, and natural attitudes (Kasper-Fuehrer and Ashkanasy, 2001).

There are numerous definitions of trust. However, trust has been studied in diverse contexts, by researchers from various disciplines and backgrounds, and numerous definitions have been developed. Seppanen, Blomqvist and Sundqvist (2007) reviewed studies of inter-organization trust conducted from 1990 to 2003, and identified numerous differences in both its conceptualization and operation; notably, the measurement and methodology used to study trust in inter-organizational relationships also varied. Specifically, Seppanen (2007) combined different theoretical approaches, including both the transaction cost economics and socio-psychology approaches, to capture the multi-dimensional and complex nature of trust. The economic approach to trust, including competence, predictability, contracts, etc, is frequently calculative,

stressing its risk-reducing nature, and enhancing predictions or expectations regarding the future behavior of other actors. In contrast, the socio-psychological approach to trust, such as goodwill, reliability, benevolence etc, focuses on agent expectations that trading partners will behave in a mutually acceptable manner, and will act fairly when presented with opportunities.

Ba and Pavlou (2002) denoted that trust has been considered crucial in the online transaction process in traditional exchanges, and stressed that two distinct trust types as benevolence and credibility can mitigate information asymmetry by reducing transaction- specific risks, therefore generating price premiums for reputable sellers. Sako and Helper (1998) indicated trust as “an expectation held by an agent that its trading partner will behave in a mutually acceptable manner” and examined the determinants of inter-organizational trust by using survey data over 1000 suppliers of automotive industry; additionally, Sako then proposed three types of trust as goodwill trust, contract trust and competence trust. Norman (2002) used survey data to examine factors associated with a firm’s protection of knowledge from unwanted appropriation by an alliance partner, he depicted that a firm’s evaluation of the risk of a partner engaging in opportunistic behavior is most closely associated with the level of goodwill trust.

Ratnasingam (2001) synthesized multiple discussions about trust and identified three basic types of trust, namely: (1) competence trust, (2) predictability trust and (3) goodwill trust (see Table 2.2)

Table 2.2 Types of trust in business relationships

Types of Trust Sources	1st Stage Competence Trading Partner Trust Economic Foundation	2nd Stage Predictability Trading Partner Trust Familiarity Foundation	3rd Stage Goodwill Trading Partner Trust Empathic Foundation
Zucker (1986)	Process-based trust	Characteristics-based trust	Institutional-based trust
Gabarro (1987)	Character Role competence	Judgment	Motives/ Intentions
Sako (1992)	Contractual	Competence	Goodwill
Barney and Hansen(1994)	Weak form of trust	Semi-strong form of trust	Strong form of trust
Mayer, Davis and Schoorman (1995)	Ability	Integrity	Benevolence
McAllister (1995)	Cognitive	Cognitive → affective	Affective
Lewicki and Bunker (1996)	Deterrence/ Calculus	Knowledge	Identification
Mishra (1996)	Competence	Reliability	Openness Care Concern
Dyer and Chu (2000)	Reliability	Fairness	Goodwill

The three types of inter-organizational trust that Ratnasingam (2001) proposed were described as: First, competence trust determines the ability, skills, competence, and technical knowledge of trading partners to transact correctly. Second, predictability trust depends on the ability of one party make forecasts, predictions and judgments regarding their partner based on previous experience. Finally, goodwill trust involves dependence on the care, concern, honesty and benevolence of a trading partner (see Table 2.3).

Table 2.3 The definitions of three types of inter-organization trust

Construct	Sub-Concepts	Definition
Trust in Trading Partners		Trust behaviors that determine competence, predictability, and goodwill types of trading partner trust:
	Competence Trust	Reliance upon the ability, skills, knowledge, and competence of a trading partner to perform business-to-business e-commerce correctly and completely. Competence trust examines a trading partner's ability, skills, and level of competence to undertake e-commerce operations and fulfill expectations.
	Predictability Trust	Reliance upon the consistent behaviors of trading partners that allow another trading partner to make predictions and judgments based on prior experiences. Predictability trust examines trading partners' consistent behaviors based on past experiences.
	Goodwill Trust	Reliance upon the care, concern, honesty, and benevolence shown by trading partners that allow the other trading partner to further invest in the trading partner relationship. Goodwill trust examines a trading partner's honesty, care, and concern as well as the willingness to share information, cooperate, and commit to long-term investments.

Saunders (2004) noted that trust is a complex construct and explores in depth five key dimensions of trust that have been discussed most frequently: *benevolence, integrity, competence, predictability, and openness*, they are described as:

- The main purpose for benevolence is to guard against opportunism on the part of the trustees; similarly, a trustee with benevolent intentions does not take advantage of such opportunities at the expense of the trusting party.
- The integrity means the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable.
- The competence is the expectation of technically competent role performance; accordingly, it relates to a partner's ability to perform according to the specified agreement or contract.
- The predictability means the other party's behavior is predictable or acts in accordance with expectations.
- The openness means the other party is willing to share information

about its business.

These five dimensions are consistent with three types of trust proposed by Ratnasingam (2005) in business relationships including competence trust (economic foundation), predictability trust (familiarity foundation or track record), and goodwill trust (empathy foundation).

2.5 Initial Trust and Reputation

Trust has traditionally been studied in terms of long-term relationships; accordingly, trust builds incrementally and accumulates over time. Relationships among participants in collaborative supply chain as virtual business relationships may be characterized by project-based manner, neither without past history of interaction, nor any plan for future cooperation. This does not mean that trust can not exist in temporary groups; on the contrary, trust in initial relationships can often be high (Kasper-Fuehrer and Ashkanasy, 2001). Additionally, Jarvenpaa and Leidner (1998) noted that trust is crucially important in new and temporary organizations, since it acts as a substitute for the traditional mechanisms of control and coordination.

Initial trust lies in the temporal context of trust development. Koufaris and Hampton-Sosa (2004) defined that the initial trust is willingness to rely on a third party following the initial interaction with that party, yet the initial trust beliefs can be formed without any prior experience or interaction between two parties. Hampton-Sosa demonstrated that perceived reputation positively influenced initial trust in a firm; restated, despite the lack of previous experience with a company, new customers could form opinions regarding its reputation, and these perceptions impacted their initial trust in the company.

Kwon and Suh (2004) contended that successful supply chain performance is based on a high level of trust and a strong commitment among supply chain partners. Kwon demonstrated that partner reputation in business transactions significantly and positively impacts level of trust; meanwhile, partner’s reputation is a critical trust building agent for individuals with no experience of interaction with a firm.

2.6 Reputation System and Referral System

Reputation is defined as ‘what is generally said or believed about the character or standing of a person or thing’. Additionally, reputation system is based on allowing parties to rate each other, and to use the aggregation information as ratings of a specific party and derive the score in the form of reputation or trust, which can assist other parties in deciding whether to do business with that party in the future (Josang, et al., 2007). Resnick, Seckhauser, Friedman and Kuwabara (2000) explained why reputation system is so important in fostering trust among strangers. First, when people interact with one another over time, past history informs them of their abilities and dispositions. Second, expectations of reciprocity or retaliation in future interactions create an incentive for good behavior.

Reputation system can be considered a collective measure of trustworthiness base on the referrals or ratings from members in a community. Therefore, there are two fundamental aspects to consider (Josang and Ismail, 2002):

- Propagation mechanism: This enables entities to obtain the needed information to calculate reputation score.
- Reputation engine: This calculates the value of user reputation ratings using various inputs, including feedback from other parties.

There are two available approaches for entities to implement reputation information propagation (Josang, Ismail and Boyd, 2007):

- Centralized approach:

  As e-Bay, the central authority as reputation center that collects all the ratings, then derives a reputation score for all participants, and makes all information publicly available. Figure 2.5 shows a centralized reputation system, where parties (e.g., A and C) denote interaction for business and then save the ratings of other party in the centralized database. Consequently, the updated database provides the history of ratings of specific party for all participants to see, and it can be used to decide whether or not to transact with a particular party.

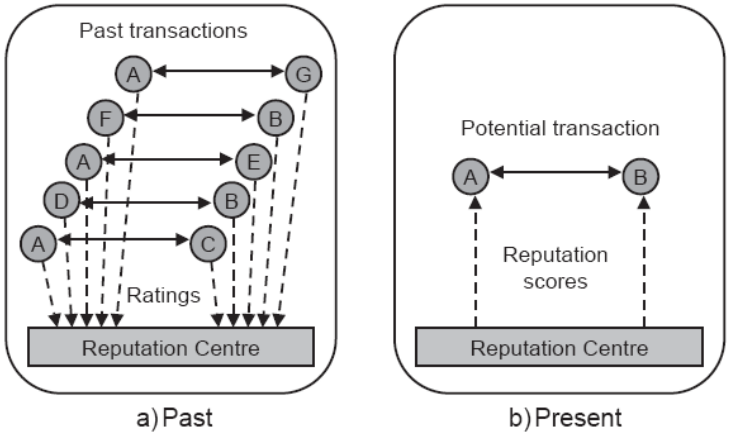

Fig. 2.5 The framework of centralized reputation system

- Distributed approach:

In this approach, every participant keeps and manages the ratings of reputation of other party. Whenever there is a need, users can ask others for the required reputation values. Specifically, each participant records the opinion about each experience with other parties, and provides this information on request from relying parties. For example, when a relying party 'A' considers transacting with other target party 'B', he has to find the distributed members, who have had experiences with B, to obtain the testimonies or ratings about B and decide whether or not to transact with that one (see Fig. 2.6).

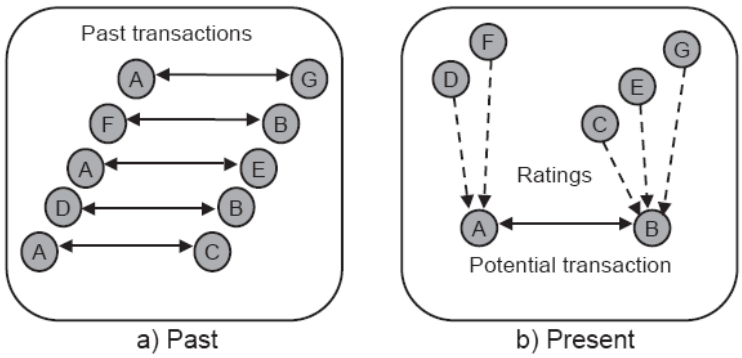

Fig. 2.6 The framework of distributed reputation system

The referral system can be used to find available resource or target

partners in the distributed environment. The basic idea of this concept is that a request specifies what information is being sought, from the requestor sends to the selected acquaintances, and then the response, if given, includes an answer or a referral. A party answers only if it is reasonably confident of its expertise matching the request. On the other hand, a referral is given only if the referring party has sufficient confidence in the relevance of the party being referred (Yu and Singh, 2003). For example, if A, a requestor, want to find a trusted car mechanic, and she trusts B and C, also B and C trust D. Then, B, C, and D, as recommenders, refer E to A, and A can derive a measure of trust in E based on the referrals of B, C, and D and combined with her trust in recommenders (see Fig. 2.7).

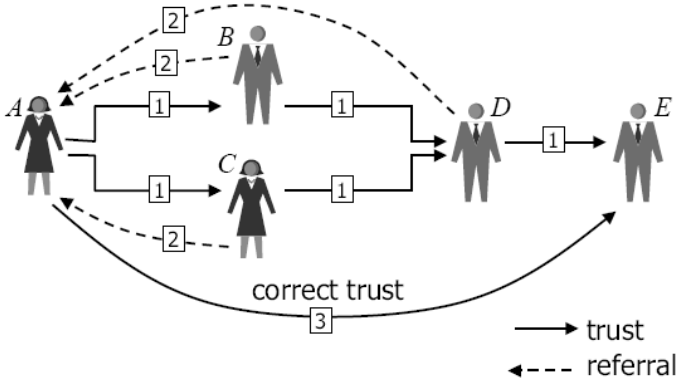

Fig. 2.7 Trust derived from referral system

The semantic of ratings, reputation scores and trust measures are important in order for participants to be able to interpret those measures. The classification of trust and reputation measure can be described as: (1) Subjective and specific measures, (2) subjective and general measures, (3) objective and specific measures, and (4) objective and general measures. Furthermore, the *specific* measure relates to a specific trust aspect like product quality, but *general* measure is supposed to an average of all aspects. On the other hand, the *subjective* measure means the rater rates the trustee based on subjective judgment, but the *objective* measure

means the rater adopt the objective assessment to trustee under formal criteria (Josang, 2007).

An obstacle to using recommendation-based trust, that the agents to share information about the perceived trustworthiness of another, is the subjectivity of trust. Josang (2007) and Resnick et al. (2000) also argue that there are numerous problems exist in all practical and academic reputation systems, they are:

- Low incentive for providing rating: The transaction partners usually have no direct incentive for providing rating about the other party, it maybe due to fear retaliation from the other one or the rater does not benefit directly from providing the ratings.
- Bias toward positive rating: The bias of positive rating maybe in the hope of getting positive rating return or avoid getting retaliation and lawsuit from the other party due to the negative rating.
- Unfair ratings: Unfair positive rating and unfair negative rating is a fundamental problem in reputation system. This is because of the subjective basis of the raters.
- Change of identities: A party with low reputation maybe in his interests to change identity or pseudonym in order to cut with the past and start from fresh.
- Quality variations over time: Variation in the quality of service or goods can be result from many factors, and the changes in quality will lead to variations in reputation.
- Discrimination: A party provides good quality to all other parties except one single party or a single rater gives fair ratings except when dealing with a specific partner.