

Measures of Complementarity and Compatibility in Strategic Alliances for Innovation: A Review of Literature

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Abstract

By focusing on resource-based view (RBV) and dynamic capability view (DCV), a target firm can be assessed for its complementarity and compatibility by the alliance-initiating firm to form a strategic technology alliance. This is because complementarity and compatibility among the partner firms affect the alliance performance. By reviewing the empirical findings on innovation through strategic alliances, this paper helps to classify various innovative capabilities possessed by a target firm as measures of complementarity or compatibility. This classification has several implications for researchers and practitioners dealing with the problem of partner selection for innovation in strategic alliances.

Keywords: Complementarity, Compatibility, Strategic Alliances, Innovation

1. Introduction

Today, with the increase in competition, firms are continuously attempting for competition through cooperation, especially in the high technology sector. Various authors recognized a fundamental shift from traditional form of competition between firms (firm vs. firm) to a new form of competition between strategic alliances (group vs. group) comprising of different firms¹⁻³. Ref. 4 is among the first to explore the increase in frequency of technology collaboration. The multiple collaborative agreements make different firms compete intensely with each other in their core areas, resulting into 'co-opetition' behavior⁵. Several studies found a positive impact^{6,7} and inverted U⁸⁻¹² relationship between technology alliance portfolio diversity and financial performance via increased product innovation performance. When firms use alliances as one of the instruments to survive in a competitive environment, it

creates another level of competition to have access to better partners and their resources¹³.

Various studies suggest that factors like complementarity, compatibility and commitment of partners contribute to the success of an alliance. Although, there may be two or more firms involved in mutual negotiation for forming alliances, the decision to partner is typically initiated by one firm¹⁴. Detailed partner assessment by the alliance-initiating firm can lead to greater success¹⁵. Target firms are assessed in terms of their innovative capabilities before forming a strategic alliance for innovation. Since the target firms possess various innovative capabilities, the alliance-initiating firm needs to correctly classify various innovative capabilities possessed by the target firms either as a measure of complementarity or compatibility. It is equally important to examine whether an innovative capability should be considered as a measure of complementarity or compatibility in the assessment of

target firms. This is because in certain situations, the complementarity among partners may be of much more importance than the compatibility or vice versa. In this study, we review the empirical work on innovation in strategic alliances and use its findings to classify various innovative capabilities of the target firm like organization capital, human capital, learning orientation, absorptive capacity, social capital and R&D capability as a measure of complementarity or compatibility. By following prescriptions from the literature, we argue that if the possession of a particular innovative capability by both the partners is leading to the success of the alliance or of its superior performance, this particular innovative capability can be considered as a measure of compatibility. Similarly, those differences in innovative capabilities of the partner firms leading either to the success of an alliance or its superior performance can be considered as measures of complementarity. This classification is useful to researchers for developing new research questions and for practitioners in properly assessing target firms before forming strategic alliances.

This paper is organized into eight sections. In second section, we discuss various motivations of firms to form strategic alliances, especially for innovation. Third section discusses the factors relating to complementarity and compatibility of alliance partners. In fourth section, we discuss the relationship between innovative capabilities of firms and their performance. Section 5 classifies various innovative capabilities of a target firm as a measure of complementarity or compatibility. Implications of this classification are discussed in the section six. Section 7 discusses limitations of the classification and future research directions. Finally, section seven concludes the paper.

2. Strategic Alliances and Innovation

Strategic alliance is a cooperative agreement between two or more partner firms intended to affect the long-term product market position of at least one partner¹⁶. In the last couple of decades, many firms have used strategic alliance as a key growth strategy¹⁵. Firms generally have different motivations or objectives for forming alliances. These motivations include enhancing market power^{17,18}, acquiring and exchanging skills^{4,18-20}, increasing efficiencies²¹, gaining economies of scale and scope^{22,23}, getting access to new and critical resources

or capabilities²⁴, sharing risk and investment^{25,26}, facilitating strategic renewal²⁷, entering new markets²⁸, achieving innovation and market performance²⁹ and acquiring various kinds of legitimacy³⁰. There are various means to increase access to the resources possessed by other firms, for example mergers and acquisitions. However, alliances offer faster and cheaper route to achieve this³¹. Further, in the context of transaction-cost reasoning, alliances are preferred over acquisitions when the needed asset is specific, access cost is prohibitive and uncertainty exists over the assessment of performance of the target firm³². Ref. 33 studied alliance formation of fortune 1000 companies and found that CEO's of 80% of companies believed that alliances generate around 26% of their companies' revenues. Increasingly, it has been shown by scholars^{34,35} that strategic alliances are also being used as a means to learn and understand new business environments. Ref. 36 has identified 15 reasons explaining why firms might enter into a strategic alliance.

However, the failure rate of alliances is also very high³⁷. Literature suggests that approximately 30-70% of strategic alliances failed because they neither helped the partner firms to achieve their goals, nor provided them any operational or strategic benefits³⁸. Approximately 50% of these alliances was terminated eventually³⁹. In few cases, alliances even resulted into value destruction of the shareholders of parent companies⁴⁰.

Coming to the strategic technology alliances, Ref. 41 define strategic technology alliance as "*cooperative agreements for reciprocal technology sharing and joint undertaking of research between independent actors that keep their own corporate identity during the collaboration*". There are various motivations to go for a strategic technology alliance like reduction in cost and risk associated with R&D, transference of technology in order to improve innovation performance, reduction in time-to-market and search for new technological opportunities⁴¹. Two of the most common explanations for forming inter-organizational ties are interdependence and complementarities⁴²⁻⁴⁴. The external resource scarcity is the most important reason for engaging in collaborative agreements⁴⁵ (Park, Chen, and Gallagher, 2002). Acquisition of new technical skills or technological capabilities of partner firms is another important motivation for forming technology

collaborations^{4,46-50}. Since the firm specific technological capabilities reside in the form of tacit knowledge, forming alliance is a better instrument to gain access to such capabilities. Because of rapid technological change, new knowledge expires quickly in high technology industries, which demand quick strategic response and timely learning. Such strategic response and timely learning is possible through strategic alliances in comparison to other forms of formal and hierarchal control mechanisms^{16,17}.

Further, Ref. 51 carried out a study on the preferences that companies have in using alternative sources of innovative competencies such as strategic technology alliances, mergers and acquisitions or a mix of these. They found that companies that are operating in the high technology sector, strategic technology alliance are a preferred mechanism for acquiring external innovative capabilities. Forming a technology alliance improves the functioning of partner firms and creates breakthrough innovations⁵². For example, Ref. 41 demonstrated a positive relationship between entry into technology alliances and the rate of innovation. However, the success of an alliance largely depends upon careful and detailed assessment of the target firms by the alliance-initiating firm⁵³.

3. Complementarity and Compatibility of Partner Firms in Strategic Alliances

To take advantage of each other, firms rush to form alliances and often fail to account for the negative effects of poor partner selection^{4,53}. The success of an alliance is largely depends upon smart partner selection⁵³. Firm characteristics often affect their chances for being selected by alliance initiating firm in forming strategic alliances and in turn affects the success of such alliances⁵⁴⁻⁵⁸. Alliance evolution has three main stages 1) formation phase, 2) design phase and 3) post formation phase. The success of an alliance depends upon certain critical factors at each stage of evolution⁵⁹. For instance, partner selection is critical in alliance formation phase, setting up the appropriate governance structure is critical in alliance design phase and managing alliance continuously to realize value is important in post formation phase⁶⁰.

Partner selection requires assessment in terms of relative attractiveness of target firms¹⁴. This attractiveness for example depends upon to what extent the target firm can enhance the financial value of the

alliance or of the alliance-initiating firm, thus providing strategic advantages⁶¹⁻⁶⁴. This attractiveness is also depends upon the degree to which an alliance-initiating firm evaluates the target firm as desirable, favorable, appealing and valuable. More attractive a target firm is, more are its chances of being chosen by the alliance-initiating firm for forming strategic alliances¹⁴. Smart partner selection is also important because lack of good strategic fit between partner firms may lead to alliance failure⁶⁵. Ref. 66 distinguishes between theoretically important notions of task-related criteria and partner-related criteria used by various firms for partner selection. The former includes operational skills and resources which a venture requires for its competitive success, including patents and technical expertise, financial resources, experienced managerial personnel, and access to marketing and distribution systems. The later refers to the efficiency and effectiveness of partner's cooperation, which includes partner's national or corporate culture, size or structure, the degree of favorable past association between the partners, compatibility and trust between partners' top management team.

Ref. 14 reviewed more than 40 studies and found three major partner traits that play a critical role in the success of a strategic alliance. These partner traits are partner complementarity, partner compatibility or fit and partner commitment. Partner complementarity is the measure of non-overlapping resources that the partners bring to the alliance relationship. If the partner firms are similar in terms of strategic resources and competitive postures, it may lead to higher direct competition between them⁶⁷⁻⁶⁹. Ref. 58 labels this competing similarity as Type I diversity indicating how similar two partners are in their possession of strategic resources and skills. The lesser is the difference, less they have to offer to each other and greater is the likelihood of competition between them. Too much similarity in terms of resources could limit the alliance benefits⁷⁰ and partners may find themselves actually competing rather than cooperating⁵⁶.

Partner compatibility refers to the fit between firms in terms of factors like working styles and culture. An alliance between similar firms is expected to be successful than asymmetric firms^{55,71}. Ref. 58 labels this cooperating similarity as Type II diversity. This kind of similarity leads to attraction causing attitudes to become positive, leading to favorable outcomes^{72,73}.

Partner commitment is the willingness of the partners towards contributing required resources to the alliance and sacrificing short-term gains against long-term success of the alliance⁷⁴. Partner complementarity and partner compatibility can be analyzed during partner selection process while partner commitment can be evaluated only during post formation phase. Since this paper is about partner selection process, we focus only upon partner complementarity and partner compatibility. Since this paper considers the resource based view and the dynamic capability view of firm, we will also analyze how the complementarity and the compatibility between the partner firms affect the performance of a strategic technology alliance. The paper also examines which innovative capabilities can provide measure for assessing complementarity and compatibility of target firms in partner selection process for forming strategic technology alliances.

4. Innovative Capabilities and Firm Performance

Technology and innovation must be managed. Technology is one of the resources that require alignment with the overall organizational strategy. Competition and rapid changes in the technological paradigms require improvement in the organization's innovation and its innovative capability. The resource based theory of the firm⁷⁵⁻⁷⁷ and the dynamic capability view of the firm⁷⁸ emphasizes the importance of unique innovative capabilities, which create sustained competitive differences among various firms. These two distinct views help in assessing firms in terms of their innovative capabilities. The resource-based view reflects the resources available in the organization to develop and exploit its innovative capability. The resource-based view includes the way firms secure factors needed to create the core competencies and capabilities which can be the basis for establishing and sustaining competitive advantage. Coming to dynamic capability view, Ref. 79 define dynamic capabilities as "*the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments*". Such capabilities evolve over time.

Innovative capabilities can be defined as the comprehensive set of characteristics of an organization that facilitates and supports innovation⁸⁰. Ref. 80 proposed an innovation audit framework for assessing

innovative capabilities of an organization in terms of five important classes of variables 1) Understanding competitor's innovative strategies and multi-industry evolution 2) Understanding corporate technological environment 3) Corporate strategic management capacity 4) Resource availability and allocation 5) Corporate structural and cultural context. A combination of these variables is able to determine the relative strength of an organization in formulating and implementing innovation strategies. Since we are considering only the resource-based view and the dynamic capability view of a firm, we ignore the first three variables and focus only on the other two.

Out of the two selected classes of variables, the "Resource availability and allocation" includes measures like breadth and depth of skills at business unit level in R&D, engineering and market research, distinctive competencies in the areas of technology relevant to the business unit and R&D funding. Business Unit structural and cultural context includes measures like mechanisms for managing R&D efforts, transferring technology from research to development, integrating different functional groups in the new product development process and for eliciting new ideas from employees.

The internal R&D capability of a firm, which measures the technology expertise and R&D investments, has a positive impact on innovation output⁸¹ and financial performance⁸² of the same firm. Continued investment in R&D creates in-house research capability for developing new technology or by assimilating it from outside⁸³. Such R&D capabilities are valuable, rare, inimitable and non-substitutable resource for superior innovation performance^{75,84,85}. Significant R&D capability of a firm increases the effectiveness of its intellectual human capital because of better research facilities, cultural norms and processes⁸⁶. The human intellectual capital of the firms is also found to be closely associated with their innovation output (for example Ref. 81, 86). Scholars have shown the effect of a firm's ability to manage and utilize knowledge resources on its innovation output. In order to accumulate and utilize knowledge, organizations adopt different approaches that are determined by different aspects of intellectual capital, namely human, organizational and social capital⁸⁷⁻⁸⁹. Human capital is defined as the "*knowledge, skills, and abilities residing with and utilized by individuals*"⁸⁹, whereas

organizational capital is the “*institutionalized knowledge and codified experience residing within and utilized through databases, patents, manuals, structures, systems, and processes*”⁹⁰. The third aspect, namely social capital is defined as “*the knowledge embedded within, available through and utilized by interactions among individuals and their networks of interrelationships*”⁸⁸.

Innovations can either be incremental or radical⁹¹. Incremental innovation improves existing products, services, or technologies but reinforces existing design and technologies. However, radical innovations are major transformations of the existing products, services, or technologies. Radical innovations do not reinforce the existing design and technology, but rather makes them obsolete⁹². Ref. 93 observed that the incremental innovation involve “*improving and exploiting an existing technological trajectory*” whereas radical innovation involves “*disruption in an existing technological trajectory*”. Ref. 94 noted that the incremental innovation “*build on and reinforce the applicability of existing knowledge*” while the radical innovation “*destroy the value of an existing knowledge base*”. Thus, the incremental and radical innovation both draws organizational knowledge differently. Incremental innovation draws reinforced existing knowledge and often requires improvement and updating of this existing knowledge, whereas radical innovation requires transformed knowledge and makes the existing knowledge obsolete. This transformation of knowledge could be either addition of knowledge or morphing old knowledge into something new. It is found that the organizational capital (organizational knowledge) possessed by the firms is positively related to their incremental innovative capability⁹⁵. Ref. 96 identified convergence between the domain knowledge an organization possesses and the knowledge of fresh patenting activities.

The human capital describes a firm’s propensity for access and exposure to diverse knowledge domains. Creative and bright human individuals can become sources of new ideas and knowledge for innovation^{97,98}. Ref. 81 in their study found that the firms maintain a significant level of intellectual human capital to produce more innovations. Such human individuals are also found to be flexible in acquiring new skills⁹⁹. Radical innovations require tying of ideas of those individuals to one another. According to Ref. 95, one of the key

attributes of social capital is ties and links. The sharing of information and knowledge can be encouraged with the help of these ties and links. Thus, if human capital can generate new ideas and knowledge, social capital can connect them to achieve radical breakthroughs. The greater the social capital in an organization, stronger will be the influence of human capital on radical innovative capability⁹⁵. In addition, the higher the innovativeness of a firm, greater will be its performance^{100,101}.

Further, innovation is also strongly related to a firm’s absorptive capacity and learning orientation. Ref. 102 defines the concept of absorptive capacity as a “*firm’s ability to evaluate, assimilate and apply new external knowledge to a firm’s operational environment*”. The ability to evaluate and utilize outside knowledge depends upon a firm’s prior related knowledge¹⁰². The absorptive capacity of firms is positively related to their innovation efforts¹⁰³, innovation output¹⁰⁴ and performance¹⁰⁴⁻¹⁰⁶. Ref. 107 found a positive relationship between the absorptive capacity of firms (small and medium enterprises) and their performance.

The learning orientation of an organization refers to the activities for creating and using knowledge within and across the organization. Ref. 108 shown that the organizational learning helps firms to develop new knowledge repositories and is crucial to their innovation capability and performance. Learning orientation determines what kind of information the organization gathers¹⁰⁹, how it is interpreted¹¹⁰, evaluated¹¹¹, and shared¹¹². Extensive empirical evidences suggest that learning orientation and organizational learning positively influences financial and non-financial performances of the individual firms^{57,113-115}.

Learning also requires an effective and efficient system of information sharing. Such a system would help an organization to prepare a single repository of information and knowledge and learn from the accumulation of individual learning. The loss of knowledge due to employee turnover or transfer can also be minimized with the appropriate management of such knowledge repositories¹¹⁶. However, even if an organization has a shared vision and is committed to learning, the learning cannot be achieved until and unless the organization has an accumulation of knowledge¹¹². Some recent studies suggest that the organizational learning is positively related to firm

performance, contingent upon the factors like organization's age¹¹⁷ and the governance mechanisms¹¹⁸. Figure 1 explains the relationship between various innovative capabilities of a firm and its innovativeness and performance.

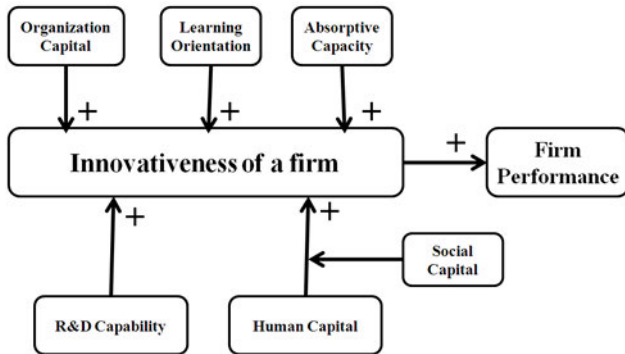


Fig. 1. Innovative Capabilities and Firm Performance

5. Innovative Capabilities as a measure of Complementarity or Compatibility

The discussion presented in previous sections clearly indicates that the complementarity and the compatibility among partner firms are very critical for the success of an alliance. The extant literature relied on a variety of objective and subjective measures to assess the performance or success of an alliance, namely financial results^{22,23,119}, survival¹²⁰, duration^{121,122}, perceived satisfaction^{123,124}, motivations for learning¹²⁵, improve in strategic positioning²² and inter-firm trust^{126,127}. For a thorough analysis, see Ref. 128 and Ref. 129.

Resource based theories suggest a direct positive relation between success of an alliance and the complementarity among alliance partners and studies have found support for this. Partner complementarity actually provides assurance about the outcomes even if it is difficult to assess the outcomes initially¹⁴. The competing similarity between alliance partners is negatively related to alliance performance⁷². In addition to partner complementarity, partner firms must be compatible for alliance formation and success¹³⁰. The greater the cooperating similarity, higher will be the expected performance levels⁷². Similarly, the corporate culture and similarity in management practices among alliance partners is positively related to the performance of such alliances⁷². Therefore, there is a positive effect of complementarity and compatibility among partner

firms on the performance of a strategic alliance (Figure 2).

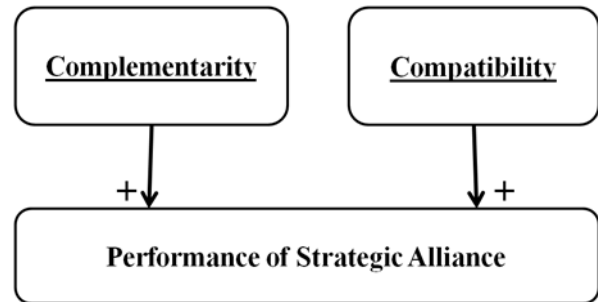


Fig. 2. Complementarity and Compatibility among partner firms effecting alliance performance

We have discussed the effects of various innovative capabilities on a firm's innovation output and on its performance. Broadly, we can classify various innovative capabilities into two classes' namely tangible resources and intangible resources. Tangible resources include the physical infrastructure, financial capability, number of patents, technological position and capabilities, and organizational capital. Intangible resources include the absorptive capacity of the firm, learning orientation of the work force and the organization, social capital, resource coordination, person's coordination, ability to manage and utilize knowledge resources, and knowledge transfer capacity. These innovative capabilities can be considered either as a complementary measure or a compatibility measure for the partner selection in a strategic technology alliance. Studies have shown that possession of these innovative capabilities affects the innovation output and ultimately the performance of a firm. By assessing the extent of meeting the targets or the objectives (in terms of superior benefits, superior financial performance of partners, greater organizational learning and knowledge transfer among the partners) the success of a strategic alliance can be measured. A strategic alliance is considered successful when the partners are mutually benefited. Therefore, by following prescriptions from the literature, we argue that if the possession of a particular innovative capability by both the partners is leading to the success of the alliance or of its superior performance, this particular innovative capability can be considered as a measure of compatibility. Similarly, those differences in innovative capabilities of the partner firms leading either to the success of an alliance or its superior performance can be considered as

measures of complementarity. In order to verify these arguments, we now refer to some empirical studies on strategic alliances for innovation and their findings.

5.1 Technological Domain and Human Capital

When the innovation output of two firms is similar, they occupy structurally equivalent positions and will appear very near to each other in a technology network. A technology network provides the relative position of various firms with respect to their domain of technology operation and their competencies. Such firms even can substitute each other in their innovative roles. Patent overlaps or the number of patents in various technology domains can also help to identify position of firms in a technology network. The number of patents secured by a firm is an externally validated measure of innovation output and represents the technological competence of a firm¹³¹. These patenting records are closely related to the stature of the firm in a technical arena^{131,132}. Firms possessing patents in the same technological domain will be close to each other in a technology network. Ref. 96 studied the technological position of firms and their chances of forming alliances. The results of their study indicate a positive association between the propensity of a firm to form alliances and the degree to which it innovates in technological fields that are not directly associated with those in which it has developed technologies in the past. In addition, the past technological capabilities also determine the position of the firm in a knowledge space. Knowledge space is used to identify the knowledge levels of various firms. The overlap between partner firms in knowledge space can be used to assess the similarity in organizational capital of the partner firms. Ref. 133 discuss about the knowledge assets possessed by the partners and their role in the success of knowledge creating alliances. Sharing of knowledge (including technology expertise and organizational capability) is found to be one of the dominant objectives of strategic alliances^{20,48,134-143}. According to Ref. 133, there will be high chances of forming alliance by two firms if they have an optimal overlap in knowledge space. Studies have also found moderating effect of new product development process characteristics and external environmental factors on the relationship between knowledge complementarity of partners and alliance's new product innovativeness¹⁴⁴.

However, as knowledge overlap among alliance partners' increases, the chances of separation also

increase. Firms whose overlap is near optimum level have a high propensity of forming alliances. Over time, when partner firms involve themselves with joint activities, their knowledge overlap increases, making each other less attractive and the alliance dissolves. When two firms are distant in technological space and the knowledge space, they tend to form an alliance to learn from each other and increase the knowledge overlap^{20,145}. However, if the firms are too far apart, they may also face difficulty in understanding each other, sharing and recombining^{146,147}. If the overlap is either very large or small, the cost of the alliance will exceed its expected benefits. Ref. 148 also found a similar inverted U relationship between knowledge base overlaps and innovation performance – not in strategic alliances but rather in acquisitions. Hence, as the distance between the partners in the technology network and knowledge space increases, greater will be their chances of forming a successful alliance. If the distance between the alliance partners is very low, they will not have much to offer to each other, resulting into fewer chances of successful alliance formation. Ref. 149 in their study found that that alliance portfolio with greater organizational and functional diversity is related to higher firm performance. According to Ref. 149, “*the organization and functional diversity capture the learning and resource access benefits accruing from collaborating with diverse organizations for a wide scope of functional purposes*”. In addition, knowledge complementarity is positively related to firm learning¹⁵⁰. Hence, the organizational capital (which includes technological position, technological capabilities, and patents) and human capital (knowledge and skills) can be considered as measures of complementary while assessing the attractiveness of a target firm for forming an alliance.

5.2 Learning Orientation

Going further, optimum knowledge overlaps among partner firms is not enough for the success of an alliance. What is more important is whether the human capital of the partner firms is able to learn from each other and increase the knowledge overlap. Learning in alliance situations can take place mainly in three ways. First, alliance partners can learn either by accessing or by internalizing some critical information, capabilities or skills, which are beneficial to the partners¹³⁸. Second, they can learn to manage the collaboration process and

relationships more effectively^{1,151} and third, they can learn to manage the alliance and its capability^{152,153}. In this paper, we discuss only the first kind of learning which is more important in a strategic alliance for innovation and has been widely studied in the literature.

For a strategic alliance to succeed, the partners should not only learn from their own and increase their knowledge base, but should learn to learn together to make them interdependent^{72,154-155}. Learning together requires that the partners must think and behave similarly¹⁵⁵. This learning largely can be ascribed to the absorptive capacity of firms. Ref. 156 conceptualized absorptive capacity as “*a broad set of skills needed to deal with the tacit component of transferring knowledge of the partner company and the need to modify this knowledge for the firm's own specific environment*”. Ref. 157 found that the increase in the absorptive capability of a firm improves its ability to exploit sources of technical knowledge outside its boundaries. Absorptive capacity affects the ability of partner firms to learn¹⁵⁸ and develop new and competitive products to strengthen their financial performance. However, it is also found to depend upon the relationship characteristics between the partners^{159,160} and the alliance structure¹⁰⁵.

However, literature has also reported some discouraging behaviors of partners. The transaction cost literature has emphasized the opportunistic behavior of partners in inter-organizational relationships, leading to learning race¹³⁸ between the partners. Using case studies, Ref. 4 indicated that the firm, which possesses a strong learning intentional and develops a learning environment, wins the race to learn. In such cases, partners face a challenge of balancing between trying to learn and trying to protect. Inter-partner relationships and trust in alliances or in exchange situations^{16, 161-162} plays an important role in diluting these challenges. Ref. 137 demonstrated the existence of characteristics like level of mutual trust, respect and friendship through relationship capital of the alliance. The analytic framework developed by Ref. 138 describes the dynamics of learning race by showing that the firm's incentive to learn depends upon expected payoffs associated with such learning. Thus, the learning strategy adopted by a partner firm depends upon the motivation and capacity to assert its receptivity as well as on motivation and capacity to cooperate by being transparent¹³⁹. Receptivity as defined by Ref. 163 “*is the*

readiness of the learning partner to appreciate and receive the knowledge brought in by the teaching partner”. This receptivity is also limited by learning intent of the firm⁴.

According to Ref. 164, the learning-oriented cooperative strategies involve a denser and a more varied set of inter-organizational interactions as compared to performance-oriented or output-oriented strategies. The motivation to learn is one of the major determinants of learning, resulting into the absorption of knowledge in the context of individual learning¹⁶⁵⁻¹⁶⁷ as well as in the context of inter-organizational setting such as strategic alliances⁴. Learning intent is found to be having the most decisive influence on the acquisition of specific competencies by alliance partners^{46,168,169}. Ref. 4 argues that partner learning is a more powerful determinant of alliance success in comparison to its stability or longevity. The higher the learning intent of the partners, the higher will be the resource based learning capacity (commitment of human and tangible support assets), the cognitive based learning capacity (general attitude and behavior towards learning) and the knowledge transfer¹⁷⁰. According to Ref. 171, knowledge transfer is the process by which one member in the network is affected by the experience of another member. Knowledge transfer is a result of organizational learning. Organizations, which are able to transfer knowledge, effectively from one organizational unit to another are found to be more productive than those who are less capable of doing so¹⁷²⁻¹⁷⁶. Social exchanges such as reciprocal commitment, trust and mutual influence among partners are positively associated with learning and knowledge transfer in strategic alliances¹⁷⁷. However, the ease of learning and knowledge transfer may also be influenced by the type (e.g. Tacit or explicit) of knowledge^{146,178}.

Further, the literature has also identified two distinct dimensions of knowledge management, namely exploration⁹⁹ or knowledge generation¹⁷⁹ and exploitation⁹⁹ or knowledge application¹⁷⁹. Knowledge generation involves activities that increase an organization's stock of knowledge and knowledge application involves activities that deploy existing knowledge to create value. Building upon this, Ref. 160 argue that intensive inter-organizational learning is not necessary in the case of strategic alliances created for exploitation of existing technologies but is crucial for alliances created for exploring new technologies.

5.3 Social Capital

In addition, the strength of network ties creates value in the social network¹⁸⁰. Ref. 181 defines strong ties as “*combination of the amount of time, emotional intensity, mutual confiding and reciprocal services*”. Strong ties expect trust and non-opportunistic behavior from the partners¹⁸⁰. Trust has important implications on the allied success and is defined as the expectation that individuals will fulfill obligations in predictable, fair and reliable ways^{182,183}. Trust allows open access of information, stimulates collaboration and promotes cooperation^{26,162,184-190} resulting in deeper access to information⁸⁸ thus, creating opportunities for learning. Strong ties (trust in one’s contact) are positively related to learning of firms¹⁵⁰. Mutual trust among partners is a major ingredient in the success or failure of a strategic alliance^{32,151,161,191,192}. Ref. 193 found that the trust between partners is positively related to learning among them and such learning is positively related to innovation. Trust is also positively related to international strategic alliance performance^{15,162,194-199}. For a detailed review of the role played by trust in the context of strategic alliances, see Ref. 200.

5.4 Absorptive Capacity

Furthermore, learning not only depends upon access to information, but the ability or absorptive capacity of firms and the individuals within it. This absorptive capability depends upon the knowledge gained by the partner firms, accumulated over the years and its relatedness with the external knowledge. Though some level of complementarity or diversity in knowledge is required for learning²⁰¹, some basis of relatedness is necessary to facilitate communication and exchange of ideas among partner firms^{102,158,202,203}. Further, the differences in human capital allocated and embodied by the partners have the power to influence their learning process. The individual’s ability to utilize new knowledge depends upon his/her own level of expertise within a specific domain¹⁵⁰. This expertise develops over a period with the extensive involvement of individuals in understanding and developing a repository of knowledge. As a result, individuals with high level of expertise easily assimilate information and link it to their existing knowledge, enabling them to solve problems quickly and effectively in comparison to

those having a lower level of expertise²⁰⁴. Ref. 150 found that a positive relationship between an individual’s expertise and firm learning is stronger for large firms and weaker for smaller ones. Ref. 205 found that the knowledge acquisition and knowledge creation both enhance innovative performance.

Moreover, the pre-alliance relationship between the patent portfolios of partner firms also found to affect the ability of such firms to absorb the technological capabilities from its partners¹⁴⁵. Ref. 206 found that the relationship between organizational learning and performance of the partners is stronger in joint ventures and in those alliances where the scope of collaborative activity is broader than in the case of contractual alliances. Innovation is considered to be positively related to learning in international strategic alliances¹⁹³. However, innovations are also possible without learning (knowledge transfer) because innovations are often made up of dissimilar knowledge bases, which may best be maintained in separate organizations²⁰⁷. According to the findings of Ref. 193, the learning and innovation in international strategic alliances are influenced by a firm’s ability (expertise) and the willingness (protectiveness) to transfer knowledge and are mediated by the codifiability and transferability of knowledge to be shared (tacitness) and the quality of the relationship (trust). Therefore, the more is the absorptive capacity of partner firms, more will be learning from each other and the greater will be the success of the alliance²⁰⁸⁻²¹⁰. The lack of organizational fit between the partners in terms of culture, processes and systems in place may lead to the failure of a strategic alliance¹³⁷. Ref. 211 studied the impact of three indicator of technology strategy relevant to absorptive capacity on the innovation performance. The three indicators are proportion of R&D alliance in an alliance portfolio, technological distance and R&D intensity. They found positive relationship between R&D intensity and innovative outcomes. It is generally argued that when partners are similar in characteristics and routine, there will be more effective knowledge transfer and easier communication, which will benefit inter-organizational collaboration. Certain degree of absorptive capacity is required for effective learning in inter-organizational collaborations^{212,213}. Therefore, the learning orientation, social capital and absorptive capacity of partner firms can be considered as measures of compatibility between the partner firms.

5.5 R&D Capability

Coming to tangible resources possessed by partner firms, the R&D capability of a firm can be attributed to the possession of assets, financial strength and physical infrastructure. Ref. 214 has found that the greater the technological capabilities of a high-tech firm alliance partner, higher will be the rate of innovation of that firm. Ref. 214 studied the effect of firm level characteristics (namely technological competencies, innovativeness, extent of market coverage, substantial stock of technological resources and the size) on the performance of the partner firms and the success of the alliance. Ref. 214 found that in technology alliances, large, innovative firms helped their partners to improve their baseline innovation and growth rate while small and unsophisticated partners had very slight or immaterial effect on the other partners. Ref. 214 also studied the alliance formation between a young and small firm with an old and large firm and found that having a highly innovative partner has greater benefit of the former than to the later type of firms. However, an alliance is considered successful when the partners are mutually benefited. Research has shown that the attractiveness of a firm for alliance formation is positively related to the resources possessed by it^{17, 215-217} because alliances are often used as a means to acquire the valuable resources possessed by other firms. Most of the existing literature considers resource alignment of partners only in terms of resource similarity. However, Ref. 128 derives four types of inter-partner resource alignments using the dimensions of resource similarity and resource utilization namely supplementary (similar-performing), surplus (similar-non performing), complementary (dissimilar-performing) and wasteful (dissimilar-non performing). Supplementary and complementary resource alignments have significant impact on the collective strength of an alliance^{128,218-220}.

Therefore, the greater the R&D capabilities of a high tech firm's alliance partner, the higher will be the rate of innovation. In addition, the greater the innovativeness of the partner firms, greater will be the innovativeness and the chances of success of the alliance. Ref 221 and 222 found positive effects of similarity of partners in their technical assets for successful cooperation in joint ventures. Thus, R&D capability can be considered as a compatibility measure for partner selection in strategic alliances for innovation. Figure 3 provides the

classification of various innovative capabilities of partner firms as measures of complementarity and compatibility, which positively influence the performance of a strategic technology alliance.

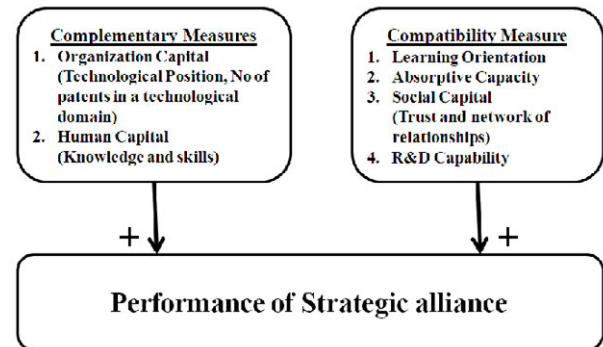


Fig. 3. Innovative Capabilities as measures of Complementarity and Compatibility

6. Implications

Alliance partner selection for innovation is a discrete alternative multi-criteria decision problem in which the target firms are the alternatives and the innovative capabilities are the criteria for evaluation^{223,224}. However, it is equally important to examine whether an innovative capability should be considered as a measure of complementarity or compatibility in the assessment of target firms. This is because in certain situations, the complementarity among partners may be of much more importance than the compatibility or vice versa. For example, Ref. 224 identified various motivations for forming strategic alliances (strategy oriented, cost oriented, resource oriented and learning oriented) and proposed a multi-criteria framework considering these motivations. It is likely that the technology-oriented motivations may give more importance to the complementarity of the target firm than to its compatibility. Similarly, learning oriented motivations may emphasize the compatibility more than the complementarity. Ref. 66 and Ref. 120 distinction of task-related criteria and partner-related criteria used by various firms for the selection of alliance partners may also differently emphasize the complementarity and the compatibility of the target firm with the alliance-initiating firm. The classification presented in this paper is helpful to researchers exploring partner selection traits in strategic alliances for innovation.

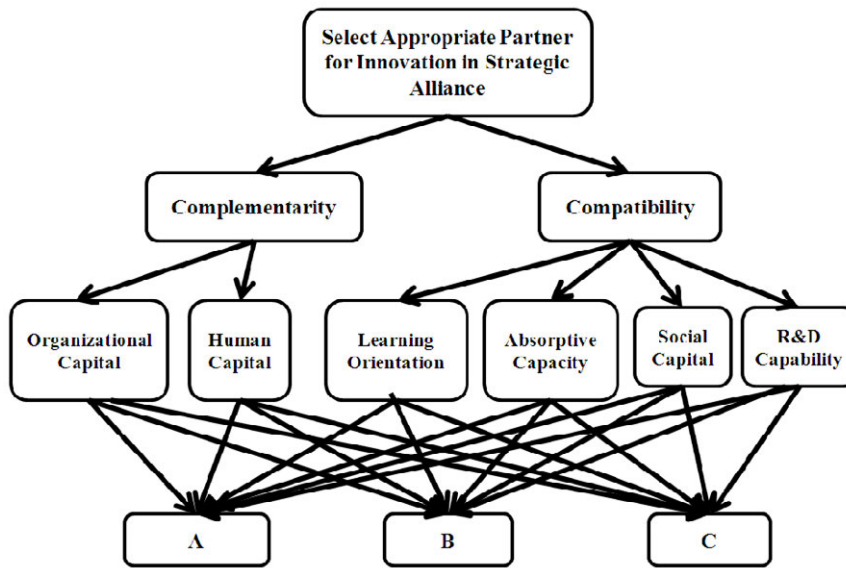


Fig. 4. Multi-Criteria Decision Hierarchy for partner selection problem

7. Limitations and Future Research Directions

This paper suggests a classification of few of the innovative capabilities as measures of complementarity or compatibility. Organizational capital and human capital are classified as measures of complementarity, while learning orientation, absorptive capacity, social capital and R&D capability are classified as measures of compatibility. This paper focused on strategic technology alliances from various industries including information technology, pharmaceutical etc. Firms possess various innovative capabilities and that too differ in various innovation context. Future research can strive to identify other innovative capabilities that are important in specific innovation context.

Further, Ref. 223 and Ref. 224 had proposed two frameworks based on the Analytic Network Process (ANP) and the Analytic Hierarchy Process (AHP) and their applications for the assessment of target firms for innovation in strategic alliances. Both AHP and ANP are well-established multi-criteria decision-making (MCDM) methods. AHP is a theory of ratio scale estimation and is a special case of the Analytic Network Process (ANP). When using AHP, the multi-criteria decision problem is structured in the form of a hierarchy. The hierarchy begins with the overall objective of the problem at the top, followed by the criteria (and sub-criteria) and the alternatives at the bottom. The flow of influence is assumed top to bottom

in comparison to ANP where it can be all around. Both methods capture the preference of the decision maker (DM) and synthesize them in order to generate a preferred rank order of alternatives.

Furthermore, if the DM knows the distinction between various innovative capabilities (as either a complementarity or a compatibility measure), he/she will be in a better position to judge the target firm as per the expectations or motivations to form of the strategic alliance. Some of these innovative capabilities must be considered as measures of complementarity while the others as measures of compatibility. Listing out all the innovative capabilities of target firms and selecting a partner firm without giving varied importance to complementarity and compatibility may result into poor partner selection, which might affect the outcomes of the strategic alliance. Based on the discussion in this paper, we suggest that there should be an intermediate level in the decision hierarchy of partner selection problem for innovation in a strategic alliance. For example, see the decision hierarchy in Figure 4 where three target firms (A, B, C) are to be assessed for forming a strategic alliance. The DM needs to define the importance of expected complementary and compatibility along with other relevant criteria when assessing the target firms. Given a decision situation, the DM can give preferences not only in terms of alternatives and their innovative capabilities, but also the expectations of the alliance-initiating firm in terms

of the importance to complementarity and compatibility. Future research can examine the problem structure developed in the form of decision hierarchy (Figure 4) and apply various MCDM for partner selection in innovation in strategic alliances.

8. Conclusion

The performance of an innovative firm can be judged by its innovative capabilities. Since a single firm may find difficulty in carrying out innovation and bearing the cost and the risk associated with new technology development, alliance are used by firms to gain access to various innovative capabilities of other firms. Selecting a firm to form an alliance for innovation requires proper assessment in terms of innovative capabilities. Some of these innovative capabilities must be considered as measures of complementarity while the others as measures of compatibility. By extensively reviewing the existing literature, this paper advances the view that various innovative capabilities can be classified as measures of complementarity or compatibility. Listing out all innovative capabilities of a target firm and measuring its complementarity and compatibility by the alliance-initiating firm helps in intelligent partner selection, which subsequently can lead to superior performance of the alliance.

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