Holistic model for an efficient knowledge transfer of high-tech firms

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Abstract

Though research on technology transfer and business performance topics is widely tackled by academics and practitioners, very few studies directly treat the connection between both from a holistic and overall perspective. The purpose of the research is to investigate about Knowledge Transfer (KT) issue by building a representative conceptual model for high tech industries, and enlightening its relationship with business performance. A descriptive literature review methodology allows setting a profile of the KT phenomenon from the perspective of determinants of impact. Model is developed based on a bundle of dimensions and master determinants, featured as attributes and mechanisms. The matching between KT master determinants and business management practices is showed. According to knowledge-based view of the firm theory, high tech companies could be understood as systematic multi-level flows of knowledge. Theoretical conclusion is attained: an optimal management and administration of the (un)aware multi-transfer phenomenon results in an excellent business performance and competitiveness of high tech firms. The contribution of the research and its uniqueness are showed: the complex and multifactorial KT phenomenon of the high-tech companies is profiled through a set of conceptual business terms, enabling the development of practical business management tools to improve efficiency and business performance. Further implications are discussed and future research should be executed to validate empirically the conclusions.

Keywords Knowledge transfer, Determinant factors of knowledge transfer; High technology companies, Competitiveness and business performance

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1. Introduction

According to the theories of economics and management sciences (Grant, 2002), KT is regarded as a scientific and business discipline integrated into the knowledge management field. However, there are different approaches to the phenomenon built on theories of: organizational engineering, project management, information and communication sciences, social and human sciences, information technologies... Thus, many research studies related to KT, mainly developed during the last 20 years, follow the rise of the knowledge economy (Grant, 2002), and recognize the breadth and complexity of this subject and the huge difficulty to profile the concept in order to define a shaped framework, allowing easier analysis and study on the topic (Becker and Knudsen, 2006; Graham, 2008). The investigations face the issue supported by different methodologies and techniques (Kumar and Ganesh, 2009), highlighting the methods whose main purpose is to review the literature or carry out an empirical study to establish a model or taxonomy to enable and enhance the understanding of the phenomenon (Cook, 1999; Bozeman, 2000; Kumar and Ganesh, 2009; Blumenberg et al, 2009; Eckl, 2012). However, current bibliography does not exhibit consistent description of the KT concept, since there are a lot of definitions sourced from many different points of view (Becker and Knudsen, 2006). In fact, the disparity of approaches causes the collection of many elements that characterize the KT (Kumar and Ganesh, 2009), as well as, sets of descriptive factors (Bozeman, 2000; Becker and Knudsen, 2006). The characterizing factors of knowledge transfer are the elements that let us describe a knowledge transfer event regardless of the plentiful and disparity of existing cases (Spender, 1996; Becker and Knudsen, 2006; Zuo et al, 2013.) Knowledge transfer can be performed within a intra- or inter- organizational context (Van Wijk et al, 2008), or can be held between units or areas of an organization, or among teams, groups of people or individuals (Hansen, 2002; Lin, 2007). As well, the context of the transfer could be domestic or international (Van Wijk et al, 2008), and vertical or horizontal, depending on the organizational boundaries, which entails the use of different mechanisms during the phenomenon. In fact, there is current scientific consensus in the categorization and classification of these main levels and stereotypes of KT (Becker and Knudsen, 2006; Kumar and Ganesh, 2009).

Other scientific articles also analyze this phenomenon from the perspective of the factors which moderate the performance, enhancing or hindering the process and operations. These

factors, known as determinants of KT, are the components, elements or conditions that influence in the KT results, both favorably and unfavorably, within any diverse KT case, and throughout the time it is held or it lasts. Determinants can be classified as: barriers or obstacles, when they impede, hinder, cancel and / or limit the transfer of knowledge; and facilitators, when they facilitate, promote, enable and / or assure transfer of knowledge (Spender, 1996; Becker and Knudsen, 2006; Zuo et al, 2013). Among the determinants, there is a set of factors named mechanisms featured by the capability to make KT more effective (Cook, 1999), i.e., they bear ability to be operated as variables by means of diverse kinds of practices, instruments and tools in order to achieve desired KT results or impact (Lockett et al, 2008; Paik et al, 2009; Zuo et al, 2013).

In the same way, a relevant research subject links KT and organizational learning as a current trending topic (Kogut and Zander, 1993), particularly related to organizations with high burden of knowledge and technological intensity (Cook, 1999; Al-Salti et al, 2010). These studies focus on: high-tech manufacturing and developing firms (Almeida et al, 2002; Santoro and Chakrabarti, 2002; Hansen, 2002; Agrawal, 2004; Lin, 2007; Wang and Wang, 2012), knowledge-intensive business services (Gottschalk and Solli-Sather, 2007; Blumenberg et al, 2009), scientist and academics institutions (Lockett et al, 2008), and clusters of companies (Carayannis and Borowik, 2011). Conclusions are clearly shown: KT is a strategic asset (Wennberg et al, 2011; Knockaert, 2011) and each entity acts with a dual characterization in respect of KT: as an agent, and as a media or a carrier. In this regard, a close degree of relationship of these organizations with the phenomenon of KT in the life cycle is noted (Santoro and Chakrabarti, 2002; Wang and Wang, 2012), and a connection with the business performance (Albors et al, 2006; Zakrzewska-Bielawska, 2010). In fact, last researches highlight a clear differentiation of KT operational features for high-tech sectors compared to other industries of economic activity (Santoro and Chakrabarti, 2002; Santamaria et al, 2009; Zakrzewska-Bielawska, 2010; Azagra et al, 2012).

Presently, there is not a unified methodology to define high-tech industries and, rightly, label the companies belonging to them, since defining the boundaries of such concept is complex and manifold. On the one hand, according to OECD methodology these industries could be identified depending on the intensity of the investments and expenditures for R & D activities. On the other hand, a high-tech sector is acknowledged by the systematic scientific and

technological production, agile innovation diffusion, rapid obsolescence of property, extensive staff of highly qualified personnel, intense agenda of cooperation, strong capital expenditures and rotating equipment, and a high business risk. This study is accepting as high-tech organizations those fulfilling following requirements (Zakrzewska-Bielawska, 2010): an innovative company, belonging to a sector labeled as high technology, basing existence and evolution in knowledge and learning assets and processes, and requiring modern technology for the business operations.

In addition, resource-based view of the firm theory, states that enterprise resources are cumulative, they can be mixed and combined, and a successful management of these assets entails a competitive advantage (Barney and Clark, 2007). Equivalently, knowledge-based view of the firm theory asserts that knowledge is the principal and most strategic resource of the organization (Ding et al, 2009), and handling it under optimal management guidelines derives also in a competitive advantage (Grant, 2002). Thus, a company performance depends on the right integration of knowledge in the business processes, and on the suitable skills developed (Spender, 1996; Kogut and Zander, 1993; Grant, 2002), i.e., there is a chained loop between knowledge and capabilities of an organization.

Finally, current scientific literature is in need of KT models designed merging multiple perspectives under a general understanding: implementing an eclectic research method and a holistic approach to the phenomenon, encompassing the global scope of the high technology industries, and discovering details of the components making up the model. According to these lacks, we propose a methodological research framework based in literature review, which enables an insight into the phenomenon of KT in high-tech companies and expand knowledge related to the optimization, the achievement of profitable impacts, and enhancing the business performance. This relationship is expected to be even more remarkable within those entities whose growth and evolution is closely linked to knowledge as the principal resource, such as: high technology manufacturing sectors and knowledge intensive services-based companies, composing the high-tech industry according to OECD and the most representative Statistic Agencies worldwide. The companies, thanks to the successful impact of a mere KT event, may attain a timely improvement of performance, but higher continuous performance may also be reached when these organizations underpin knowledge as the strategic resource (Hoopes and Postrel, 1999) So, we build a conceptual model of KT, by identifying the key factors that

moderate the optimization of KT phenomena that take place at all levels in the organization. This model is customizable for all kinds of high-technology organizations and settles a solid scientific foundation for future potential conversion into a practical business management tool related to the improving competitiveness. Once the research is completed, we have formulated a descriptive conceptual model of the complex phenomenon of KT for the high-tech industries. We have also set out a compendium of evidence emerged during the investigation which will foster higher achievements of competitiveness, and guidelines for a better management and governance of these organizations. Likewise, we have also discovered patterns of interest pertaining to innovation and KT affairs for policy makers, business associations, and any other institutions interested in economic development of the high-tech sectors; as well as a solid scientific basis for further researches.

2. Scope and methodology

KT is a challenging field of investigation for the researchers due to the breath, complexity and scope of its contents (Bozeman, 2000; Becker and Knudsen, 2006). In fact, these contents could be related to the diversity of concepts and terms used; the multiple purposes and activities pursued; and the huge existing volume of models, studies and resources. There are some basic recommendations for professionals interested in exploring the discipline of KT (Graham, 2008): due to the richness of the semantic framework the whole terminology should be contemplated; in order to ensure that all key elements are reviewed in case of a broad perspective of research, the study should be restricted into a specific topic; theoretical, empirical and case studies concerning KT should be analyzed; a strategy for the theoretical approach should be defined in advance; and to let enlighten the connections and interactions among the elements, descriptive means of research support should be handled.

Methodology for the research follows the guidelines mentioned above, and it is also customized in order to support the process of documentary research and literature review. The aim is to collect, gather and select the most relevant information about the research topic. Therefore, stocked published literature is examined and filtered in accordance with the goal set, by means of following working tasks: information analysis, data collection, data categorization and classification, and conclusions extraction (Day and Gastel, 2012). The research strategy is suitable especially for investigations which require a continuous update on concepts of areas

under constant review (Day and Gastel, 2012), as, for example, it is the KT practice for high-technology organizations. Thus, methodology incorporates the following methods and techniques:

- Searching throughout the scientific literature demands selecting appropriate information sources, and the definition of a strategy for gathering documentation using key descriptors and alternative terms. Bibliographic and scientific search engines and databases (Graham, 2008) are used to point at highly cited scientific publications. A diverse set of keywords with similar meaning is handled to assure papers dealing with the subject are examined (knowledge and technology; transfer, sharing, flow and exchange; determinant, barrier and facilitator; impact, results and effectiveness; high-technology).
- The articles retrieved are filtered in order to limit the documentation to be scanned. They must fulfill the following criteria: edited in English; issued by journals about engineering, technology, and business, economic and / or social sciences (Graham, 2008) whose priorities of aim and scope are high technology related; papers focused on identifying and describing, theoretically or empirically, factors moderating the KT outcomes. We also seek on internationally published books addressing KT and on working papers elaborated as specific studies of companies, sectors or areas of high technology or knowledge-intensive practices. Figure 1 shows the synthesis of the collection and filtering process.

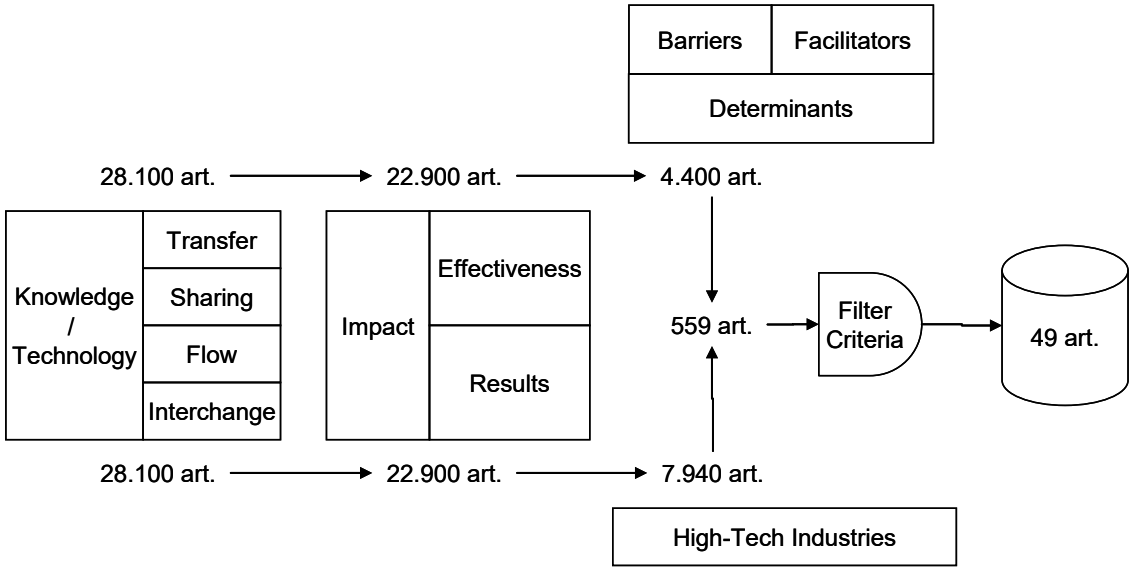

Figure 1: Information search process

We use content analysis technique to process technical documentation (Silverman, 2000). This method is appropriate to analyze texts and scientific articles, and to deepen into concepts already discovered or elaborated by other authors.

- SLIP technique ("Sort", "Label", "Integrate", "Prioritize") (Maeda, 2006) is handled to arrange materials, in order to simplify the information and to convert it into structured knowledge. Then, a summarized table of contents or bibliographic corpus is developed as the method to extract key information of each publication. Finally, the technique of drawing a concept map for graphical representation of relationships between terms is used.
- The edition of conclusions is ruled by standards of clarity, conciseness, accuracy, and simplicity (Day and Gastel, 2012)

3. Research Development

Proceeding with the analysis of the data set extracted from the literature review, we display them in an exhaustive list of factors. These variables present all the determinants, either as facilitators or as barriers, which may moderate and influence the impact of KT on a high tech organization. Putting on the technique of conceptual clustering (Maeda, 2006), we sort and classify factors under 22 master determinants, and then we synthesized them in 6 root master determinants, all belonging to two different KT contexts: internal and external environments. Thereby, we name master determinants to the conceptual groupings of KT moderating factors, and we call root determinants to the classification done with the master determinants according to criteria of homogeneous structure of terms (Bozeman, 2000), also called dimension of determinants. Accordingly, a master determinant explains an intermediate conceptual level between the determining factor layer and the coined root determinant. This sort lets handle information and mine data with the enough extent of granularity to enable the development of a comprehensive, understandable and manageable KT model. We describe the processing in detail as follows, so that it is displayed the set of factors leading to the creation of master and corresponding root determinants:

The attributes of the external context are the characteristics that define the external environment or site outward the playground where KT is hold, as well as those events and

contextual factors which externally moderate KT (Bozeman, 2000). This root determinant is composed by three sets of factors (Table 1): characteristics of economic, technical and business framework; characteristics of educational, scientific and cultural context; and characteristics of the legal, social, political and administrative framework:

Table 1: Breakdown of attributes of the external context

Master determinant	**Factors**	**Authors**
Characteristics of economic, technical and business framework	Characteristics of urban and regional economic structure. Strategic and organizational characteristics of clusters. Characteristics of the sector and industry culture of innovation.	Almeida et al, 2011; Carayannis y Borowik, 2011
Characteristics of educational, scientific and cultural context	Technological capacity of the region. Infrastructures of scientific and technological production and innovation support innovation.	Abetti y Rancourt, 2008; Maxwell y Levesque, 2011
Characteristics of the legal, social, political and administrative framework	Scientific and technological public policies and other actions and programmes of the public administrations.	Segarra-Blasco y Arauzo-Carod, 2008

The attributes of the internal context encompass the characterization of all the elements that act and intervene in the celebration of KT, setting, therefore, the type, level, scope, and knowledge subject within the KT phenomenon (Becker and Knudsen, 2006; Van Wijk et al, 2008). These attributes are constituted by five root determinants, each one composed by an array of master determinants, as we explain below:

The attributes of the object of knowledge gather all the features of nature, format and type of the knowledge item, in relation to the extent of complexity to be purpose of KT, and moreover, the characteristics of subjective contextual construction that knowledge bears (Ko et al, 2005; Kim and Vonortans, 2006; Minvaeba, 2007). This root determinant could be broken down into four sets of influential factors (Table 2): complexity of knowledge by composition; by extent of causal ambiguity; by degree of codificability; and by measure of dependence:

Table 2: Breakdown of attributes of the object of knowledge

Master determinant	Factors	Authors
Complexity of knowledge by composition	Characteristics of the elements which compose the knowledge. Architecture of the knowledge object. Technological multidisciplinarity of the knowledge. Mix and apportionment of knowledge among carriers and other media.	Ko et al, 2005; Kim y Vonortans, 2006; Poikela, 2006; Blumenberg et al, 2009; Wan et al, 2010; Al-Salti et al, 2010; Hamid y Salim, 2011; Wang y Wang, 2012
Complexity of knowledge by extent of causal ambiguity	Features of causal ambiguity of the knowledge.	Liu y Liu, 2008; Wan et al, 2010; Al-Salti et al, 2010
Complexity of knowledge by extent of codificability	Features of tacitness, codificability and teachability of knowledge.	Hansen, 2002; Jassimudin, 2007; Liu y Liu, 2008; Al-Salti et al, 2010
Complexity of knowledge by extent of dependence	Features of stickiness, immobility, incontinence, intangibility, and complexity of mobilization of the knowledge.	Al-Salti et al, 2010

The attributes of the actors are all the characteristics of, both individual and collective players acting as sender and receiver, which describe the protagonists of the KT (Amesse and Cohendet, 2001; Becker and Knudsen, 2006; Lockett et al, 2008; Azagra-Caro et al, 2012). This root determinant is built on the collection of five sets of factors (Table 3): characteristics of attitude; characteristics of competence; structural and organizational characteristics; characteristics of former experience and stock of knowledge; and organizational culture:

Table 3: Breakdown of attributes of the actors

Master determinant	Factors	Authors
Characteristics of attitude, motivation, engagement and implication.	Motivational factors and individual predisposition of employees to participate and collaborate. Individual culture pro KT.	Ko et al, 2005; Lin, 2007; Wan et al, 2010; Al-Salti et al, 2010; Zakrzewska-Bielawska, 2010
Characteristics of aptitude, competence, and capability.	Intellectual capital: training and human resources intelligentsia or human capital. Individual ability,	Cook, 1999; Amesse y Cohendet, 2001; Lin, 2007; Jassimudin, 2007; Al-Salti et

Master determinant	Factors	Authors
	efficacy and knowledge proficiency. Status and credibility. Relational capital.	al, 2010
Structural, technological and organizational characteristics.	Intellectual capital: structural and organizational capital features. Profile of the organization. Internal organizational resources for KT; knowledge management; intellectual and relational capital management; technological skills management. Abilities and skills: technological, collaborative, adaptive, and market capabilities; knowledge development capabilities; delivery, transmission and distribution capabilities; ability to select, understand, adopt, integrate and use knowledge	Gibson y Smilor, 1991; Cook, 1999; Santoro y Chakrabarti, 2002; Hansen, 2002; Agrawal y Henderson, 2002; Almeida et al, 2002; Albors et al, 2006; Agrawal et al, 2004; Slaughter y Kirsch, 2006; Chen-Kuo et al, 2008; Segarra-Blasco y Arauzo-Carod, 2008; Chen-Kuo et al, 2008; Blumenberg et al, 2009; Al-Salti et al, 2010; Wan et al, 2010; Sampedro, 2010; Valdaliso et al, 2011; Feria e Hidalgo, 2011; Zabaleta et al, 2012; Alexander y Martin, 2013
Characteristics of previous experience and stock of knowledge.	Intellectual and relational capital acquired due to prior experiences: relations; processes; organizational learning and research; technology and business; commercial activities. Types and features of knowledge in the organization: accumulation of organizational knowledge; means of accumulation; intangible assets; human capital; basis of assets; intangible capital; intellectual capital; technological capital.	Kim y Vonortans, 2006; Sampedro, 2010; Wennberg et al, 2011; Knockaert, 2011; Zabaleta et al, 2012; Padilla y Del Aguila, 2012;
Organizational culture.	Organizational culture features: values, commitment to KT, innovation and global cooperation, extent of leadership, management support intensity.	Cook, 1999; Albors et al, 2006; Lin, 2007; Al-Salti et al, 2010; Wan et al, 2010; Al-Gharibeh, 2011

The attributes of the relationships among the actors comprise the factors and characteristics of relations and social ties, both formal and informal, that they set individually and collectively (Slaughter and Kirsch, 2006; Jassimudin, 2007; Blumenberg et al , 2009; Wan et al, 2010, Al-Salti et al, 2010; Padilla and Del Aguila, 2012). This root determinant is formed by two sets of factors (Table 4): distance between actors, and the characteristics of the interaction:

Table 4: Breakdown of attributes of the relationships among the actors

Master determinant	Factors	Authors
Distance between actors: cultural contrast, geographical remoteness, structural and organizational difference, and technical and intellectual gap	Characteristics and extent of cultural contrast and cultural empathy. Geographical remoteness and proximity. Distinctiveness and differences of organizational characteristics. Gap between intellectual characteristics of the participants.	Gibson y Smilor, 1991; Albors et al, 2006; Segarra-Blasco y Arauzo-Carod, 2008; Al-Salti et al, 2010; Fyer y Pika, 2011; Knockaert, 2011
Characteristics of the interaction	Features and extent of interactivity. Bidirectional features of interpersonal and organizational communication among actors. Features of social processes and interactions and synergies in formal, informal and virtual relationships. Features of the nodes and links of relationship and interaction between agents.	Gibson y Smilor, 1991; Hansen, 2002; Ko et al, 2005; Jassimudin, 2005; Gottschalk y Solli-Sather, 2007; Lockett et al, 2008; Lech, 2011; Azagra-Caro et al, 2012

The mechanisms of means area made up of tools and business practices defined and implemented by an organization to arrange and execute the strategy, processes, procedures, and channels, for all the ways to transfer knowledge (Zuo et al, 2013). They include following types and characteristics: rich and poor; offline and virtual; formal and informal; spanning all extent of intensity and frequency of use; direction-based and routine-based (Amesse and Cohendet, 2001; Almeida et al, 2002; Slaughter and Kirsch, 2006; Kim and Vonortans, 2006; Jassimudin, 2007; Paik et al, 2009). The root determinant consists of three sets of factors (Table 5): cooperation and collaboration mechanisms; collaborative networks; and process mechanisms.

Table 5: Breakdown of mechanisms of means

Master determinant	Factors	Authors
Cooperation and collaboration mechanisms	Types and characteristics of cooperation and collaboration mechanisms among organizations: aim and objectives of cooperation; agreements and arrangements features; strategic alliances; scope and coverage.	Santoro y Chakrabarti, 2002; Gottschalk y Solli-Sather, 2007; Segarra-Blasco y Arauzo-Carod; 2008
Collaborative networks	Types and characteristics of the networks and cooperation structures: actors; network model; sorts of relationships; goal and objectives, strategy, policies, terms & conditions; values; procedures and tools; activity level and network intensity; cooperation term; complementarity and members skills map; degree of relationships strength.	Hansen, 2002; Albors et al, 2006; Gottschalk y Solli-Sather, 2007; Segarra-Blasco y Arauzo-Carod, 2008; Sampedro, 2010; Lech, 2011; Valdaliso et al, 2011; Carayannis y Borowik, 2011; Padilla y Del Aguila, 2012
Process mechanisms	Process characteristics and methods of KT. Design and process planning: resources and materials definition; systematisation and standardization; flow design; mechanisms selection and articulation; goals expectations; HR role; training of the receiver; chronology. Process implementation and performance: assimilation, adoption, implementation, integration, and utilization of knowledge. Process control and support. Process evaluation: evaluation of generation, execution, and absorption.	Almeida et al, 2002; Jensen y Szulanski, 2007; Jassimudin, 2007; Lockett et al, 2008; Paik et al, 2009; Wan et al, 2010; Lech, 2011; Knockaert, 2011

The mechanisms of strategy and corporate management gather all the tools and business practices defined and implemented by an organization to design, plan, run and control KT at corporate level (Albors et al, 2006; Pries and Guild, 2007; Segarra-Blasco and Arauzo- Carod, 2008; Padilla and Del Aguila, 2012; Fair and Hidalgo, 2011). Following types and characteristics of mechanisms for strategy management of the firm should be considered: systems and management tools (strategic plan, technology plan, quality system, business strategy, communication and marketing strategy, investment strategy, dissemination and marketing plan) and strategic management of intangible assets (intellectual capital: human, organizational and technological, and relational capital) (Gibson and Smilor, 1991; Cook, 1999; Comstock and

Sjolseth, 1999; Albors et al, 2006; Agrawal et al, 2004; Pries and Guild, 2007; Segarra-Blasco and Arauzo-Carod, 2008; Padilla and Del Aguila, 2012; Fair and Hidalgo, 2011; Wennberg et al, 2011). The root determinant is formulated according with five sets of factors (Table 6): internal mechanisms of organizational management; human resources management mechanisms; mechanisms for learning and knowledge management; technological resources mechanisms; and corporate R&D and innovation mechanisms:

Table 6: Breakdown of mechanisms of strategy and corporate management

Master determinant	**Factors**	**Authors**
Internal mechanisms of organizational management	Types and characteristics of organizational management mechanisms for structural influence - formal and informal - and material influence - resources: design and organizational context suitability; organizational maturity; project-based approach; R & D units; "flexi-rigid" structures; processes for knowledge development and management; competitive intelligence systems: technology intelligence and surveillance; management of intellectual property rights.	Rohrbeck et al, 2006; Kim y Vonortans, 2006; Chen-Kuo et al, 2008; Hamid y Salim, 2011; Zabaleta et al, 2012; Feria y Hidalgo, 2011; Padilla y Del Aguila, 2012
Human resources management mechanisms.	Types and characteristics of people management mechanisms of intrinsic and extrinsic nature: organizational incentives; cultural influence; skills development and evolution; motivation and recognition systems.	Lockett et al, 2008; Wan et al, 2010; Padilla y Del Aguila, 2012
Mechanisms for learning and knowledge management.	Types and characteristics of intra-organizational and inter-organizational mechanisms to develop skills and organizational intelligence. Mechanisms for knowledge management and linkage with organizational learning. Organizational systems for transactive memory and knowledge storage in social and technological networks.	Cook, 1999; Amesse y Cohendet, 2001; Albors et al, 2006; Jassimudin, 2005; Poikela, 2006; Sampedro, 2010; Gibson y Mahdjoubi, 2010; Hamid y Salim, 2011; Wang y Wang, 2012;
Technological resources mechanisms.	Types and characteristics of mechanisms of information and communication technologies resources	Jassimudin, 2005; Slaughter y Kirsch, 2006; Al-Gharibeh,

Master determinant	Factors	Authors
	as means of: transfer, communication, and storage of knowledge.	2011
Corporate R&D and innovation mechanisms.	Types and characteristics of mechanisms for comprehensive corporate strategy of innovation and R&D: strategies, models and R&D&I management plans integrated and aligned with business management; R&D&I tools and techniques; R&D&I processes integrated in business processes.	Comstock y Sjolseth, 1999; Santoro y Chakrabarti, 2002; Agrawal et al, 2004; Albors et al, 2006; Chen-Kuo et al, 2008; Segarra-Blasco y Arauzo-Carod, 2008; ; Lockett et al, 2008; Knockaert, 2011; Feria y Hidalgo, 2011; Wennberg et al, 2011

4. Results

We group all root and master determinants described above, and we get a "tree KT determinants-based model" for high-tech enterprises (Figure 2). Once concepts of root and master determinants are set forth, the model presents the whole body of elements that influence and moderate and event of KT. The diagram is depicted thanks to a four detailed component levels scheme and sorted into two main groups: external factors, and internal factors. The second level shows the root determinants or dimensions of business terms with a high level of abstraction but clearly connected with the variables that characterize a phenomenon of KT (Bozeman, 2000). Likewise, each root determinant is decomposed into a small ensemble of master determinants of a first category of abstraction, and in turn, these could also be broken into one or more second category of abstraction master determinants. A master determinant encompasses a set of factors that research studies have proved decisively influential in KT impact and each one represents a concise standard business term. Therefore, the model illustrates the complete corpus of parameters which effectively influence the business performance of a company sited in high technology industry.

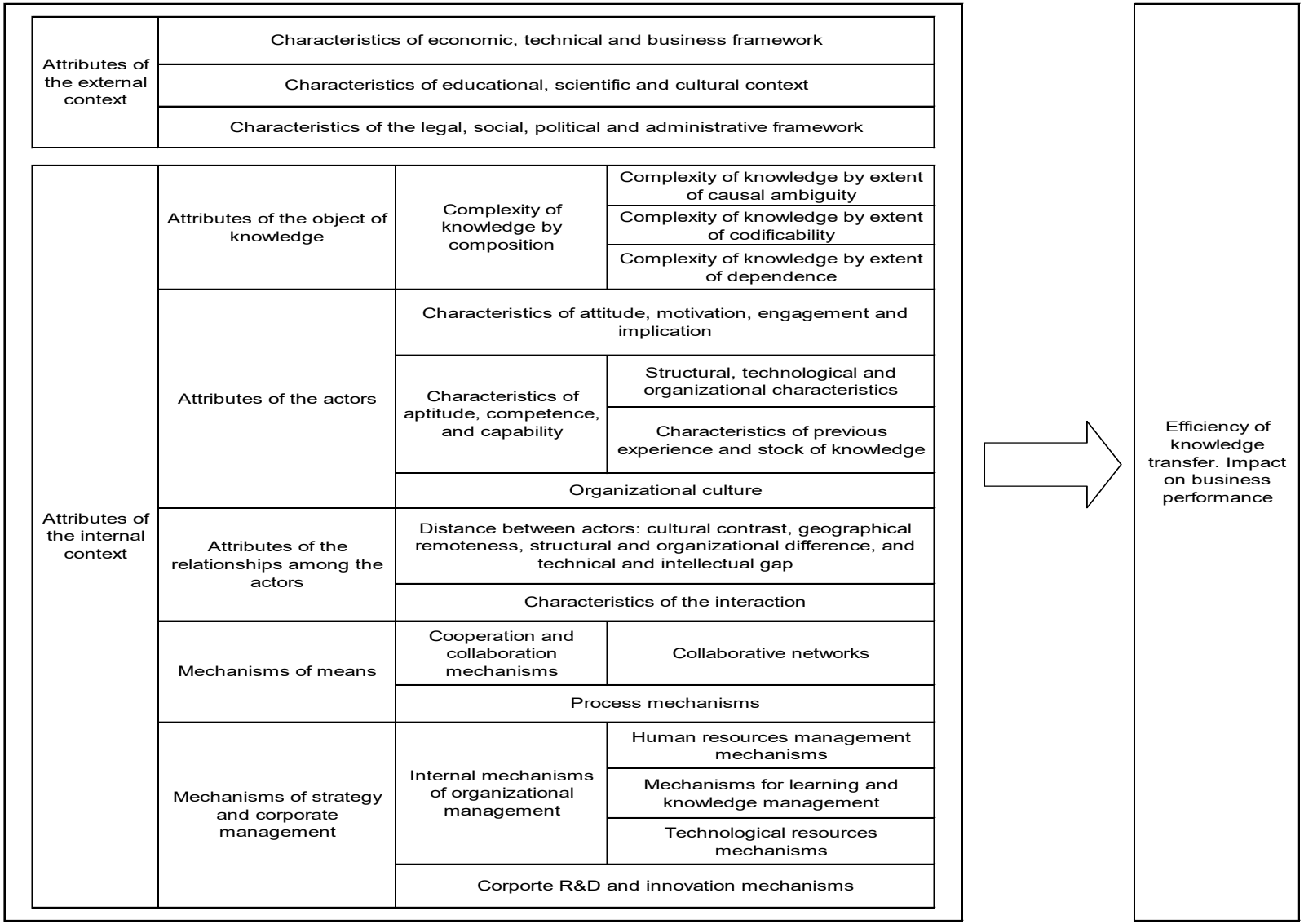

Figure 2: knowledge transfer determinants-based tree model for high-tech firms

5. Discussion

We have elaborated a model which portrays a comprehensive perimeter of dimensions or sets of factors influencing the results of the phenomenon of KT of high-technology organizations, and which enables the identification and understanding of the main impact key variables. This model is developed after identifying, arranging and categorizing a body of determinants retrieved of research studies from scientific literature, and whose formulation represents the phenomenon. Therefore, the model could be a guide to lead and conduct KT events and achieve more effective outcomes. Likewise, the resource-based view of the firm theory (RBV) and the knowledge-based view of the firm theory (KBV), postulate that knowledge is the key factor for the originality and differentiation of a company (Kogut and Zander, 1993; Grant, 2002), and that business performance depends on skills and abilities evolved thanks to handle of knowledge (Ding et al, 2009), i.e., once these capacities are optimized, a competitive advantage of the organization is attained with regard to the business segment (Tallman, 2003). Consequently, an optimal KT provides an improving competitiveness and sustainability of organizations. Thus, thanks to this research, we formulate a model which presents an action guideline to improve competitiveness and sustainability of high-tech organizations. The guideline details are discussed as follows:

Firstly, the study denotes the large volume and complexity of determinants of impact that typifies the phenomenon of KT within the high-tech organizations. In contrast to already devised models and taxonomies by other authors (Cook, 1999; Bozeman, 2000; Kumar and Ganesh, 2009; Blumenberg et al, 2009; Eckl, 2012), our model introduces a level of detail that is reached due to the conclusions stem from the analysis and information processing. In particular:

The attributes of the internal context of KT for high-tech organizations constitute the complete contour of the phenomenon, as the determinants set the type, scope, and subjects of knowledge involved. In these industries, the framework is global and the scope of KT is total at corporate level, so, KT is not restricted to a single level or particular context but it extends over all business processes and practices. Such implicated subjects are: high technology developed through R&D activities; products, services and processes as a result of innovation initiatives, and individual and organizational skills. All of them act as the foundation for the existence and

business operations of the company. That is, a high-tech organization runs, consciously or unconsciously, a non-stop state of multiple transfers of knowledge. In fact, the investigations evidence that there is a differential role of the determinant factors at the different levels of KT (Van Wijk et al, 2008; Becker and Nudsen, 2006), highlighting the importance of approaching the entire frame of the issue for this kind of organizations (Easterby-Smith et al, 2008).

The characteristics of the actor roles, sender and receiver, are diluted and merged in the attributes of the actors, because the fixed and static role of each role disappears, becoming a dual actor or double role actor. This finding reinforces the investigations that point at the strategy of high-tech companies to leverage the generation of knowledge as a strategic process for the existence and sustainability. They also state that knowledge could be simultaneously created externally and internally (Ding et al, 2009), and that internal units or people should be required to become dynamic as keeping transmitter and receiver papers at once.

High-tech companies own a deep richness of determinant factors related to the mechanisms of strategy and corporate management. We find the evidence of the importance about designing and defining corporate strategic plans which encompass integrated and aligned core business elements (Comstock and Sjolseth, 1999; Wennberg et al, 2011; Anokhin et al, 2011; Iskoskov and Chernova, 2013): objectives, strategies and tactics, procedures, business management systems, research and development, innovation, quality, and remarkably: marketing, commercialization and dissemination of knowledge and technology. Emphasis is placed on strategic and efficient management of intangible assets of the organization or intellectual capital: human, relational and technological-organizational capital (Valdaliso et al, 2011; Padilla and Del Aguila, 2012). This fact confirms that KT, in a high-tech organization, is inherent to the business operations, resulting in practice an integrated and inseparable phenomenon of business dynamics.

There is also a great profuseness of determinants related to the use of mechanisms of cooperation and collaboration in the advanced technological industries, particularly with the implementation of collaborative networks (Zakrzewska-Bielawska, 2010). There is proven evidence about the suitability of such mechanisms featured by specific characteristics of breadth, depth, frequency, strength and wealth of established partnerships (Hansen, 2002), for efficient

KT (Segarra-Blasco and Arauzo-Carod, 2008). This finding justifies the strategic commitment of high-tech organizations to maintain an active and effective management of relationships along with the entire ecosystem of actors and in accordance with multipurpose objectives (Carayannis and Borowik, 2011): learning or exploration; and exploitation or commercialization, of knowledge. In summary, cooperation is an instrument with outstanding significance for the industry due to the close relationship with organizational learning (Ding et al, 2009).

The characteristics of complexity of knowledge star a significant role for the KT phenomenon across the whole economy (Szulanski, 1996). In the particular case of high-technology organizations, this research highlights the multidisciplinary nature of knowledge, the extent of intangibility and immobility, and the multimodal incarnation (Almeida et al, 2002; Agrawal et al, 2004; Al-Salti et al, 2010; Wennberg et al, 2011; Wang and Wang, 2012). That is, a feature that we could denominate as a multi-knowledge object or a mix of multiple elements of knowledge. This finding expose that the phenomenon of KT in terms of the object of knowledge is richer and more complex for these organizations, and carry with much greater transformational power and opportunity.

6. Implications and research limitation

The findings have significant practical implications for the community of KT professionals and public policy makers, especially for managers of high-tech companies. The prime strength of the work pertains to the model revelation as a scientific rigorous scheme which enables the development of guidelines to assist high-tech firms in enhancing competitiveness and sustainability. Furthermore, the model switches on and pushes the motivation, encouraging the innovation of the organizations.

There is a limitation of this research related to the used criteria for the identification and selection of bibliographical references. The huge abundance of studies on the KT field, has forced us to a strong restriction of articles through a filtering process, with a certain risk of loss of information.

7. Future research

Further researches should be performed in order to develop new knowledge and to search out complementary findings related to the illustrated model. We recommend deepening into each master determinant displayed, with the aim of detecting and detailing the influence they play on the impact of KT. Likewise, we encourage to obtain empirical evidence of the relationship between KT and business performance, by studying the behavior of different high tech organizations pursuant to the suitability of the conditions for KT, as a result of the attribute factors and mechanism factors implemented.

8. Conclusions

Knowledge transfer within the high-technology organizations is a phenomenon that could be represented by means of a customized body of factors arranged as root and master determinants. This corpus moderates the outcomes of the event or KT impact, and could be depicted as a model called “knowledge transfer determinants-based tree model for high-tech firms”. These entities are characterized by a strong reliance on knowledge as a strategic resource that regulates their competitiveness and sustainability. Therefore, an efficient management of the aggregate of the multiple flows of diverse knowledge existing within and around the organization becomes a key pattern for the direction and governance of the company. The pattern, likened to an executive steering instrument, could be based on the previously defined model, which maps all variables that determine the result of each event of transfer.

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