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## **Explaining the competitive advantage in strategic research and technology management for research and technology organisations**

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**Abstract:** Effective management of research and technology organisations (RTOs), lie in creating and delivering competitive advantage through creating value for customers. Due to the absence of models that explains the competitive advantage in RTOs, this study attempts to define the competitive advantage in strategic research and technology management in RTOs. Regarding to the identity of RTOs which is fully mixed with knowledge and technology, the base of competition in this category of organisations is providing integrated technology-based solutions for related businesses. Hence, the basis of discussion regarding strategic management in this area is interwoven to the concept of rapid technological changes and consequently dynamic capability with emphasis on technological innovation and entrepreneurship. Therefore, the latest theories of strategic management with an emphasis on dynamic capabilities (and evolutionary approaches) were used to develop a model in order to explain the competitive advantage in strategic research and technology management in RTOs.

**Keywords:** strategic research; technology management; research and technology organisations; ROTs; competitive advantage; strategic management approach.

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## 1 Introduction

One of the prominent features of knowledge-based development process during the last decades in developed countries and in developing countries is the emergence and growth of research and technology organisations (RTOs). This group of organisations, which are the most important components of the knowledge-based economy era, plays an important role in the trend of technological changes during the last three decades (Albors-Garrigós et al., 2014).

Study on the technological trends in developed countries, indicates the intensity of competition in the field of technology development and orientation types in organisational and national levels. The emergence of an active player like China during the last 20 years in the field of technology development and its awesome position that has acquired in this area represents the role of appropriate national and organisational policies in development and evolution trend of these organisations (Readman et al., 2018).

Due to the rapid expansion of the area and intensity of competition at organisational, national, regional and international levels in research and technology, study and defining the factors that influence gaining competitive advantage on organisational level is of major concerns contributing policy making in this field (Tang, 2010).

Furthermore, the basic orientation of the strategies of RTOs should be determined and planned on “identification and creation of the updated values that are demanded by the customers.” Accordingly, in order to carry out the mission of RTOs in creating of technological knowledge and contributing to commercialise it, the continuous creation of the competitive advantage should always be considered by RTOs and their technological and research achievements should include the desired features of customers to result in formation of the constructive interaction among the RTOs and customers and provide the technological competitiveness of the related industries and therefore the effectiveness of RTOs (Barge-Gil et al., 2011; Rincón Díaz and Garrigós, 2017).

Accordingly, the effective management of RTOs depends more on creating and providing competitive advantage for customers that requires strategic models to explain the competitive advantage in these organisations. In the other words, research and technology strategy should be on the basis of creating competitive advantage for RTOs. Hence the strategic research and technology management (RTM) in RTOs requires models to explain the competitive advantage in these organisations (Albors-Garrigós et al., 2010).

Accordingly, the focus of this article is to explain the phenomenon of the competitive advantage in RTOs and the main question that arises is:

- What are the constructing factors of the conceptual model of competitive advantage at the RTOs level?

Study on the published research during the last three decades in relation to the strategy indicates that the competition issue as the heart of the strategy theory has always been considered by researchers. In this regard, the competitive advantage as one of the most controversial and challenging topics has been deliberated and studied from different attitudes and aspects (Wen-Cheng et al., 2011).

Despite the extensive efforts for explaining the concept of competitive advantage, it can be concluded that the mentioned term is still one of the mysterious terminology used in business management literature. The widespread use of the competitive advantage term

by the researchers in various specialised fields during the last two decades has also contributed to the complexity of the conceptual conundrum (Nason and Wiklund, 2018).

Regarding the need for a concise and clear image of the concept and theory of competitive advantage as a basic necessity and prerequisite to conceptualise the competitive advantage in the field of RTOs, the concept of competition and competitive advantage will be briefly studied later in this article.

This article intends to explain the dimensions of the competitive advantage issue in RTOs based on a conceptual framework. Accordingly, the position of RTM will be discussed in the modern economy first, then the concept of competition and competitive advantage, will be briefly studied and then the most important theories of competitive advantage at firm-level will be examined and compared. After that by explaining the main challenges and requirements relating to it, the competitive advantage in the strategic RTM for RTOs will be explained by using a conceptual framework and analytic research methodology.

## 2 A literature review

### 2.1 *Position of the RTM in the modern economy*

Due to the rapid environmental changes and increasing intensified of competition, the activity platform and business environment of RTOs have been mainly evolved. So that nowadays the term ‘the new world economy’ is used to introduce this new situation.

Three main elements of the modern economy include ‘globalisation’, ‘advanced technology’ which act mainly based on knowledge and new technologies of information and communication, and ‘network partnership’ that has mainly intellectual and knowledge-based nature and is in contrast to the modern industrial economy with physical and objectivist nature (Albors-Garrigós et al., 2010; Anwar et al., 2014).

RTM as the focal point of technology-based efforts has completely different nature compared to traditional economy for the transformation of inputs into knowledge-based outputs in the new economic environment. The most important characteristics of the RTM in traditional economy compared to modern economy is presented in Table 1.

On this basis adopting the strategic approaches to the RTM will be essential. Strategic role of RTM in activities of RTOs can be analysed by a four-stage evolutionary model as mentioned in Table 2 (Hayes and Wheelwright, 1984; Bandarian, 2018). In this model, the strategic role of the RTM is illustrated on a continuum from a complete neutral and passive position to proactive and complete effective position.

Defining the role of RTM in RTOs by the innovative and technological support of related industries in creating and sustaining the competitive advantage in the modern economy condition, requires paying attention to the concept of competition and competitive advantage in RTOs and consequently in the strategy literature (Barge-Gil et al., 2011).

Creating and sustaining the competitive advantage for the related industries requires the provision of the innovative and technological supports that has a competitive advantage by RTOs themselves.

The main mission of the strategy in the field of business is helping firms to acquire or create the competitive advantage. The fundamental assumption of the strategy related researches is that “achieving the competitive advantage results in accessibility of the

organisations to the high levels of performance compared to competitors.” Due to the role of competitive advantage in the strategy concept, the basic theories and approaches of competitive advantage have completely different dimensions based on the nature of ‘economic rents’ that the following sections will be referred to it (Wen-Cheng et al., 2011; Teece, 2014).

**Table 1** Comparison of RTM dimensions in the traditional and new economy

<i>Economic atmosphere</i>	<i>Traditional or old economy</i>	<i>New economy</i>
<i>RTM dimension</i>		
RTOs	Independent organisations	A network of colleagues
The structure of research and technological achievements	Individual achievements	a package of complementary and compatible achievements and services aligned with technological competency areas
Management focus	management of static flow of research and technology through internal processes	Management of very flexible and variable dynamics of technological paths within the network
Tools of improving	Process improvement	Improvement of technological paths
Control mechanism in RTOs	Direct control	Indirect control (trust, negotiation, rewarding and ...)
Competition	Efforts to reach the static goals at the earliest possible opportunity	Different and numerous methods for competition due to the level and dynamics of competition nature

*Source:* Anwar et al. (2014)

**Table 2** Four-stage model for strategic role of RTM in RTOs

<i>Stage</i>	<i>Strategic role of RTM</i>	<i>Proposed objectives for RTM</i>	<i>Expectations of RTM</i>
1	Internally neutral	minimising the destructive impacts and mistakes in R&T	RTM as an inevitable essential
2	Externally neutral	Accessing to the equal level of competitors	RTM follows the proposed patterns in similar cases
3	Internally supportive	Reliable support of RTOs business strategy implementation	RTM develop and implement the business strategy of RTOs
4	Externally supportive	Creating the competitive advantage for RTOs by providing the technological and innovative capabilities required by the related industries	RTM has pivotal role in promoting the innovative and technological capability of related industries and supporting there strategy

*Source:* Hayes and Wheelwright (1984) and Barnes and Rowbotham (2003)

Due to the increasing role of advanced technologies in the new economy and the rapid emergence and growth of RTOs across the globe, especially in the developed countries, this study attempts to discuss the issues of explaining the competitive advantage in RTOs by emphasising on the fourth pattern of the referred roles in Table 2.

## *2.2 Competition and competitive advantage*

The competition is a rational way to deal with the restriction of recognition and information in a complex and constantly changing environment, a method that causes the greatest mobility and motivation to the members of society.

Thus, making efforts to innovative means to find methods better than conventional ones, it is the path that thinking ability is developed through it and the society will get benefit from it (Hollingsworth and Müller, 2008).

Regarding the importance and serious role of the competition and competitive advantage issue, several have been provided by experts for the concept of competitive advantage which are significantly similar in terms of content and disagreements are mainly on the way and process of the competitive advantage creation. Survey on the different definitions indicates that the main focus of the competitive advantage structure is on having some superiority compared to competitors in one or more desired factors of customer (Wen-Cheng et al., 2011)

Based on Hesterly and Barney (2008) definition, the competitive advantage is a situation that enables an organisation to create greater economic value for their customers in comparison with competitors (Asmussen, 2014).

Accordingly, the concept of competitive advantage is directly linked to the customer's values, so that in a comparative spectrum, whatever the proposed values of an organisation is, it has to be closer or more consistent with the desired values of customers, so that it can be said that the organisation has a superiority or advantage compared to its competitors on one or more competitive criterion. In other words, sustainable competitive advantages refers to those competitive advantages that are valuable for customers by utilising the competencies of the organisation, and they are not easily imitated or copied by competitors and bring proper performance and competitiveness for the organisation (Nason and Wiklund, 2018).

## *2.3 Theories of the competitive advantage*

Despite countless theories provided by researchers about the source of competitive advantage in past two decades, many of them have been built upon unstable approaches. Some of the main frameworks and accepted strategic management approaches to explore and study competitive advantage are as follows: industrial organisation economy (including Porter's five competitive forces and strategic conflict), resource base view, knowledge base view, dynamic capabilities view and strategic entrepreneurship theory to the strategic management (Carlisle and Manning, 2000; Andreozzi, 2010; Schumpeter, 2010; Wen-Cheng et al., 2011; Zahra and Nambisan, 2012; Salmador and Florin, 2013; Reimann, 2013; Atiq and Karatas-Ozkan, 2013; Sune and Gibb, 2015; Chen et al., 2016).

Different approaches of competitive advantage are complementary in many ways and a thorough understanding of the organisation's competitive advantage requires a comprehensive understanding of each approach (Mahrokian et al., 2010).

Applying theories of firm to analyse competitive advantage can be performed on the basis of two attitudes of 'discrimination approach' and 'integration approach'. In orientation discrimination approach, one of recognised attitudes to firm will be criterion and in integration approach, it is mixture of considerable attitudes.

### 3 Explaining of the main challenge

As mentioned, competitive environment of RTOs will experience a completely different situation compared to the prevailing conditions in 21st century. In fact, evidence suggests that the basis for formation of the new economic space is knowledge and technology and responding to future challenges requires integrated solutions based on technology. Emergence and rapid development of RTOs (as custodians of the development of technological solutions) indicates the situation of this process. As evidence shows, it is expected that role and situation of RTOs in the knowledge-based economy is getting stronger and more obvious (Readman et al., 2018)

With regard to the identity of RTOs which fully arises of knowledge and new technologies, the basis of competition in the category of organisations in technology and presenting technology-based integrated solutions is latent. success in this field is not based on neoclassical economic models, it is price-based, it is not based on industrial organisation approaches, emphasises on the concept and role of efficiency in competition, it is not a resource-based attitude that searches source of success in a set of owned specific resources, it is based on ability of gaining advantage through new opportunities to create value in technology-based businesses. Therefore, the discussion of competitive advantage in this area is linked to the concept of technological innovation and entrepreneurship (de Lurdes Calisto and Sarkar, 2017).

In such circumstances, previous models do not meet the required efficiency and a radical revision of strategy research models and conventional models is needed. With regard to the identity of interdisciplinary knowledge and new technologies, for this matter, the approaches of interdisciplinary studies of the theoretical concepts of strategic management such as: business management, management of research and technology, integrated management of value chain of research and technology and market orientation can be used. We must give priority to the concepts of technological innovation and entrepreneurship as the core of competitive advantage model in the field of RTOs, a new conceptual framework must be formed and based on it, a specific conceptual model should be presented for this area of organisation.

As mentioned above, the main features of the model of competitive advantage in RTOs are as follows:

- explaining the concept of competitive advantage in RTOs
- identifying the structures of competitive advantage in RTOs
- identifying key factors associated with competitive advantage structure in RTOs
- configuration of competitive advantage structures in RTOs in form of a conceptual model which has potential to explain their competition ability associate with providing a solution to promote it.

With regard to above notes and defined features for competitive model of RTOs, a model that recognise and promotes competitive advantage of the strategic RTM within the related frameworks must respond to this question:

- What elements or factors shape competitive advantage in RTOs? And how they can be configured in the form of a conceptual model.

Studies conducted in the world shows that the relevant management research in this area is still in early stages of development. But competition and competitive advantage are major issues and of managers in RTOs. Despite the importance of this matter, few studies have been done regarding the issue (Bandarian, 2018).

Based on dynamic and knowledge-based nature of RTOs, there must be enough attention on using the suitable approaches in the literature to study the topic of competitive advantage in the literature of competitive advantage (in previous part noted). In this study, by emphasising on entrepreneurial nature of RTOs, a mixed approach is used to utilise the elements of different theories of competitive advantage in making conceptual framework of the research. Conceptual framework of research is introduced in following section.

#### **4 Theoretical framework for developing the pattern to explain the competitive advantage in RTOs**

RTOs as responsible for technology development in science and technology system and they have become one of the main issues in the process of knowledge-based economic development and their management is considered as a critical issue by researchers in the areas of management, strategic management, business administration, management of technology development and management of research. Furthermore, a competitive advantage as one of the main issues during the last three decades has been seriously considered by investigators of strategy. The body of knowledge related to growth in recent decades has had a significant competitive advantage so that in the early '80s, with the emergence of Michael Porter's works, the area of discussion to a decade was in the hand of proponents of industrial economy. Besides the attitude of industrial economy, the theory of dynamic competition or the game theory and the theory of transaction cost economics (TCE) in this decade posed and gradually attracted the attention of researchers. All these attitudes focused on the external sources of competitive advantage beyond the firm's boundary, so they are called market-oriented theories. In the same period, along with market-oriented theories, resource-based approach was formed with emphasis on the search for competitive advantage inside the firm and began its evolution. It could be call the 1990s the decade of explosive growth of competitive advantage theories, because in this period, resource-based approach was widely considered by researchers of competitive advantage and due to this space, the theory of TCE, attitudes based on knowledge, evolutionary approach and dynamic capabilities were formed and evolved rapidly. Theory of strategic entrepreneurship and entrepreneurial approach are the latest approach to firm theory and they have become popular in recent years and are experiencing rapid growth and use.

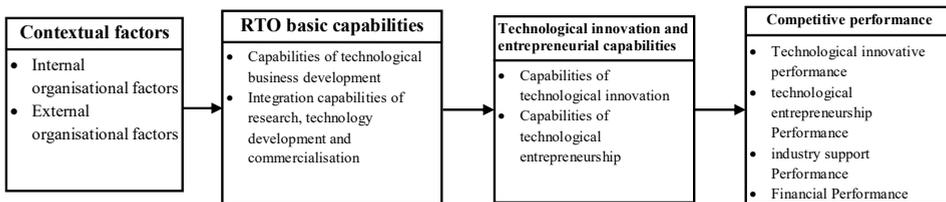
Environmental dynamics and turbulence, intensity of uncertainty in the business environment, and the increasing volume of information and knowledge related to various aspects of the business which is presented in the context of information and communication technology, including the basic characteristics of business environment in the knowledge-based economy (Schiuma, 2012). In such an environment competitive mechanisms considered by active businessmen to achieve superior performance is also getting more sophisticated and diversified (Poister et al., 2013). RTOs which are known as a driving force behind the development and growth of knowledge-based economy in

developed countries encounter with more depth of challenges due to the highly dynamic and uncertainty in these organisations (Campbell and Naidoo, 2017). The concept of competitive advantage in this context will be a complex and multidimensional nature-based activity, so that the need for a pluralistic view is necessary to understand this phenomenon (Müller and Schmitz, 2016).

Since RTOs are the main discussion of this study, the administration and application of theories of competitive advantage for these organisations should be addressed to determine characteristics and the business environment. Due to the characteristics of the business environment of RTOs, it can be said that constant change and being a knowledge-based business are among the fundamental characterises of this kind of organisations, therefore, based on integration approaches, five competitive advantage theories emphasising the dynamic capability view and theory of entrepreneurship strategy based on technological innovation and entrepreneurship were used to form the concepts of competitive advantage in this group of organisations which is more appropriate.

The conceptual framework is represented in Figure 1. Since the main goal of this research is to explain competitive advantage for RTOs, in the modelling process, the conceptual framework should be reformed and modified.

**Figure 1** Theoretical framework to explain competitive advantage in RTOs



The conceptual framework of research comprises of seven theoretical structures linked together in the form of four sections including contextual factors (environmental and internal organisational), RTOs basic capabilities (technological business development capabilities and integration capability), capability of technological innovation and entrepreneurship (capabilities related to technological innovation and entrepreneurship), and competitive performance. In the following these elements will be discussed in detail with the using of the results of previous studies.

## 5 Methodology

Research method of this study according to the Wacker (2008) classification is a conceptual analytical method.

This study aims to develop a model to explain the competitive advantage in RTOs. As the competitive advantage structure is a multidimensional concept and finds its objectivity in interaction of organisation with environment, hence the explanation of competitive advantage at the organisational level requires design and implementation of appropriate research method. Therefore, this study with the aims to provide a conceptual model for competitive advantage structure concentrates on the qualitative modelling. For this purpose, the ‘conceptual analytical research method’ based on the configuration

approach will be used and the result provided a model to explain the competitive advantage in RTOs.

Configuration is a conceptual model that is expressed by a set of interrelated variables. The effects of other variables in the model can strengthen or hinder the effectiveness of different variables on each other, and sub-groups can offer different domains. Configuration approach is returned to a research method in which new figures are created. The strong point of configuration approach is a necessary precondition for the development of conceptual models in great detail, including a large number of interrelated and complex variables. Then the configuration approach has been used as a research method for this study. Based on configuration approach this study carried out a detailed study on academic research and literature in the area of competitive advantage in RTOs. The application of this approach and tools are aimed for a better understanding of complex interactions among a large number of variables and identifies areas (figures) for designing a conceptual model for competitive advantage in RTOs. This approach is useful in analysing the relationship between several areas simultaneously to create conceptual models that are used in more than one field (Kraus et al., 2012).

In configuration approach, each important variable in the context of other variables that might have an effect on these variables, or could be affected by these variables is analysed. Therefore, not only correlations, but also interdependencies can be analysed. In short, the ideal figures can be either quantitative or qualitative methods such as clustering identified through empirical or theoretical reasoning. Based on theoretical reasoning and analytical development, the typology of the species is ideal. Configuration approach can be used both in qualitative research and quantitative research (Kraus et al., 2011).

In this study, theoretical approach is used and empirical findings indirectly reached by analysing the empirical evidence on previous research studies. In addition to related articles published in reputable databases, many of the references of articles (pyramid method) were investigated.

A special attention has given to empirical evidences of these researches. The configuration approach represented in this study is directly based on theoretical arguments, deep literature review and the use of empirical evidences around the competitive advantage in RTOs indirectly. So the design of the qualitative model for competitive advantage at organisational level for RTOs is based on 'conceptual analytical research' and further steps are described as follows.

### *5.1 Preparation the list of related factors of competitive advantage*

#### *a Extracting related factors based on theoretical studies*

Since present study is about competitive advantage in RTOs, so according to theoretical studies, key factors associated with theoretical structure, competitive advantage is extracted and these factors are conceptual framework of research.

#### *b Refining the list of relevant factors based on the analysis of essentials, needs and characteristics of RTOs*

Since the extracted list of research results is derived from theoretical studies outside RTOs, the number of factors is relatively high and it is necessary to reduce as much as possible, therefore, in the second stage, this list should be reviewed with a number of experts who are familiar with RTOs.

## 5.2 *Discussion and surveying structure of the model and its key elements and explaining the relationships among them is based on qualitative analysis and the results published by others*

Based on the results published by other researchers, and using qualitative analysis, structure of the model and its key elements and their relationships will be analysed and explained.

## 6 Preparation the list of related concepts of competitive advantage

### 6.1 *Extraction of related concepts from the literature review*

A total of 35 concepts have been extracted based on detailed literature review of competitive advantage theories within the research framework. Summarised list of concepts is presented in Table 3. These concepts have four categories, including contextual factors, factors related to the basic capabilities of the organisation, the capabilities of technological innovation and entrepreneurship, and competitive performance of the organisations. The first part consists of two subdivisions as environmental and organisational factors. The second part of the two sub-sectors is divided as strategic capabilities and capabilities related to strategic integration of research, technology development and commercialisation. In the third part of the relevant factors in the form of two subdivisions, namely technological capabilities, technological innovation and entrepreneurial capabilities were defined.

### 6.2 *Refine the list of factors*

Factors extracted from the literature and previous studies, based on the characteristics and nature of the mission and business environment of RTOs and requirements of these organisations were surveyed by experts and as a result of the above list of 11 factors were eliminated or merged (eight factors in Table 3 deleted and four plots of competitive performance together constitute a new factor with the same title) and two new factors were added to the list of environmental factors (including national policies and government incentives and supporting legal context). Refined list of relevant factors of competitive advantage is presented in Table 4.

Therefore based on primary conceptual framework of research and their configuration, conceptual model explains competitive advantage in RTOs is as Figure 2.

### 6.3 *Discussion and explaining the model*

The first step in modelling the competitive advantage is to elicit and develop complex concepts related to competitive advantage. In this regard, based on the results of an extensive study of literature research and previous studies, a set of 35 related factors which was considered as a division in the conceptual framework of the study were identified. Then these factors have been studied in the context of the business environment of RTOs and refined, as a result, nine of the original removals of the concepts were added together and three new concepts were added. As a result of this process, a series of factors related to competitive advantage in RTOs, including 26 concepts is defined that is presented in Table 4.

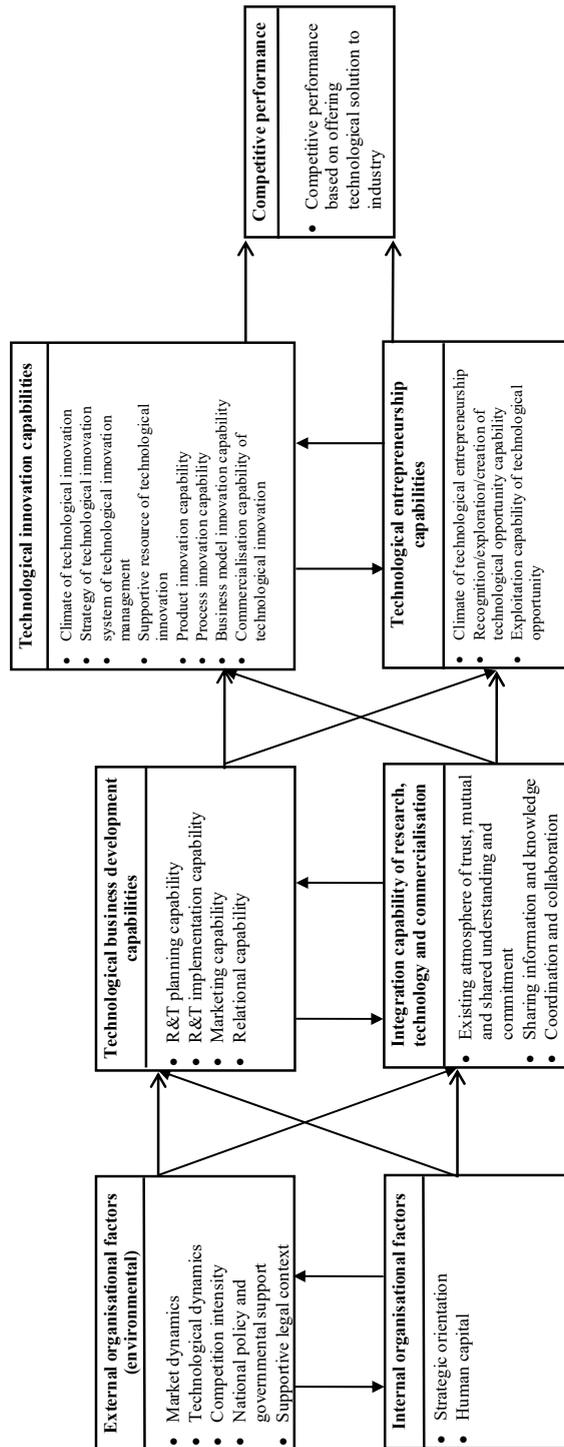
**Table 3** List of the factors related to competitive advantage derived from the literature

<i>Section</i>	<i>Subsection</i>	<i>Title of factor</i>	<i>Section</i>	<i>Subsection</i>	<i>Title of factor</i>	
Contextual factors	Environmental factors	Market dynamics	Technological innovation and entrepreneurial capabilities	Technological innovation capabilities	Technological innovation atmosphere	
		Technological dynamics			Technological innovation strategy	
		Intensity of competition			Technological innovation management system	
	Organisational factors	Strategic orientation		Technological entrepreneurship capabilities	Technological entrepreneurship atmosphere	Procurement and management of technological innovation resource
			Human capital			Innovation in product
		Organisational culture	Innovation in process			
		Capability of R&T planning	Innovation in the business			
		Capability of R&T implementation	Commercialisation of technological innovation			
		Marketing capability of research and technology results				
		Knowledge and learning capability				
Relational capabilities						
Basic capabilities of RTO	Capability to integrate research, development and commercialisation of technology	Trust, commitment and mutual understanding	Competitive performance	Performance of technological innovation	Procurement and management of entrepreneurial resources	
		Shared understanding of organisational goals			Identify/explore/create technological opportunities	
	Information and knowledge sharing	Exploitation of technological opportunities				
	Applying the coordination mechanisms and sustainable connection	Technological entrepreneurship activity				
	Cooperation and synergies	Performance of technological innovation				
Applying protocols and technical methods		Performance of technological entrepreneurship	Performance in support of industry's competitiveness	Financial performance		

**Table 4** Refined list of relevant factors of competitive advantage by adapting to the characteristics and nature of the mission RTOs

<i>Section</i>	<i>Title of factor</i>	<i>Section</i>	<i>Subsection</i>	<i>Title of factor</i>
	Market dynamics			Technological innovation atmosphere
	Technological dynamics			Technological innovation strategy
	Intensity of competition			Technological innovation management system
	National policies and government support			Procurement and management of technological innovation resource
	Supportive law contextual			Innovation in product
	Strategic orientation			Innovation in process
	Human capital			Innovation in the business
	Capability of R&T planning			Commercialisation of technological innovation
	Capability of R&T implementation			Technological entrepreneurship atmosphere
	Marketing capability of research and technology results			Identify/explore/create technological opportunities
	Relational capabilities			Exploitation of technological opportunities
	Presence of atmosphere of trust, mutual understanding and shared commitment			
	Information and knowledge sharing			
	Coordination and cooperation			

Figure 2 Basic model of the competitive advantage in RTOs



As the aim of this study is to provide a qualitative model to explain competitive advantage in RTOs, this section uses qualitative modelling in order to discuss the structure of the model. Then, according to results published by other researchers, key elements of the model and their relationships will be investigated and explained.

## **7 Modelling the explanation of competitive advantage in strategic RTM**

To explain the competitive advantage of RTOs that based on the defined conceptual framework has 26 elements, investigating all elements may be prolonged and unnecessary, but in order to observe brevity and focus on key aspects, we restricted our investigation and will study and explore the contextual or drivers factors in the conceptual framework, which includes 4 factors and also three other important factors in the conceptual framework includes: capability of technological business development, technological innovation capability and competitive performance.

As outlined in the conceptual framework contextual factors affecting business competitiveness in RTO is divided into two groups: environmental factors affecting organisations (law-competitive environment and infrastructure policy) and organisational factors (including human capital and strategic direction). The role of these factors in the model is clear as incentives or disincentives for the development of technological capabilities of RTOs. A competitive environment based on the concepts of market dynamics, technological dynamism, and the intensity of competition is formed. Most commentators on the strategy literature, including DeSarbo et al. (2005), Zhou et al. (2005), Lau et al. (2008), Gebauer et al. (2008) and Slater et al. (2006), emphasised the effects of competitive environment on the strategic orientation of research and technology. Based on comments (Bridges and Freytag, 2009; Song et al., 2005; Vorhies and Morgan, 2005; Ang, 2008), the subject of influencing the capability of RTOs in the development of technological business from the competitive environment is emphasised.

Considering the law-policy infrastructure as a variable is one of the specific characteristics of this research, because previous studies have been paid less attention to this factor. In fact the requirements of the business environment in the field of technology development and government policy-making play a fundamental role in facilitating/declining the business environment. Also the legal infrastructure that has important role in developing of related activities to research and technology, has made this element as a special factor in the conceptual framework and model.

Based on comments of Newman et al. (2005), Montagnani (2007), Fan (2004) and Fernandez-Bagues (2002) the impact of law-politics infrastructure on competitive business environment, in the field of technology development has been emphasised. Malecki (2006), Jun (2006), Peredo et al. (2004) and Nollen (2007) had emphasised on the effect of law-politics infrastructure on entrepreneurial orientation in the RTOs.

The human capital as a variable in the conceptual framework for explaining the competitive advantage in RTOs is intended. Human capital factors play a significant role in improving the competitive performance in RTO. The impact of human capital on the capabilities of technological business development in RTO has been stressed on through previous studies such as: Seleim et al. (2007), Simonen and McCann (2008), Fitzgerald et al. (2008) and Hess (2008).

‘Strategic orientation’ as a contextual factor has a fundamental role in shaping the model of competitive advantage in RTOs, because it affects many factors in the model and it is among the most influential factors affecting the competitive performance of RTO. Capability of RTO in technological business development is impacted by the status of its strategic orientation. Because according to the prevailing dynamics of technology development, acquiring and improving the capability of technological business development at the level of RTOs which requires priority in resource allocation and commitment of senior management’s of organisation and this will not be realised unless it is in line with its strategic orientation of management.

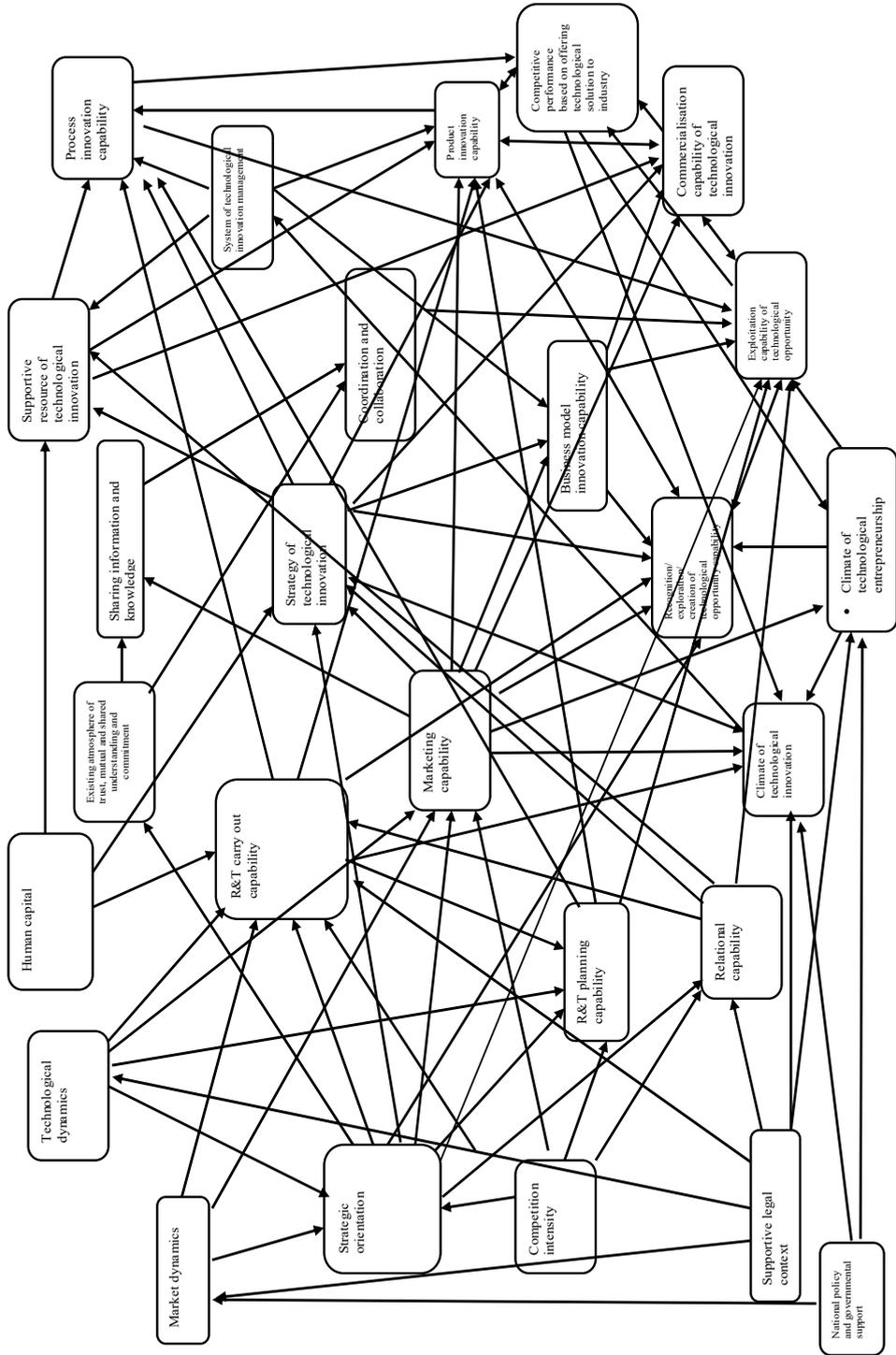
Comments of Slater et al. (2006), Lau et al. (2008), DeSarbo et al. (2005) and Kabanoff and Brown (2008) confirm this kind of effectiveness. Conducted analyses and discussions related to the field of technology development indicate that this factor has a pivotal role in determining the competitive performance of RTOs. RTOs capability in conducting technological business development which is based on four concepts of planning and implementation of research and technology, marketing capabilities of research and technology and relationship capabilities is affected by the strategic orientation of organisation. Explanations expressed in relation to the previous factor are acceptable to some extent to this factor as well, because the dynamic nature of technology development requires a dynamic capability in RTO in order to acquire and improve their capability in conducting the technology based business. It is clear that this type of capability within the RTO would not be possible without the support of strategic orientation. Achieving this level of capability requires considerable resources and passing a route which will have a serious impact on management’s decisions. Researchers such as Ling-ye and Ogunmokun (2008) and López (2008) have referred to this subject.

‘Technological innovation capability’ is the third factor directly affected by the ‘strategic orientation’. ‘Technological innovation strategy’ and ‘supporting resources of technological innovation’ are the constructing elements of this factor. Logically, the strategy that RTOs pick to conduct its technological innovation activities and required resources to perform these activities, need ‘strategic orientation’ which is aligned and supportive at the organisational level.

Lau et al. (2008), DeSarbo et al. (2005), Hall and Bagchi-Sen (2007), O’Regan et al. (2006) and Brem and Voigt (2009) published works are about. A close interaction and relationship between ‘strategic orientations’ of an organisation at the macro level and ‘innovation strategy’ of the organisation and related funding and resource allocation activities related to technological innovation.

The last factor that is influenced by the ‘strategic orientation’ is the capability of RTOs to identify technological opportunities. Due to the fact that acquiring and promotion of the ‘capability of exploring technological opportunities’ in RTOs need its required context and resources and the procurement of these requirements depends on the senior manager’s decision and orientations which is the ‘strategic orientation’ of the organisation, these two factors (strategic orientation and capability of exploring technological opportunities) are clearly correlated. The dynamic nature of rapidly changing field of technology and knowledge assets reveals that the success factor of RTOs are the capability to understand and explore new technological opportunities and without this expecting excellence in competition is almost impossible. This is discussed and emphasised by Kabanoff and Brown (2008), Schenkel (2005), Newbert (2004) and Tuggle (2004).

Figure 3 Explaining model of the competitive advantage in RTOs



As mentioned before, in addition to the contextual or drivers factors in the conceptual framework, three other key factors will be considered as well. 'Technological business development capability', is one of the factors that influence and its influence on other factors play a fundamental role in creating competitive advantages for RTOs. Since in the area of technology development, dynamics of business is ruling with a high degree and most of the customers seem to accept a high degree of the risk about to the application of technological achievements, hence this factor plays an important role in formation and enhancing the competitiveness of RTOs. In other words it can be said that this factor has a fundamental role in creation and promotion of competitive capability in RTOs and as a result its status impacts on competitive performance of these kinds of organisations. Two factors relating to the capabilities of technological innovation and entrepreneurship 'capabilities of exploring technological opportunities' and 'technological innovation capability' are influenced by the capability of RTOs in technological business development. The dynamics of business and evolutionary process in technology development reveals the unsustainable situation of opportunities in this field, thus RTOs capability in understanding, discovering and creating technological opportunities is a key to sustain and promote the competitive position of them. This factor also plays a key role in relation to the competitive advantage at the organisational level. This is confirmed by Tinoco (2007), Li (2004), Chung (2004) and Gruber et al. (2008). One of the necessary capabilities of RTOs to be successful in competition is that the manager should have a clear understanding of the dynamics of the business and by can identify and focus on attractive technological opportunities as well.

Based on the opinions of scholars such as Danneels (2007, 2008), Gammeltoft (2004), Coombs and Bierly (2006) and Dunlap-Hinkler (2006) 'technological innovation capability' is influenced by the organisation's ability in technological business development. The status of 'technological innovation capability': in a RTO is determined by the capabilities of them in planning, implementation and marketing which is called 'technological business development capability'.

'Technological innovation capability' has a central role in the elaboration of competitive performance in RTO. The two concepts of 'product innovation capability' and 'process innovation capability' are the main elements of it. Two factors related to the RTO capabilities in technological innovation and entrepreneurship includes: 'capability of explore technological opportunities' and 'capability to commercialise and exploit technological opportunities'. The other key factor is 'competitive performance', which is influenced by the status of technological innovation of RTOs. As discussed before, the capability of 'exploring technological opportunities' is a must for RTOs, so it is logical to claim that this factor gets impact from the technological innovation, especially product innovation. The rapid technological change in the technology development environment is an important characteristic which can help us to understand the nature of competitive activities, so the issue of creating technological opportunities in the business environment and its relation to new product which results from technological evolution is important for activists in this field. In other words, RTOs should have the capability of discovering technological opportunities based on their technological innovation capability, because this discovery takes place in opportunity creation somehow, which means that new technology opportunity should be based on innovation. Research conducted by Gruber et al. (2008) and Bednarek et al. (2016) focuses on this issue.

'Commercialisation and exploitation capabilities' is another factor that affects the capability of the organisation in relation to technological innovation. This factor is based on the concept of 'capacity of commercialisation technological innovation' and 'the exploitation of technological opportunities'. As RTOs are knowledge-based organisations and mainly based on the results of internal or external research activities act toward new technological achievements, hence the results of innovative activities without going through the stage of commercialisation cannot create economic value to the organisation. In other words, from competitive landscape view, promote commercialisation capacity is a significant need for knowledge-based organisations. Without it, investment of organisations in technological innovation will not have any result. This problem is certainly true in relation to the concept of 'opportunity exploitation'. Accordingly, the concept of 'opportunity exploration' which in 'entrepreneurship and innovation' literature includes activities of knowledge creation and new solutions to the customer, alongside to the concept of 'exploitation of opportunity' defined and together formed 'entrepreneurial process' or 'entrepreneurial initiative', and the concept of 'ambidexture organisation' as organisational solution to coordinated management of these two types of entrepreneurial activity has been suggested by researchers (Bednarek et al., 2016). The results of the investigations of Adams et al. (2006), Palmberg (2006) and Golder et al. (2009) proves this. It should be noted that the importance and priority of technological innovation to commercialisation and exploitation of opportunity and vice versa within the framework of the conditions of conducting technological business activities in different technological fields is discussable. Another factor that is influenced by the capability of technological innovation is 'competitive performance'. As mentioned, strategy and competitive advantage research are about to explain the driver/inhibitors factors in superior performance in the competitive business environment, so the relative relations with 'competitive performance' is naturally paramount. The competitive performance of RTOs is directly influenced by 'technological innovation' capability and due to this influence, it effects the 'commercialisation and exploitation capacity' indirectly. In other words, from the set of defined factors, 'the technological innovation', has the greatest impact on 'competitive performance' of RTO. Studies indicate that changes in technological innovation capability of RTO impacts on competitive performance. Works by Zhou (2006), Yam et al. (2004), Leskovar-Spacapan and Bastic (2007) and Tuominen and Hyvonen (2004) imply it.

'Competitive performance' is discussed as the dependent variable in strategy research in this study it has an outcome variable status and for another factor 'entrepreneurial orientation' has a causal and feedback role. In other words, the organisation's competitive performance in any situation plays an important role in promoting or falling in the organisation. This can be explained by behavioural theories of management because the essential element of any organisation is its human capital due to its role in the governance of the organisation. Based on these theories one of the motivating factors for individuals is the success rate in achieving the target. Therefore, the 'entrepreneurial orientation' in organisations, especially the risk taking and maintaining the proactive status in business environment is influenced by successful/unsuccessful experiences in business activities. Researchers such as Yang and Liu (2006), Avlonitis and Salavou (2007) and Simpson et al. (2006) have referred to this subject. Based on factors described above regarding the effectiveness of existing factors within the conceptual framework, the final model is presented.

## **8 Conclusions**

According to the dynamics of business environment in the field of RTOs which is turbulent with rapid technological change, the focal point of this study is defining competitive advantage in strategic management of these organisations. Few patterns or models have been empirically tested so there is a gap to be filled.

With regard to this issue and the dynamic and knowledge-based nature of RTOs and also due to the complexity and multi-dimensional nature of the concept of competitive advantage and special features of RTOs, the proposed approach is mentioned to theorise competitive advantage in RTOs, and it is a synthesis approach inspired by the five theories of the competitive advantage, factors related to competitiveness based on technological innovation and entrepreneurship of RTOs. In other words, to analyse the phenomenon of competitive advantage in RTOs integrated approach is recommended. In fact, according to the specific nature of RTOs using a combined approach consisting of five theoretical approaches to explain and model firms and the competitive advantage of an organisation is more appropriate.

Accordingly, based on the entrepreneurial nature of the RTOs, an integrated approach was used to take advantage of different competitive advantage theories, in order to develop an explanatory model of competitive advantage in RTOs.

The most important feature of this research is applying an integrated approach based on the five original theories of competitive advantage including industrial organisation economics approach, resource-based theory, dynamic capability view, knowledge-based view and corporate entrepreneurial attitude and in the conceptualisation of competitive advantage for RTOs.

The main contribution of this study is presenting a new model to explain the phenomenon of competitive advantage in RTOs.

With regard to specific issues of the management of the RTOs, developing a model to explain competitive advantage of RTOs is facing problems which some of them are include:

- New attention to RTOs and its poor management and soft infrastructures has caused that necessary information to do research (especially in the field of management issues) is not available to researchers.
- The technical issues taking over the management system in most of RTOs is a fact. The reason can be seen in the lack of professional attention to this kind of organisations so they are not interested to collaborate with researchers working on management issues.
- Few experts in this field are familiar with the concept of competition and competitive advantage and are able to participate in such research projects.
- The novelty of research and lack of similar studies in the field of RTOs
- The complex, multidimensional and widespread nature of competitive advantage causes a wide range of complicated and widespread factors in this context unexpectedly.

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