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LESSONS FOR ENHANCING COMPETITIVE ADVANTAGE: DYNAMIC CAPABILITIES FRAMEWORK

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Abstract

In turbulent business environments, building and exploiting competitive advantages necessitate manufacturing companies to start new strategic initiatives. For this purpose, new product development (NPD) should be seen as dynamic capabilities (DC) that enable companies to create a better match between the configuration of a firm's resources and changing conditions. This study aims to make use of the operationalised DC model including sensing, seizing and reconfiguration capacities in a hierarchical decision structure. A multi-case-studies approach is employed for validation of the DC assessment model on automotive companies which are categorized as European, Japanese and American. The qualitative analysis reveals the appropriate management practices underlying the micro-foundation of DC at the operational management level, which can help chief executives to implement the appropriate strategy for enhancing NPD performance. Managers can creatively leverage their companies' DC components by conceiving of different ways to integrate these DC components into NPD projects.

Keywords

Dynamic capabilities (DC), New product development (NPD), Supply chains (SC), NPD performance, Sustainable competitive advantage

1. INTRODUCTION

As the business world struggles with globalisation, deregulation, new technologies, economic recession, digital transformation and post Covid 19, business leaders are demanding a greater capacity for new organisational forms that are capable of carrying out effective strategies in a sustained and profitable way (Hardy, 1994; Ellström et al., 2022). Prior studies have highlighted that developing organisational capabilities via supply chain (SC) collaboration is a means by which this sustainable competitive advantage can be realised and generate an economic surplus into the future (Grant, 1996; Teece et al., 1997; Mamédio et al., 2019). In fact, organisational capabilities enable firms to acquire, develop, and deploy resources, convert these resources into value-enhancing products, and transform resources into distinctive competencies (Chen et al., 2004). Research on organisation and management theory has highlighted the importance of the bundle of proficient routines, non-routines, and also co-specialisation, and learning which build the capabilities (Augier & Teece, 2009). Moreover, capabilities consist of internal and external resources and competencies (Newbert, 2007). Dynamic capabilities (DC) introduce a set of management practices to explicate scope economies, flexibility, adaptability, integration, and disintegration with the focus on organisational change and how manufacturing firms interact with the business environment (Teece, 2009).

Over the last decade, automotive industry has faced increasing challenges, such as tighter regulations and rapid changes in customer preferences and technologies. The manufacturers need to continuously adapt to these changes in order to survive in the intensive competition (Kim, 1998). One way of survival of manufacturing companies for managing new product development (NPD) projects operating in the volatile business environment would be reliance on developing DC. In automotive industry, key suppliers have collaborated for many years in their NPD projects to build and develop DC as a holistic approach to assist automakers to facilitate strategy implementation for sustaining NPD performance or competitive advantage in long term (Tuli and Shankar, 2014; Kumar et al.,2018; Hoeft, 2021).

This study aims to validate the multi-criteria decision analysis (MCDA) framework of DC consists of the sensing, seizing, and transforming capacities (Teece et al., 1997) due to comprehensive view of management practices for improving NPD performance. This study proffers that the key to global competitiveness lies in

building micro-foundational, multidimensional and multilevel multinational orchestration capabilities gives rise to the importance of operationalized DC framework to aggrandize the prediction of competitive advantage for R&D intensive manufacturing companies (Kaur, 2022).

The paper mainly focuses on identifying sensing, seizing and reconfiguring routines and non-routines of DC that enable automotive companies to transform their existing NPD process. The effective point of this study is to aggregate all the relevant organisational and managerial process that guide and equip senior managers to make a sound decision if they plan to enhance competitive advantage and stay in competition in dealing with their NPD project. The results also underline the most important DC factors that differentiate the success and failure of NPD projects. On another side, the multi-case study findings make a significant contribution to the literature review by revising the present DC assessment framework arising from the previous empirical studies. The results would be comparable with the previous academic scholars.

2. LITERATURE REVIEW

2.1 Dynamic capabilities

Over the past two decades, the DC approach (Teece et al., 1997) has become one of the most influential research areas in the field of strategic management (Helfat & Peteraf, 2015; Schilke, 2014). The concept of the DC approach is rooted in the thought that markets, consumers' preference and demand and other business environments keep changing, and it is not possible to sustain in such environments with static capabilities (Kumar et al., 2018). The DC approach acts as a vehicle for creating or renewing organisational capabilities or special technological capabilities of firms (Eisenhardt & Martin, 2000; Teece et al., 1997). In the extant literature, various DC at different levels have been reported. Wang and Ahmed (2007) identified three DC components that are common across several industries, although firms have different processes for developing them: the ability to take in external knowledge (absorptive capability), to link the firm's innovativeness to products and markets (innovative capability), and to adapt and align resources and capabilities (adaptive capability). Verona and Ravasi (2003) also found that three types of DC (knowledge creation and absorption, knowledge integration, and knowledge reconfiguration) were needed for successful product innovations. Zott (2003) addressed conceptually and analytically the link between DC and firm performance and suggested that a specific type of DC including variation, selection, and retention is indirectly linked with firm performance by changing a firm's bundle of resources, operational routines, and competencies, which in turn affect firm performance. Moreover, Marsh and Stock (2003, 2006) focused on building DC based on providing a greater understanding of the integrative practices that contribute to the DC in NPD. Prieto et al. (2009) investigated the building of DC in the context of NPD through knowledge generation, knowledge integration, and knowledge reconfiguration. In the literature, the DC including sensing the environment, learning, coordinating and integrating to better match the spectrum of the environment have been empirically measured (Pavlou & EI Sawy, 2011). According to the study of Wang et al. (2015), DC and its dimensions including absorptive and transformative capabilities are fundamental to the understanding of differential NPD performance. The previous empirical studies found that DC is positively related to organisational performance and this relationship is mediated by variables such as high level of technological dynamism, competitive advantage (cost leadership and product differentiation) and strategic management (Fainshmidt et al., 2016; Correia et al., 2021; Arun & Yildirim, 2022). An enhanced NPD performance requires strong DC to sense, seize, and transform in conjunction with a good strategy (Teece, 2007; Teece, 2009; Teece, 2014).

2.2. Micro-foundations of dynamic capabilities

2.2.1 Sensing capacity

Firm's sensing capacity refers to the identification and creation of opportunities by means of environmental scanning, learning and investments in new technology and R&D activities (Lichtenthaler & Ernst, 2012). The sensing capacity also entails processes for gathering and interpreting data, allocating resources and tasks to generate market intelligence, disseminate market intelligence, and respond to market intelligence (Pavlou & EI Sawy, 2011; Vanpoucke et al., 2014). In the present DC assessment framework, investment in new technology, boundary spanning capabilities and supplier technology roadmap are the most important micro-foundations which have been selected for assessing the level of search for new technology for companies.

To invest in new technology, early supplier involvement in NPD process leads companies to create innovative products or processes (Ragatz et al., 1997). This practice could support potential future business with the customers, and sharing technology with a customer without assurance of a purchase order have significant impact on building sensing capacity (Henke Jr. & Zhang, 2010). Furthermore, shared goals and values when members like of a network like buyers and their key suppliers share a common understanding and approach to the achievement of network tasks and outcomes, result in an ongoing and self-reinforcing process of participation in sense making (Krause et al., 2007). A firm's ability to search for new technology and scan its environment is also referred to as a ''technology search'' or ''boundary spanning'' that enables firms to pursue the entirely new technology or even assess whether the current technology needs to be improved based on the capacity utilisation and technical

propensity of the firms (Handfield et al., 2009). To assess the rate of technological changes, companies need to review market trends, competition's capability and trends, review other companies outside of their own environment, and learn from them as well as working with universities to develop a view of product offering 5, 10 or 20 years from now (Petersen et al., 2003).

Voice of customer is another important micro-foundation for assessing the level of sensing capacity. Early customer involvement in NPD process ensures that the feedback of the customers plays a vital role in the innovation process, and they also provide innovative ideas when they specify their requirements and co-design the products with the manufacturers (Lau et al., 2010). Moreover, frontline employees put effort in frequent interaction with potential customers on a daily basis (Swink et al., 1996). They also collect information and feedback about new market developments affecting customers (e.g. QFD), and have an annual conference where a customer would present the application of the products in service (Swink et al, 2006).

To build and assess sensing capacity in automotive companies, "suppliers have become an increasingly important source of product and process innovation" (Azadegan & Dooley, 2010, p. 488). Supplier innovation like supplier specialist knowledge in breakthrough design and also generating innovative ideas when they develop new materials for manufacturers and co-design new products with the manufacturers play a vital role (Koufteros et al., 2005, 2007; Henke and Zhang, 2010; Perols et al., 2013; Wagner & Bode, 2014).

2.2.2 Seizing capacity

Seizing dimension describes the ability to address opportunity and capture the value of doing so by mobilising resources (Teece, 2012). A firm's seizing capacity, mainly requires integration of new knowledge into their existing resource bases that firms need to ensure sufficient market orientation based on this knowledge (Lichtenthaler & Ernst, 2012). Specifically, it helps firms construct decision-making protocols, build trust and commitment through effective communication and control the environment (Vanpoucke at al., 2014; Paulraj et al., 2008; Cao & Zhang, 2011). From the literature review, there are main criteria for measuring the inter-organisational communication which is operationalised in terms of the extent to which the firm and its key suppliers (1) share critical, sensitive information related to operational and strategic issues, (2) exchange such information frequently, informally and/or in a timely manner, (3) maintain frequent face-to-face meetings, and (4) closely monitor and stay abreast of events or changes that may affect both parties (Goffin et al., 2006; Paulraj et al., 2008). Direct cross functional communication as the most extensively used technique involve personnel from multiple functions (marketing, manufacturing, etc.) in design teams, early involvement of production workers and manufacturing engineers in design processes, and overlapping product and process for (Brown & Eisenhardt, 1995; Ettlie, 1995).

In the context of NPD, building trust development processes tend to be used with greater frequency when integrating new suppliers. Trust is a high level attribute and this attribute between a supplier and manufacturer is measured in terms of dependency, personal relationship, commitment, importance of supplier, long-term relationship, training of supplier, size of organisation and agreeing sharing rewards (Goffin et al., 2006; Ragatz et al., 1997; Chen et al., 2010). As reported in the previous empirical studies, the personal relationship, complaint handling contributes towards building trust in the context of supplier-manufacturer (Goffin et al., 2006).

To manage firm's boundaries and complements, the importance of outsourcing decisions (make/pseudo make/buy decisions) need to be considered. Asset specificity is related to the inter-firm relationships of a transaction (e.g. buyer and supplier relationships) (Grover & Malhotra, 2003). Calibrating asset-specificity is also a barrier against opportunism (Choi & Krause, 2006). Load versus capacity strategies are used to analyse customer demand against plant asset capacity where bottleneck constraints exist (Hinckeldyn et al., 2014). According to previous studies, the appropriability regime depends on the features of the previous core experience and tacit knowledge in process capabilities (Teece, et al., 1997). The appropriate types of product architecture and business model is the other main micro-foundation of seizing capacity. A company's ability to develop modular products has been found to improve its competitive capabilities and the literature on product modularity deals with a number of features of product components, including the extent to which modules are independent or separate, the extent to which components are specific, and the extent to which modules are transferable or reusable within the production process (Lau et al., 2009).

2.2.3 Reconfiguration capacity

To sustain superior innovation, firms require maintaining competitiveness through redirecting and realigning the resource base that involves repeated cycles of organisational learning to make changes in operating routines (Teece, 2007; Katkalo et al., 2010). To deal with the rapidly changing technological and customer requirements, managers need to focus on knowledge resources and learning mechanisms that improve the development of DC (Chien and Tsai, 2012). SC partners are particularly effective at transforming know-how are likely to outperform competitors who are not (Anand et al., 2009). Internal and external learning makes capabilities consistent with the properties of rent generation, since its evolutionary nature results from both the history of the firm that is path dependence and the location where it physically takes place that is firm specificity (Verona, 1999). The engagement of suppliers to

share the tacit knowledge and the importance of supplier associations, consulting divisions and secondment groups facilitate the knowledge sharing effectively and efficiently (Lawson & Potter, 2012). In addition to this, it would also be important for companies to cultivate a stable of network identity of suppliers that develop the overlapping knowledge bases, social interactions and reciprocity of knowledge sharing (Dyer & Singh, 1998). The level of incentives motivates members to participate in NPD activities, openly share valuable knowledge while preventing undesirable spill-over to competitors, and efficiently transfer knowledge for both explicit and tacit enhancement of NPD performance (Dyer & Nobeoka, 2000). The one way to spread organisational knowledge from function to function is through job rotation specifically rotating managers creates a knowledge sharing mechanism (Pagell, 2004). Finally, rotating employees through a part of the organisation with customer contact seemed to be a way to ensure that employees truly understood the reasons that customers bought the products they were helping to create (Pagell, 2004). Team dedication is the degree to which team members dedicate themselves to an innovative initiatives and the percentage of team members working full time on the project and team members' low turnover and long tenure contribute to knowledge sharing (Chen et al., 2010).

The governance mechanism that builds the reconfiguration capacity effects on transaction costs as well as resource sharing between partners and goal congruence that engage the SC partners to create values. This also reduces the greater risk of opportunism. Resource sharing refers to the process of leveraging capabilities and assets and investing in capabilities and assets with SC partners that include physical resources, such as manufacturing equipment and facility (Cao & Zhang, 2011). Goal congruence between SC partners is the extent to which SC partners perceive their own objectives are satisfied by accomplishing the SC objectives (Cao & Zhang, 2011). The extent, to which roles, obligations, responsibilities, contingency adaptation, and legal penalty are specified or well-detailed in formal agreement, is the definition of the contractual governance (Cao & Lumineau, 2015).

A firm's history and organisational configuration have an important influence on the strength of managers' desire for complete autonomy that lead firms to achieve competitive advantage (Porter, 1985). The empowerment of engineers and product managers who are characterised by a deep understanding of firm products and capabilities could better achieve an enhanced competitive advantage (Verona, 1999). The role of senior management style and charismatic leadership that is hard to substitute by competitors is another element for assessing autonomy. Individuals such as firm's employees and NPD team members are engaged and motivated to perform beyond their normal expectations, self-interests and higher level of self-efficacy to focus on the team's outcomes via senior management, indirectly (Chen et al., 2010).

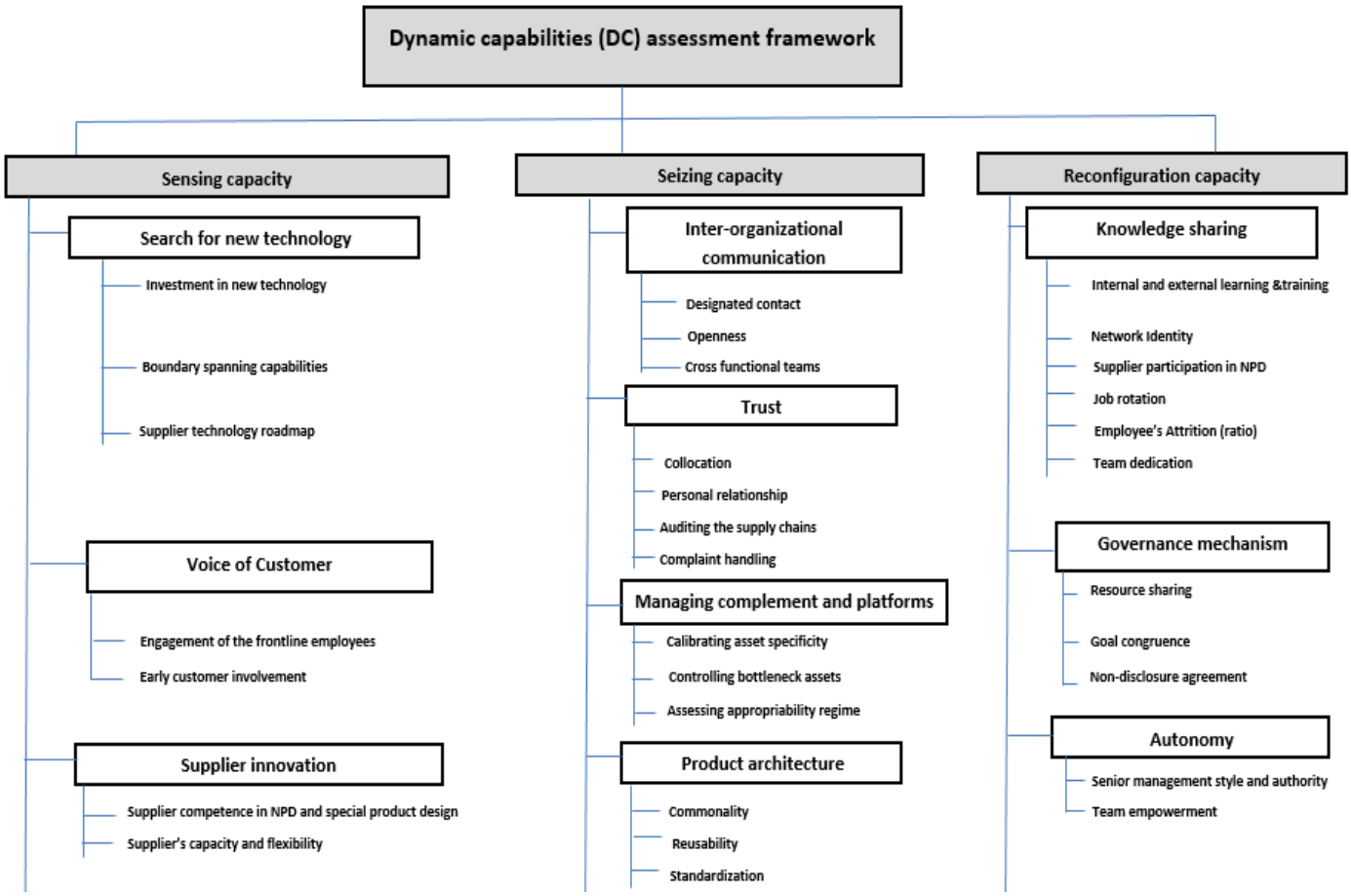

Figure 1. DC assessment framework

3. METHODOLOGY

The study presented a coherent framework of DC arising from literature review that consist of micro-foundations underlying the three dimensions of the sensing, seizing and reconfiguration. The study aims to answer the research question that what are the most important managerial and organizational processes that assist manufacturing companies to improve competitive advantage in regard to NPD projects. To execute these processes more actively and deal with risk, complexity and uncertainty more effectively, multi-case studies need to be conducted specifically at organization level where suppliers involve in NPD projects extensively. The multiple case research methodology is deemed to be more robust than a single case study, since the former can lead to the potential benefits of data richness, depth, and quality compensate for the associated shortcomings of limited representativeness and generalisability (Yin, 1994; 2003). The unit of analysis is the main part of each case study which requires considering that at which level data should be gathered, individual, group or other. The current research work tends to focus on automotive companies with four case studies in the manufacturing sector. It needs to be emphasised that the study focuses R&D intensive manufacturing companies in conjunction with NPD projects in which suppliers are extensively involved, so it is very hard to access confidential data.

A case study approach with multiple cases was adopted to validate the operationalized framework of DC and its applicability in automotive sector. The automotive companies selected as appropriate cases included C1 (American), C2 (European), C3 (European), and C4 (Asian). The aim is to provide useful guidelines for practitioners or researchers so that they can apply similar principles to their own cases. Consequently, good practices for the relevant criteria are discussed based on the evidence generated from the case studies. The conceptual DC model of (Teece, 2007), namely: sensing capacity, seizing capacity and reconfiguration capacity is applied and described for each case.

In this study, email and telephone survey are used to conduct interviews by having a business profile in the LinkedIn. Data from the interviews was analysed to justify and complement theoretical propositions as discussed with regard to the literature. The automotive companies with different culture and structure in managing NPD projects have been chosen. This is due to the importance of high technology and innovation in managing NPD process for achieving sustainable competitive advantage. The automotive industries are one of those industries where the role of the supplier in concept and engineering design as the main phase of NPD processes is so important (Ragatz et al., 1997). Moreover, an effective and efficient NPD becomes a powerful tool in those companies to radically eliminate wastes and hence generate profit in the long-term and help them to achieve the sustainable competitive advantage (Heck & Rogers, 2014).

The Template Analysis method (King, 2004) is utilised to analyse the data collected in the interviews. Template Analysis is more conducive to the needs of this research, because it is a flexible technique with fewer specified procedures, permitting researchers to tailor it to match their own requirements (King, 2004). The researchers defined and produced a list of initial codes by using the interview questions and the literature review as a guide. Modifications to the initial template were then made in order to construct an analytical template and the final template. This strategy for data gathering would be mainly based on the semi-structured interview through email with R&D intensive manufacturing companies. Key people responsible for the product development such as chief executive, R&D director, chief executive officer (CEO) and the senior managers of the companies associated with the manufacturing sector in each case study.

As is typical in case studies, the interview data can be triangulated with other data. Triangulation has this ability to secure an in-depth understanding of the research problem (Denzin & Lincoln, 2005; Ellonen et al., 2009). Diverse secondary data (statistics, annual reports, press releases, newspaper articles, for example) collection on each case would be significantly helpful since a rich source of insight from each case results in supplementing the evidence from interview transcriptions (Adam & Healy, 2000). It also contribute to have more generalisations due to the limitations of case study which does not allow us to have a wider generalisation. In comparison with the interview methods, email or online questionnaire have many advantages over the interview methods. Firstly, the main point which needs to be emphasised is that because of non-standardisation of interview method, and because of a potential need for a set of reliable data and information therefore, the email/online questionnaire seems to be a very effective way of covering the understandable questions based on the systematic way (Blumberg et al., 2005).

4. RESULTS AND DISCUSSION

In this section, a set of management practices underlying components of conceptual DC model of (Teece, 2007), namely: sensing capacity, seizing capacity and reconfiguration capacity for each cases have been discussed. The main research contribution would be building up DC approach to examine the extent to which theoretical framework rising from literature review is different from the case studies. Accordingly, the final section is the summary of case study findings which is based on aggregating practical management practices underlying micro-foundations of DC that achieved from each case study.

4.1 Case 1 (C1)

C1 manufactures and supplies a variety of products for the automotive industry and manufactures and markets a broad range of diesel and natural gas powered engines for the heavy and medium-duty truck, bus, recreational vehicle, light-duty automotive markets. The company also manufactures filtration, exhaust and fuel products for passenger cars and other vehicles. The company is well positioned to tap the opportunities arising from these growing automotive markets. The NPD performance of the company is the function of product performance, costs competitiveness and market competitiveness as highlighted by chief executive of C1 that *''any company needs to develop new product periodically if the company wants to grow their business beyond the organic growth and to be ahead of the market, ahead of your competitors''.* The importance of target market and need for huge amount of capital and funds would be essential to develop product proceeding technology (PPT) and *''... NPD needs to have a target market and fit in with the rest of the company product range and the key is to create shelves of solutions for future designs in order to reduce the time to market for new products''.*

In sensing capacity, involving vendors early in the NPD process is extremely important for the success of the programme. Investment in new product design, manufacturing process, and level of affordability to develop new products in short period of time allow the companies to improve cost, quality and productivity.*''... Efficient engines, emissions reduction and adding more personalisation options have been a major requirement in the competitive automotive market but also because of the fact that a good portion of the products are used in automotive highway applications, fuel efficiency is a major market comparative advantage and a major demand by customers''.* As described by one of respondents, *''identifying the desired supplier capabilities based on our design requirements and their design capability, innovation and reputation in terms of cost, quality and delivery''* would be one the most important responsibilities of purchasing managers that form boundary spanning capabilities. In terms of supplier's technology roadmap, every industry and every company have their uniqueness in terms of technology cycle. *''... good companies are the ones which have long term technological development like 5-10-15 years ahead on a proactive mode and not reactive. Good companies are the ones that have several PPT technology developed and on the "shelves"''. Involvement of customers in the companies' plant in development of new product phases especially design stage is a very common practice between the company and customers and the suppliers and this practice reduces design cycle time, reduces development costs and effective product cost and quality ...''.* In seizing capacity, constant communication process among the company and customers reviewing the programme, its progress and outcome is the way to avoid surprise on both sides and also reduce casual ambiguity in the NPD process. The main advantage of this is related to minimising the lead-time and development costs. *"... the more modern communication systems, video conferencing plus engineering tools to do more simulation and less real tests (too expensive), improve productivity, cost reduction and being more efficient''.* Furthermore, the importance of clear and defined mechanism to document technology findings by their critical parameters that is handed off to/ or integrated into a new product team develop seizing capacity. Moreover, managing complements and platforms including dual sourcing, load versus capacity planning, different platform lines that are based on volume, size of products and degree of complexity would be another micro-foundation of seizing capacity. Accordingly, *''the quality is built during manufacturing processes by employees and less quality audits play an important role in addressing the opportunities ''.*

Trust as one of the most commonly discussed criteria for assessing seizing capacity is high construct of supply chain collaboration in managing NPD projects. *''As trust increases and time passes, the optimal collaboration can be achieved, which leads to greater rewards for both parties. It is all about customer requirements and creating the competitive advantage z1early in the design''.* The degree of importance and complexity of the component determine the level of importance of co-location for building trust. For instance*, ''in the co-location work, the PPT technology development make sense for critical components like for cylinder block suppliers, fuel system suppliers, most castings, crankshafts''.* In seizing capacity, product architecture like *''the role of modularity is a great way to avoid components proliferation, cost increases, and extended design time and the goal is to reduce the number of new components, reduce the design/development time and reduce costs''.*

In terms of reconfiguration capacity, the knowledge sharing activities between suppliers, buying manufacturing firms and customers *''including some of the historical data between the two companies, evaluation of their engineering resources and capability, market experience, ease of doing business and the design tools used, for instance, Professional Engineering design integration develop reconfiguration capacity''* reduce the development time and costs and doing it right the first time. *''Learning upfront their critical needs ... at the early stage of the design improve the design quality and reduce lead time''. ''... the typical governance should be with clear NDAs (no disclosure agreements) and establishing the right terms of technology sharing, confidentially agreement and technology ownership''.* The importance of effective leadership, senior management style and authority has obvious cost benefits and effective team management enhancements*. ''The relationship between suppliers and customers are built with their interactions early in the process and autonomy is not imposed but conquered by providing high level services, technology and good design. In fact, autonomy is not imposed but conquered by providing high level of trust''. ''In terms of employees' empowerment, the company need more team based working, with clear metrics and team's self-management and there has been an increase in trust among*

employees and employer. Instead of having those suggestion boxes, employees identify areas of improvement and they are tasked to do their own implementation and no longer wait for someone else to do it''.

4.2 Case 2 (C2)

C2 is a global provider of integrated power systems and services to the civil aerospace, defence aerospace, marine, power and energy markets and a strong position across different market segments provides the company with a competitive advantage over its peers and increases its bargaining power. However, intense competition across all the operating segments from large industry players could result in pricing pressure, which may impact the overall revenues and profitability of the company. ''*...in recent years, new product development has been the major objective, in order to secure future product offering and win orders. Development of lighter, faster, cleaner engines and offering a service package with the engine rather than aftermarket care has been the change in the aerospace sector''.* The respondent stressed that *''the new product must have a target market yes and firm orders based on the targeted performance specification, otherwise the investment in development would not get past project phase. The new products fit in with the product portfolio within the gas turbine sector".* Moreover, new technology identification may come from a market or customer driven situation. For this purpose, *''R&D has also been applied to improve efficiencies internally, to increase operational performance by investing in new technology to reduce value added time to a product".* In addition to this*, ''identifying competitors/competitiveness knowledge and turn-key package investment i.e. full manufacturing solutions would be also important for search for new technology''.* In sensing capacity, the companies use VOC forums to develop strategies for improved performance on current products or be a basis for a new evolution design. This also helps to identify target market segments and changing customer needs. *''Listening to the VOC and reacting to this quicker than the competition, driving the enhanced efficiency and increased margins''*. In addition to this*, ''supplier innovation on manufacturing methods is built into departmental objectives to reduce cycle times, reduce set up (down time) and increase productivity which in turn increase the NPD efficiency''.* In terms of building trust, long term relationship following with clear partnership upfront, transparency, systems integration capability, people's capability and ethics are the main items that contribute to the literature review. *'' Stick to the process- release drawings, models and data as agreed to allow all teams to work well and also auditing the SC for continuity of supply, capacity and quality standards and process capability build trust ''.* In terms of assessing product architecture, ''the *product architecture and technology are generally based a previous model that will have satisfied requirements at time of going to market ...''.*

4.3 Case 3 (C3)

C3 is one of the greatest success stories of British manufacturing, headquartered in the UK; it is the country's largest automotive business. C3's operations in the UK are currently split across eight sites with three vehicle manufacturing plants. Long-term investment and cutting-edge innovation are the keys to the success and future growth. The key point for managing the NPD process is the fit of new products and technology with the rest of product portfolio. In addition to this, addressing the tactical and strategic elements of the business for achieving different goals is highly important. As expressed by company's respondent, *''... our business is the instruction of new products and technology in line with the rest of the car industry. The point of the new product introduction I believe is to address tactical as well as strategic elements of the business so...''.*

Customer satisfaction and product differentiation both are important factors for car industry. ''*Our customers are constantly demanding new products, different products, unique products and ones which particularly for our market, in the premium sector, differentiate themselves from other offerings...''.* It is also important for the company to decide which strategic objectives it tends to address in NPD process. *''Almost universally in the car industry today we recognise that key strategic trends are about to revolutionise our businesses. IT connected vehicles; Autonomous vehicles; Battery technology; changing ownership models customer is no longer wishing to use cars in the way they did in past generations''.* Time to market (TTM) is a competitive advantage for the company as shorter TTM help the companies to be much more responsive against dramatically changing customer requirements or technology needs. According to the evidence collected from the company, *''the most important consequence is lost time for me. ... The commodity of time is more important than cost. I can usually have a cost debate or argument and try to justify why I need more money for a project. I have never met anyone who can create time. Once time is lost - your project is in serious trouble and will definitely translate into far higher costs. We are very focused on control of timing plans. Most projects in all industries are very adversely affected by delay''.* To search for new technology, segmenting the market is a must for any company and any product especially for companies with Global reach. *'' ... In the automotive segment the companies have many laws to adhere to for each market into which we sell. Their products have to be tested to ensure it makes the standard requirement for that particular market.''.* Resource allocation and resourcefulness both need to be balanced for manging NPD projects. *''Traditional Western planning inevitably becomes resource poorly and late, makes a great number of changes and then throws huge resources at the end of the project. This is costly and not necessarily to the benefit of the customer. In western companies, they take increasing resources from concept to launch. However, in the Japanese companies, they take too much resource resources on upfront for NPD programme and also*

demolish them…''.Western companies increase resources at the end of the NPD. This is due to this fact that … ''*they are normally late and their quality maybe in bad shape. The costs of adding more resources at the end are twice as higher''*.

4.4 Case 4 (C4)

C4 is engaged in the manufacturing and sales of vehicles, marine products and related parts and has strong R&D capabilities, which enable the group to build a broad range of innovative products and technologies that enhances its competitive strength. Robust R&D activities enable the group to build innovative products and technologies, which enhances competitive strength and future growth opportunities. Intentions to continually invest in R&D is one of the most important DC factors that improve NPD performance. *''In a profit and loss statement (P&L) business that this is essential, not only to the longevity of the business but also the business model it adopts such as intentions to continually invest in R&D''* . In addition to this, *''making use of external bodies such as technical centres or universities and labs to develop manufacturing methods via technologies and advanced methods that perhaps the organisation does not currently have reduce lead-time to manufacture or process variation and CpK improvement''*. In this company, supplier's technological knowledge in product and process that form supplier innovation is one of the most important criteria for assessing sensing capacity. As highlighted by one of respondents, *''continual training and communications play an important role for building and developing reconfiguration capacity of companies''*. Contractual expectations as one of the most important practices underlying governance mechanism is vital for improving DC of the companies. *''The contractual expectations are very numerate and specific, and anything proven to be outside of the contractual agreement would entail warranty claims and damaged reputation''*. In terms of people/employee engagement that form the level of required autonomy, *''people / employee engagement is very important in the deployment of objectives such as innovative suggestions on improvement cycles, clear communications and transparency with business results to enhance motivational factors''*.

Table 1 shows the summary of all the selected new management practices underlying micro-foundation of sensing capacity that contribute to the existing literature review significantly. This section provided detailed explanation following with some relevant and selected evidences from the cases studies for supporting the theoretical framework depicted in figure 1. This would be a development to the dimensions of DC model of Teece (2007). The following organisational and managerial processes assist managers to scan and search emerging technological and market opportunities. The micro-foundations of sensing capacity also facilitate successful product planning activities to enhance competitive advantage.

Final template of sensing capacity
Search for new technology
Intentions to continually invest in joint collaborative R&D.
Extensive investment of time and people early in the concept design and business cycle.
Quickly spin up and disband agile teams.
Opportunistic exploration of ideas (without a lot of institutional inertia slowing it down).
Exploration and mitigate investment risk.
Needs across fields through international and domestic conference, peer- review journals and engagement with universities.
Close partnership with key suppliers.
Working with Government- UK and EU i.e. innovate UK.
Engaging with professional bodies in the industry.
Product Line Architect who has responsibility for thinking about the technology plan horizon for a specific product line or family.
Annual/ bi annual tech meetings or inviting suppliers for the company's tech meeting based on familiarity between them
Identifying the desired supplier capabilities based on our design requirements and their design capability, innovation and reputation in terms of cost, quality and delivery.
Identifying competitor's/ competitiveness knowledge.
Turn-key package investment i.e. full manufacturing solutions.
Seek for customer problem solutions always thinking to establish comparative advantage in the market.
Voice of customer
Determine very early via testing product, service, application assumptions for user needs, desires, wants interests, value, etc.
Improve based upon customer feedback and continue to test at each gate.
Understanding what regions the company will play at, who are company's customers and what are their needs.
Make a target market as compared with existing solutions, and fit in with the rest of the company product range.
The skills of listening in special to the company's customers and fully understanding their needs.
Assessment and evaluation of customer requirements and creating the competitive advantage early in the concept design.
Evaluate existing customers for highest need, move outward to lesser known customers and potential customers. Never assume build it and they will come.
Customer clinics.
Follow up after sales.

Social media interactions.
Global and national trend analysis - generation z, y vs gen x / baby boomers.
Locate design elements in global markets-even if only a small unit.
Prototype buyoff requirements of customers.
Monitor complaints/ observation of new uses and invitations for suggestions.
Supplier innovation
Previous project experience.
Invention and production scalable, rampable, and within expertise.
Degree of breakthrough in the design, innovation in new materials and manufacturing processes, Pro E design integration capability of key suppliers.

Table 1. Summary of selected evidences of micro-foundations of sensing capacity

Final template of seizing capacity
Inter-organizational communication
Fully engagement of purchasing functions with the design teams
Level of involvement on both sides-should have steering committee meetings occasionally with more senior people at both company.
Lead with technical personnel across technology, science, production, and distribution silos, rewarding honesty and troubleshooting.
Modern communication systems, video conferencing plus engineering tools to do more simulation and less real tests (too expensive).
At a micro level, company newsletters and brochures are handed out to employees or posted to their home address.
At a micro level, shift and daily team briefings take place to ensure the same message is delivered in terms of departmental performance and activities to ensure the plan is achieved.
At a micro level, monthly plant briefings are important where the plant manager would brief the whole workforce on how the plant is operating against its objectives and what the key challenges are.
At a macro level, there are quarterly briefings from a director to detail how the business is doing and what lies ahead in terms of challenges.
At a macro level, usually an annual story board session looking at longer term strategic objectives, challenges and latest technology development is important.
At a macro level, stand up briefs, visual aids, constant message and make it happen because everyone expects it to fail.
There are all employee surveys that take place annually that talk specifically about motivational factors within the workplace from a social responsibility perspective.
Building trust
Clear partnership upfront transparency, systems integration capability and people's capability and ethics.
Integrity of the technical leadership, building working relationships that are valued and transparent.
Roper behaviour from both sides (buyer and supplier) to balance authority in order to be survived.
Stick to the process- release drawings, models and data as agreed to allow all teams to work well.
Agree key priorities for each team and work to them.
On-site engineers through project duration.
Use of one system i.e. portal within dealers that interfaces direct with Plant and QA functions.
The agreed contract deliverables and key deliverable performance in the last few years between the firm and its vendors, the vendor's financial success and health, technology development capability.
Reduce the number of Tier 1 suppliers and work more closely with the ones that remain.
Product architecture
Product architecture and technology are generally based a previous model, that will have satisfied requirements at time of going to market.
Integrate with existing plus affordable improvements.
Fit between new customers and within the scope of an existing product frame size.
Common vehicle platform and inspection methods.
Competitiveness across portfolio frame sizes and vehicle size.
Pursue only those inventions/products that integrate with current technology and architecture with rationally affordable improvements.
Managing complements and platforms
Reliability program limited- regular structured analysis of risks, issues and opportunities.
Change the process to accept internal actions, try and accomplish external actions outside the internal cycle
Understand the processes to build the new product, and then do a FEMCA on the processes for the purpose of early identification of mistakes in the concept and design gates.
Look fully at the physics of failure such as fault of the design (patent defect) or a result of a hidden issue with the manufacturing process (latent defect).
Process Cp and CpK are vital as well as asset constraint management for managing complements and platforms.

Table 2. Summary of selected evidences of micro-foundations of seizing capacity

Reconfiguration capacity specializes alignment and realignment of organizational assets and structures as a company face with changing market (Teece, 2007). It is facilitated by the organisational and managerial processes that have been described in the table 3.

Final template of reconfiguration capacity
Knowledge sharing
Training based on people's capability, management capability and leadership skills and all depends on the employee's responsibility.
Training based on ''Hire to Develop'' process.
Integrate Purchase, Operations and STA into the early design team. Follow through to launch.
Lessons learnt logs.
Formal qualifications and internal training are given to leaders to ensure they are the 'go to' person within their teams, to develop leadership qualities.
The learning and experience that has been gained has been developed into a production system.
A need for concurrent engineering, having suppliers in our technical centres and some of our engineers at the vendor's sites.
Keeping the right history between the two partners in terms of design experiences and problem solving.
Governance mechanism
Growth and win-win between customers and company that both grow the business.
The company develop long term supply agreement that makes suppliers more finance robust.
Maintaining the product cost at competitive levels by purchasing functions.
Need to adapt to those needs and employees need to continually evaluate the customer behaviour changes.
Clear performance management system monitoring employee performance and their individual development requirements.
The hierarchical structure tends to be flatter than taller. The manager function has shift from management to coaching.
The importance of corporate and social responsibility seriously and invest time and resources into developing education institutes, local community and under privileged groups.
Development of shop floor measures and kept it really simple geared around safety, cost and on-time delivery on how manufacturing were supporting the business.
The company delegated more to vendors to monitor the quality and do minimal inspection in the company.
Aligned and integrated goals must be monitored on short interval control to ensure attainment and sustainment.
Monitoring of goals/metrics should focus upon the few critical indicators that reflect the core values and purpose of the firm.
Sufficiently protected IP- no supplier wants to share its IP with customers who will just dump them in the future.
Improve production methods to drive out waste continuously.
Check the supply chain about what risks are flowed down, and how these are managed, and what SPC measures can be put in place.
The importance of engineering controlled products that innovation on manufacturing methods is built into departmental objectives.
Diversity policies and fairly stringent management procedures.
Good brand brings returning custom and an expectation in advance of trying the product out.
Autonomy
Senior managers would deal directly with the workforce rather than have supervisors and team leaders in place
Interactions early in the process between supplier and buyer. Autonomy is not imposed but conquered by providing high level services, technology and good design.
Ability to change drawing during test piece or production trials.
Incentives for design and implementation of performance based reward systems.
Tendency to encourage more employees doing predictive reliability analysis than inspection.
Reward long-term planning, performance, imagination, invention, and critical analysis.
Willingness to acknowledge error, misdeed, and inadequacy by senior managers.

Table 3. Summary of selected evidences of micro-foundations of reconfiguration capacity

5. CONCLUSION

The present study proposed a validated multidimensional measure of micro-foundation of DC building on the relevant prior literature and the multi-case study approach. This study explained how manufacturing companies would be able to improve competitive advantage by reliance on novel and generic framework of DC based on exploring skills, activities and routines. Development of DC has a strong influence on the product development process in the automotive industry. In terms of replicability and reproducibility of the DC assessment framework, manufacturing companies would be able to successfully implement a variety of organisational and managerial processes explained in the figure 1 and case studying findings to aid the development of the three characteristics of DC for managing their NPD process.

The proposed framework provides a roadmap for senior managers and chief executives to make efficient and robust decision for the purpose of continuous performance improvement based on capability perspective. The advantage of the DC assessment framework could be used to enhance the knowledge of how the success of manufacturing companies in conjunction with NPD projects/programmes can be sustained. The research findings generated from this study provide several guidelines for managers, particularly in the automotive industry, for the effective planning and execution of NPD activities. These guidelines can assist them to implement appropriate strategies for supporting the NPD process and outcome. In this regard, the framework developed in this research is suitable for developing and maintaining sustainability by organizing SC collaboration and DC. The study can help alleviates the shortcomings that exist in the DC and NPD literature for answering the question of how manufacturing companies can achieve competitive advantage in the long run. By integrating the SC, NPD and DC literature, this study strives to explain that management practices that relate to micro-foundations of DC at multi-dimensional level can help senior managers to assess and improve the performance of NPD projects.

6. LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

Further research needs to be conducted to consider DC assessment from all aspects of social, technical and environmental to make a better and precise decision for managing NPD projects. The DC model can be generalised to a wider area of DC assessment, as well as to any cases of multiple criteria assessment. In addition to this, the relationship between micro-foundations of DC can be tested through large scale data collection using efficient MCDA methods such as the evidential reason (ER) approach. It is also important to consider the unit of analysis for much wider communication with different R&D managers and purchasing managers who have knowledge of NPD projects and SC for developing DC.

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