

FIRMS' DYNAMIC CAPABILITIES, INNOVATIVE TYPES AND SUSTAINABILITY: A THEORETICAL FRAMEWORK

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Sustainability of innovations reflects not only the economic aspect, but also the social and environmental concerns embedded on innovation, whilst dynamic capability indicates the sources of knowledge to achieve that sustainability. Hence, this paper places an emphasis on innovation as the means to add not only economic value, but also to the environment and society and also in capabilities that bring about sustainability-related innovation in firms. Its goal is to delineate a conceptual model about the relationship amongst firms' dynamic capabilities, innovative outcome and innovation performance. This model will be applied to test whether differences in dynamic capabilities dimensions namely, adaptive capability (ability to identify market opportunities), absorptive capability (ability to absorb external knowledge) and innovative capability (ability to create knowledge), at the business unit-level, are related to technological innovations types and to variations in sustainability of innovations, regarding economic, social and environmental results. Hence, a bibliographical research about the themes was carried out and an in-depth study of the selected literature was undertaken. Specifically, we revise the proposed theoretical approaches; critically assess the suggested analytical models; and conclude with an integrative model focusing on the relationship above. The research question: are the outcomes of firms' innovative activities in terms of types and sustainability performance affected by differentiation in dynamic capabilities? After the evaluation of the literature, this paper's proposal is that a firm possessing higher levels of adaptive, absorptive and innovative capabilities focuses on developing innovations which bring not only high profits, but also social equity and environmental protection. In this case the firm is orientated by an innovative strategy focused in sustainable outcomes, its dynamic capabilities may direct toward concentrating its assets on developing capabilities, which results in higher levels of sustainability in new products or services. In contrast, the lower levels of adaptive, absorptive and innovative capabilities lead the firm to focus on a cost leadership innovative strategy, which results in lower levels of sustainability in new products or services. Hence, the sustainability of the innovation outcome is greater in firms with high levels of adaptive, absorptive and innovative capabilities, which in turn is steered by firm

innovative strategy. From this defined framework, we will research how firms evolve on adaptive, absorptive and innovative capabilities

Palavras-chaves: dynamic capabilities, sustainability, innovation

Introduction

The publication of the report of the Club of Rome (Meadow & Meadow, 1972) can be seen as a landmark for a widespread discussion of the concept of sustainable development. In addition, a concern for the public at large, a strategic notion for many companies and theme on the international agenda were placed with the publication of Our Common Future Report by the Brundtland Commission to the UN in 1987 and after the 1992 Earth Summit in Rio (Dijkema et al., 2006; WCED, 1988; Pezzey, 1992; Atkinsons, 2000; Dyllick and Hockerts, 2002).

In turn, as Zhou and Wu (2010) stressed, innovation is critical for firms to adapt to turbulent environments and achieve a sustainable competitive advantage. Hence, the fields of innovation and sustainability are more and more recognized as the major concerns of business in the 21st century. Whilst firms need a continuous innovation process to respond to the ever-fast environmental changes, the goal of sustainability requires new ways of doing business.

However, Dijkema et al. (2006) doubt whether the accelerated rate of technical change within firms and amongst entrepreneurs is compatible with a route to sustainability. According to Ely and Scoones (2009) the predominant questions of —how much-, —how fast-, and —where- innovation is happening – posit in the discussions of innovation and globalization are linked with a treatment of innovation in a simple scalar fashion as a component necessary for economic competitiveness. However, they suggest that to improve the debate about innovative activity, the objectives of poverty reduction and environmental sustainability should be added to these discussions, which unveil questions about the direction of innovation (—innovation to what ends?) and the distribution of its benefits (—innovation for whom?)”. This a very important step since the type of innovation efforts that are pursued and prioritized is very influenced by them.

As Simanis and Hart (2009, p.79) stresses in “the ongoing effort to serve the mass consumer, today’s corporate growth and innovation strategies continue to reflect and reinforce a disembedded logic which stresses Communities framed as target markets; Ecological systems treated as natural resources that supply raw materials, and People’s aspirations for a better life register as market demand”. In line with this, Dyllick and Hockerts (2002) claim that the practical results since Rio towards sustainable development are not very encouraging. At the firm level, Nidumolu et al. (2009) posit that executives believe that to choose between the social benefits of developing sustainable products or processes and the financial costs of doing so are mutually exclusive.

However, Werbach (2009) point that nowadays societies and firms are searching for new sustainable patterns of development, avoiding the environmental cost of the relentless creation and destruction of products, processes and services. Hence, for him (p.323), ‘developing new technologies that enable communities to prosper in a healthy and sustainable way, without depleting the natural environment, has become a prime driver of technological innovation. Innovation is required in production processes for reducing, reusing, and recycling materials’. The results of the research carried out by Berns et al. (2009) suit with this since over 92% of surveyed companies were already addressing sustainability in some way (p.21), even whether they differ in the definition of sustainability. In line with this, the Former President of the United States, Clinton (2009), states that the idea that firms choose

between doing good and being profitable is being replaced each more by the understanding that they have responsibility not only to their investors, but also to the society and environment in which they operate.

As Nidumolu et al. (2009) show in their research about the sustainability initiatives of 30 large corporations, sustainability is a mother lode of organizational and technological innovations that enables companies to create new businesses, lowers costs, and generates additional revenues. Hence, they suggest that companies now treat sustainability as innovation's new frontier.

Sustainability of innovations reflects not only the economic aspect, but also the social and environmental concerns embedded on innovation, whilst innovation capability indicates the sources of knowledge to achieve that sustainability. Hence, this paper places an emphasis on innovation as the means to add not only economic value, but also to the environment and society and also in capabilities that bring about sustainability-related innovation in firms.

In doing so, we intend to advance in the understanding of the causal relationship of firms' dynamic capabilities, innovative outcome and innovation performance. The goal is to delineate a conceptual model on how firms evolve on adaptive, absorptive and innovative capabilities, how innovativeness is reflected by these capabilities, and how innovativeness reflects on sustainability, regarding economic, social and environmental aspects. This model shall be applied in a research assessing the mutual relationship amongst sources and consequences of innovation in the Brazilian agro-food firms.

Hence, it is proposed the following question: are the outcomes of firms' innovative activities in terms of types and sustainability performance affected by differentiation in dynamic capabilities? In other terms: which capabilities are related to the innovation process and which innovation outcome is being produced?

In methodological terms, the paper is characterized by a bibliographical research and an in-depth study of the literature about the relationship dynamic capabilities, innovative types and innovative outcome, in terms of the economic, social and environmental results. In this direction, we revise the actual trends in the field and critically assess the suggested analytical models. The proposed integration of the revised models in a synthesis not only will base future empirical research but also serve to managers and public policies makers in their work of assess the process of generation, adoption and technology transfer.

This is an important aim since the literature and research about the relationship above is scarce, in spite of a lever in the attention on innovation processes towards sustainable development. This paper adds to this literature by defining a theoretical framework for examining differences in firms' innovative-related activities and the implications of these activities for a firm's performance and sustainability of the innovative process.

To achieve the goal, the remaining of the paper is structured as follows: first it is assessed the literature about dynamic capabilities as mechanisms of innovation at firm level; in the second section the typologies of innovation are evaluated; in the third section it is assessed the literature about sustainable innovations; the fourth section presents an analysis of the literature about the relationship dynamic capabilities, innovations types and sustainable outcome, and, the following section presents the devised conceptual model for the analysis of the relationship between capabilities with innovations and performance. Then, the paper is finished with the concluding remarks.

1. Dynamic Capabilities

This section presents the result of an in depth analysis of the literature about dynamic capabilities as internal determinants of sustainable innovations.

Nelson (1991) suggests the sustainability of competitive advantage will depend on the extent to which the firm is able to develop capabilities for innovation. Specifically in the case of sustainable innovations, according to Nidumolu et al. (2009), firms face different challenges at each stage and must develop new capabilities to tackle them.

This suggestion dates back to proposals, pioneered by Penrose (1959), that resources and capabilities are the basis for innovations. In these proposals, a set of in-house resources and capabilities, broadly defined to incorporate inelastic productive resources, is claimed to give rise to intra-industry heterogeneity and idiosyncratic (firm-specific) sources of competitive advantage.

The resource-based theory (RBV) foundation is that firms are heterogeneous with respect to their resources and capabilities, which are the basis of the firm growth and competitive advantage. Hence, the strategy literature has put in the last years a considerable attention to understand how firms create, maintain, and enhance these capabilities.

Amit and Schoemaker (1993), Teece et al. (1997), amongst others, distinguish resources from capabilities. Resources refer to firm-specific assets, tangible and intangible, such as physical, financial, human and organization (Barney, 1996). Hence, these resources form stock of available factors owned or controlled by an organization (Amit and Schoemaker, 1993). Examples of resources are production plants, property, organizational routines, workers' skills, reputation, structure, and brand name. Capabilities involve the use and adaptation of a set of resources based on accumulated organizational or collective experience, to fulfill the objectives of the firm and provide it with a competitive advantage. In short, capabilities refer to the capacity to deploy the resources of an organization (Amit and Schoemaker, 1993). Resources and capabilities provide competitive advantage when they are difficult to imitate, replicate, or substitute. While resources can be tradable in (nearly perfect) factor markets, capabilities cannot, since they are firm-specific, i.e. created inside firms over time. Hence, authors as Mahoney and Pandian (1992) stress which firms' asymmetries are not defined by the ownership of resources, but by the way that they use these resources (capabilities). Wang and Ahmed (2007), refer to resources as the 'zero-order' element of the hierarchy, since they do not persist over time and hence cannot be a source of sustainable competitive advantage.

The "dynamic capabilities approach" (Teece et al., 1990), is built upon this resource-based theory (RBV). However, as Priem and Butler (2001) stressed RBV is essentially a static theory since it does not explain the evolution over time of the resources and capabilities that form the basis of competitive advantage. Hence, one should not just view a firm as a bundle of resources, but note also the 'mechanisms by which the firms learn and accumulate new skills and capabilities, and the forces that limit the ratio and direction of this process' (Teece et al., 1990, p.11). In this sense, Teece et al. (1997:516) define 'dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments'.

According to Wang and Ahmed (2007), although the notion of dynamic capabilities complements the premise of the RBV, capabilities and core capabilities, and has leveraged vigour into empirical research in the last decade, several issues surrounding its conceptualization remain ambivalent. However, based on the empirical advancement about the subject, they suggest that dynamic capabilities can be analysed by its three main elements: adaptive capabilities, absorptive capabilities and innovative capabilities.

Based on the literature, Wang and Ahmed (2007) define adaptive capability as a firm's ability to identify and capitalize on emerging market. They stress that adaptive is different of adaptation and that measures in the literature of the former are multidimensional, as those proposed by Oktemgil and Gordon (1997) including a firm's ability to adapt their product–market scope to respond to external opportunities; to scan the market, monitor customers and competitors and allocate resources to marketing activities; and to respond to changing market conditions in a speedy manner; and those proposed by Gibson and Birkinshaw (2004) evaluating whether firm's management systems lead the firm to respond quickly to changes in the market and evolve rapidly in response to shifts in its business priorities.

Absorptive capability is defined, following Cohen and Levinthal (1990) seminal proposal, as 'the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends... the ability to evaluate and utilize outside knowledge is largely a function of the level of prior knowledge'. Hence, the development of this capacity is path-dependent which demands a continuous investment to maintain a technical capability in that area.

This absorptive capacity is often reflected in the firm's innovativeness and its ability to exploit new knowledge (Zahra & George, 2002) and is pivotal to the firm's innovative activities (Cohen & Levinthal, 1990). This idea represents a wide consensus and in consequence, according to Abreu et al. (2007), has been widely researched at the level of firms, sectors, regions and nations.

Innovative capability refers to a firm's ability to develop new products and/or markets, through aligning strategic innovative orientation with innovative behaviours and processes (Wang & Ahmed, 2004). In turn, Dodgson et. al. (2008 p.97) define 'innovative capabilities as bundles and patterns of skills used by firms to formulate and implement an innovation strategy involving the creation, extension and modification of those resources used for innovation'. In line with this, Bell (2009) defines innovation capabilities as the 'capabilities needed to imagine, develop and implement new configurations of product and process technology and to implement changes and improvements to technologies already in use'.

Innovative capabilities, according to Pekka and Thomas (2006) cover besides technological capabilities also aspects of management and organization in order to move from technological chance to innovation. For them (p.70), 'the innovative capability of a firm relies on its innovative system, which is embedded in the firm's resource base, management system, organizational structures and business routines'. Hence, the preconditions for innovativeness demands more than R&D activities, alone. 'Innovative capabilities are defined as the firm's capabilities to generate customer value by developing and introducing to the market new products and services or reducing the costs induced by the value creation process' (Pekka & Thomas, 2006). Hagedoorn and Duysters (2002) also stress that innovative capability concerns the specific expertise and competence related to the development and introduction of new processes and products.

In turn, Subramanian and Youndt (2005), Sen and Egelhoff (2000), amongst others, classify innovative capabilities by two different types: incremental and radical. Accordingly, Incremental innovation capabilities are focused on improving existing products and processes; and radical innovation capabilities are focused on developing new products and processes based on entirely different concepts and theories.

The classification of capabilities according to directions of innovations is the base for diverse proposals of typologies of innovations, as we will see in the next section.

2. Typologies of Innovations

According to Moors and Vergrat (2002), many firms are adopting incremental technological changes in their production systems in order to taking up the environmental challenge, which they think are no longer enough. For them, high-level sustainability goals require radical innovations in industrial production.

This position is corroborated by Geels et al. (2004) who stress that the environmental challenge demands a change in socio-technical systems or a system innovation. This involves substantial changes in industries, firms, technical knowledge, user contexts and symbolic meanings; on the supply and the user side. System innovations are defined by Geels (2004, p.19) ‘as large-scale transformations in the way societal functions such as transportation, communication, housing, feeding, are fulfilled’.

However, Berkhout et al. (2004) propose a more ‘flexible’ view of transitions to sustainability, suggesting a typology of four ‘ideal types’, based on the degree of coordination of regime change between actors, networks and institutions; and on the locus required to respond to selection pressures acting on the regime. These types are: purposive transitions – derived from expectation located outside the regime; endogenous renewal – incremental transformation guided by past experience; re-orientation of trajectories – radical transformation formed within the regime; and, emergent transformations – derived from uncoordinated pressure for change beyond the incumbent regime, in general science-based.

Geels and Kemp (2007) also offer a typology of changes based on a multi-level perspective of innovation. Three types of change processes are identified: reproduction, transformation and transition. ‘Reproduction’ refers to incremental change along existing trajectories. ‘Transformation’ refers to a change in the direction of trajectories, related to a change in rules that guide innovative action. ‘Transition’ refers to a discontinuous shift to a new trajectory and system. Using the multi-level perspective, the underlying mechanisms of these change processes are identified. Table 1 summarises the differences between these change processes in terms of underlying mechanisms.

	Reproduction	Transformation	Transition
Levels involved	Regime dynamics	<ul style="list-style-type: none"> ● Pressure from landscape ● Adaptation and reorientation in regime 	<ul style="list-style-type: none"> ● Pressure from landscape ● Increasing problems in regime, and attempts at re-orientation ● New innovation in niches that eventually break through
Role of actors	Incumbent regime actors	<ul style="list-style-type: none"> ● Pressure from outsiders ● Incumbent regime actors respond through re-orienting innovative trajectories 	<ul style="list-style-type: none"> ● Pressure from outsiders ● Incumbent actors fail to solve regime problems ● Outsiders develop new innovations

Source: Geels and Kemp (2007)

Table 1 – Different mechanisms in change processes

Common to these proposals is the suggestion that different types of innovations are linked to different levels of sustainable outcome, as it is shown in section 3.

3. Sustainability of Innovations

According to Werbach (2009) the growing evidences of damages caused by environmental catastrophes around the world, ‘have increased the recognition that economic prosperity is intimately entwined with environmental and social sustainability’ and ‘societies and the business that generate economic prosperity are searching for new sustainable patterns of development’ (p.322-3). As detached by Bryson and Lombardi (2009), the rise of the concept of sustainable development in the 1990s have lead to the inclusion of environmental and later social issues into business decision-making.

In spite of this recognition, there is not a clear consensus on how sustainability-ideas should be formulated (Carrilo-Heromisilla et al., 2009). However, Berns et al. (2009) found in their research that 64% of experts surveyed used one of two widely accepted definitions: the so-called Brundtland Commission definition or the triple bottom line definition, both of which incorporate economic, environmental and social considerations. In this line, Werbach (2009, pp.7-8) stresses that ‘a successful strategy for sustainability is different from and much bigger than just “green”: it must take into account every dimension of the environment in which your business operates – social, economic, and cultural, not just the natural environment’.

According to Bos-Brouwers (2009) sustainable innovation has become nowadays the focal point to deliver evidence for the commitments of companies to the triple P (people, planet and profit) bottom line.

Hence, sustainability is defined here in accordance with the proposal presented by the Brundtland Commission to the UN since it is the most well-known definition of what had become known as sustainable development: “meeting the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1988, p.43). From this definition, Dyllick and Hockerts (2002, p.131) suggest the definition of corporate sustainability ‘as meeting the needs of a firm’s direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc), without compromising

its ability to meet the needs of future stakeholders as well'. This concept is a new and evolving management paradigm since acknowledges that although profit (economic dimension) is a must for the firm survival, it is not enough for the overall sustainability of a corporation, demanding for this the integration of social and environmental dimensions.

In turn, 'sustainable innovations are defined as innovations in which the renewal or improvement of products, services, technological or organizational processes not only delivers an improved economical performance (sustain economic growth), but also an enhanced environmental (conserve the environment, minimize environmental impact and protect the natural environment) and social performance (improve quality of life and quality of employment), both in the short and long term' (Bos-Brouwers, 2009; Yakovleva & Flynn 2004). The integration of economic, social and environmental aspects distinguishes sustainable innovations from conventional ones (Bos-Brouwers, 2009; Yakovleva & Flynn, 2004). Hence, not every innovation achieves sustainability.

Also Yakovleva and Flynn (2004) show that concerns about sustainability arise either as a direct result of technological developments or as a by-product, as exemplified by the case of the food system where 'the global sourcing strategies of food manufacturers and retailers is dependent upon innovations in distribution, storage and packaging. There are also, however, a number of benefits that will arise from innovations in the food industry or allied sectors. These will include reductions in waste up to the point of retail sale and more efficient use of energy per unit of output' (p.227-8).

4. Capabilities, Typology of Innovations and Sustainability: The Relationship

One can conclude with the analysis above, in special the case of no sustainability of all innovations and varied developments, that the relationship between capabilities, technological innovations and sustainability is by no means straightforward. This section presents a review of the proposed models.

According to Knight and Cavusgil (2004) organizational capabilities are the main sources of firms' performance. Hence, firms develop knowledge and capacities that make them innovative, which in consequence, leverage their performance up.

As Nelson and Winter (1982) stressed the superior ability showed by some firms to innovate and, consequently, create new knowledge, motivates the development of organizational capacities, comprising of internalized routines and core capabilities. These capacities are linked with superior performance in firms, especially in competitive or challenging environments. For them, an established innovative behavior makes firms more capable, which in turn is linked to performance. Hence, the relationship firms' capacities and innovation, in a dynamic way, is bidirectional and mediated by environmental aspects.

In turn, according to Lee et al. (2006) the technological capacity of firms limits the use of the numerous technological options open to them. Hence, Lee et al. (2009) stress that the search for technology opportunity is bounded by technology capability analysis, which affect both the areas in which firms choose to do business, and how successful they will then be in such areas.

This link between capabilities and innovative performance is mediated by innovative type according to the degree of complexity and change. According to Bos-Brouwers (2009)

many sustainable innovations directed at the improvement of technological processes (eco-efficiency) and to lower costs of production are incremental in nature. However, firms with sustainability integrated in their orientation and innovation processes show the development of products new to the market (radical innovations or transformational by nature).

5. Capabilities, Typology of Innovations and Sustainability: The Model

With this work we intend to advance in the understanding of the antecedents (dynamic capabilities) and consequents (sustainable outcome) of firms' innovative process. This section presents the relationship to be assed in the empirical research.

From the review, we can propose a research model that innovative strategies mediate the relationship between adaptive, absorptive and innovative capabilities with the level of sustainability of the innovative outcome. Hence, a firm possessing higher levels of adaptive, absorptive and innovative capabilities focuses on developing innovations which bring not only high profits, but also social equity and environmental protection. In this case the firm is orientated by an innovative strategy focused in sustainable outcomes, its dynamic capabilities may direct toward concentrating its assets on developing capabilities, which results in higher levels of sustainability in new products or services. In contrast, the lower levels of adaptive, absorptive and innovative capabilities lead the firm to focus on a cost leadership innovative strategy, which results in lower levels of sustainability in new products or services. Hence, this paper proposes that the sustainability of the innovation outcome is greater in firms with high levels of adaptive, absorptive and innovative, which in turn is steered by firm innovative strategy.

The proposed model, presented in Figure 1, shows the relationship mediated by types of innovations. So, the three capabilities are the antecedents of innovation and the consequent is the level of sustainability of innovations, whilst the full mediator is type of innovations.

DYNAMIC CAPABILITIES INNOVATIVE OUTCOME SUSTAINABILITY

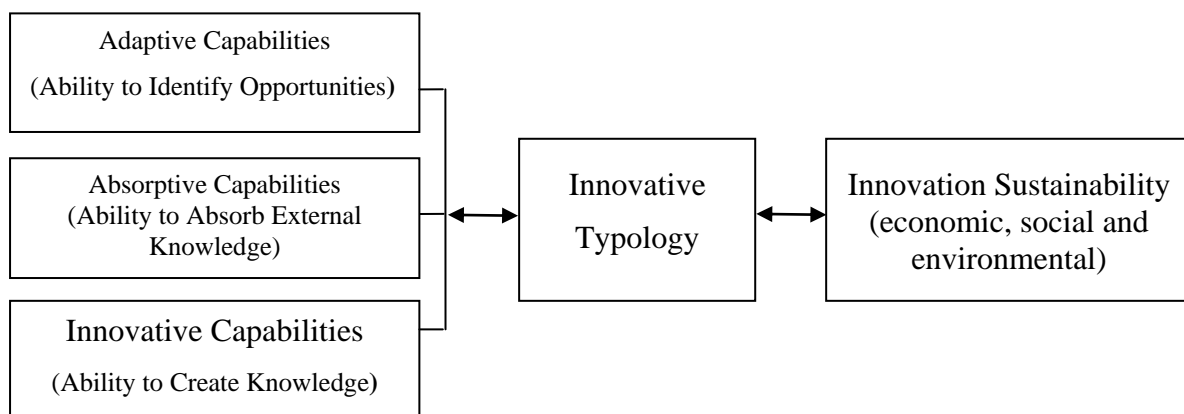


Figure 1. The relationship dynamic capabilities, innovations type and sustainability

According to this model, sustainable innovation is determined by differentiated types of innovations with the full mediation of types of innovations. The bidirectional arrows to and from capabilities indicate that there is mutual interaction between them. In other words, the relationship is not of cause-effect, but systemic.

Hence, the future work shall respond to the following questions:

1. What is sustainable innovation and how is it different from conventional innovation processes?
2. Dynamic capabilities are linked to innovation kind (from incremental to systemic in a continuum) and sustainable outcomes (levels of sustainability)? In other words, which relationships between capabilities, innovation types and sustainability outcomes can we find?
3. Dynamic capabilities affect differently innovation types and sustainable outcomes, i.e., ability to create (likely to science-based) generates more systemic innovations and greater sustainability or ability to absorb (likely to supplier-dominated) or ability to identify opportunities do? Can we wait that there is a link between higher capabilities, higher level of change of innovations and higher outcomes in sustainability?

Concluding Remarks

This paper, after in-depth evaluation of the literature about sources and impacts of sustainable innovations, delineates a multidimensional model of the relationship amongst dynamic capabilities with sustainable innovations, including mediation of types of innovations.

From the scientific-academic point of view, the model fills in an important gap in studies about the determinants and sustainability results of innovative activities.

The model goes in the direction to assess what Ely and Bell (2009, p.35) propose regarding directionality of innovations: “The role for innovation in the current context is not merely to drive economic growth, but rather to contribute to objectives of development and sustainability, as defined by different actors, at different levels. This may include economic growth (at least in the least productive economies), but prioritises those forms of growth which are more equitable in their distribution of benefits and risks, and which are environmentally sustainable”.

The model will be applied in one research at a Brazilian food chain with the role of assessing the relationship between adaptive, absorptive and innovative capabilities, types of innovation and sustainability.

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