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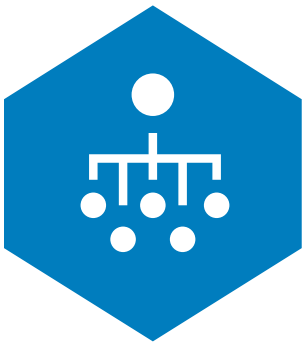

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How to Measure Tacit Knowledge?

The V.R.I.N Model's Method

KHALED TAMZINI, TAHAR LAZHAR AYED, AND AISHA WOOD BOULANOUAR

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How to Measure Tacit Knowledge?: The V.R.I.N Model's Method

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Abstract: This paper aims to provide researchers with an original quantitative method to measure tacit knowledge. The authors have called this quantitative method: "The V.R.I.N model's method" which is built upon Barney's (1991) resource-based view. The methodology of "The V.R.I.N model's method" is based on the operationalization of the four dimensions which were advanced and considered by Barney (1991) as attributes of a resource: value; rarity; inimitability and non-substitutability. The main finding of this study is to confirm Tamzini's (2015) previous findings, mainly the fact that tacit knowledge is quadridimensional and its dimensions are unidimensional and to confirm the V.R.I.N model of Barney (1991). This paper contributes to cope with: (1) the empirical research scarcity, (2) the dominance of the qualitative methods, and (3) the risks to abuse in using proxies to measure tacit knowledge by providing researchers with an original quantitative method in the field of the resource-based view of the firm.

Keywords: Tacit Knowledge, V.R.I.N Model's Method, Knowledge Management, ICT Firms

Introduction

Both proponents and detractors of the resource-based view attest that empirical research on how we can measure tacit knowledge is still very scarce (Ambrosini and Bowman 2001). This scarcity could be explained by the fact that tacit knowledge is a specific intangible resource which is difficult to identify, difficult to measure, and inherently difficult for practitioners to handle (Montgomery 1996; Priem and Butler 2001a). Tacit knowledge resists operationalization due to its intrinsic characteristics. Tacit knowledge is: (1) difficult to formalize; (2) a personal knowledge; (3) practical, describing a process; and (4) is context specific (Ambrosini and Bowman 2001). For Tamzini (2015), tacit knowledge is a kind of knowledge which is difficult to communicate through language.

As tacit knowledge has these features, more empirical studies are needed to delineate it (Jensen 1993, quoted in Ambrosini and Bowman 2001). Moreover, the literature review related to the operationalization of tacit knowledge shows that most of the empirical studies have adopted and were based on qualitative methods, rather than on quantitative methods. Thus, the authors distinguish four main qualitative approaches: the critical-incident technique (Flanagan 1954; McClelland 1976, quoted in Sternberg et al. 1999); the simulation approach (Frederiken 1966; Frederiken et al. 1957; Bray 1982; Thornton and Byham 1982, quoted in Sternberg et al. 1999); the tacit-knowledge approach (Sternberg et al. 2000); and the causal mapping techniques (Ambrosini and Bowman 2001; Ambrosini 2003).

Regarding quantitative methods, most of the empirical studies have used proxies to measure tacit knowledge (Berman et al. 2002; Edmonson et al. 2003; Ryan and O'Connor 2009, quoted in Jackson 2011). However, the use of proxies to measure the unobservable constructs in general, and tacit knowledge in particular, is not without risk (Ryan and O'Connor 2009; Taub et al. 2001, quoted in Jackson 2011).

Given this background, the aim of this contribution is to cope with: (1) the empirical research scarcity, (2) the dominance of the qualitative methods, and (3) the risks to abuse in using proxies to measure tacit knowledge, by providing researchers with an original quantitative method in the field of the resource-based view of the firm. The authors have called this

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quantitative method: "*The V.R.I.N model's method"* which is built upon Barney's resource-based view. In fact, according to Barney (1991), the resource-based view has two fundamental assumptions: (1) valuable and rare (scarce) resources could offer a competitive advantage to the firm and, (2) these resources are simultaneously inimitable, difficult to substitute, and which could be considered as a source of sustainable competitive advantage and superior performance. For Barney (1991) these resources could be considered "strategic" in that way that their possession and their effective deployment in products could provide superior performance to the firm. Barney (1986, 1991) argues that strategic resources must have four dimensions: (1) value; (2) rarity; (3) inimitability, and (4) non-substitutability. Tamzini (2015) examines these four attributes as the V.R.I.N framework of Barney (1991) and has considered them the main dimensions of a strategic resource.

Knowing that tacit knowledge is considered to be the most important strategic resource by the proponents of the knowledge-based view (Grant 1996; Kogut 2000; Chaminda et al. 2007), the authors have advanced the assumption according to which tacit knowledge obeys Barney's V.R.I.N model. Thus, the methodology of "*The V.R.I.N model's method"* is based on the operationalization of the four dimensions which were advanced and considered by Barney (1991) as attributes of a resource.

The results of this study, conducted in the Tunisian *industry of Information Communication and Technology (ICT)* and preceded with the adaptation and validation of a set of measurement scales based on an exploratory factor analysis (performed with SPSS 18.0) and confirmatory factor analysis (performed with AMOS 16.0), demonstrate that if tacit knowledge is quadridimensional, its dimensions (value, rarity, inimitability, and non-substitutability) are unidimensional, as argued by Tamzini (2015). As formulated by Tamzini (2015), value and rarity are considered "the *ex-ante* conditions of competitiveness" (emphasis added) which are required to achieve firm competitive advantage. However, inimitability and non-substitutability are considered a source of the sustainability of competitive advantage. Tamzini (2015) has called them "the *ex-post* conditions of competitiveness" (emphasis added).

Therefore, besides the fact that the main finding of this study is to confirm both Tamzini (2015) previous findings and the Barney (1991)V.R.I.N model, this study contributes by measuring tacit knowledge to address criticism formulated against the resource-based view, especially those advanced by Priem and Butler (2001a) and Doz (1994).

This paper is divided into three sections. The first section is a review of the literature related to the definitions and features of tacit knowledge. The second section presents a review of the qualitative and quantitative methods which have been used to measure tacit knowledge. The third section presents and develops this quantitative method to operationalize tacit knowledge based on Barney's V.R.I.N model. The final section presents the study's method, how the data was analyzed, and is followed by a discussion of the results and implications of this work on future research in the area.

Theoretical Development

In this section tacit knowledge will be introduced. Firstly, based on the degree of articulation of knowledge, which distinguishes between its two tacit and explicit dimensions and, secondly, based on its degree of aggregation, which distinguishes between its individual and collective dimensions. Therefore, the authors will distinguish between individual tacit knowledge and collective tacit knowledge.

Tacit Knowledge: Definitions

Tamzini (2015, 149) argues that tacit knowledge as "opposed to explicit knowledge, is a form of impossible knowledge (or very difficult) to translate in a speech: it is incommunicable through language." Ambrosini and Bowman (2001) have advanced four features of tacit knowledge: (1)

tacit knowledge is difficult to formalize (Polanyi 1962); (2) tacit knowledge is personal knowledge (Chang et al. 2014; Holste and Fields 2010; Ravetz 1971); (3) tacit knowledge is a practical knowledge which describes a process (Nonaka 1991), and (4) tacit knowledge is context-specific (Morris et al. 2014; Sternberg 1994; Nonaka 1994).The last two features are considered the basis of Reix's typology. Reix (1995) decomposed knowledge into two types: "specific-context knowledge" and "practical knowledge." The first type is considered to be a set of values and implicit norms more or less widely shared. The practical knowledge is acquired both within and through a practice and corresponds to the part of knowledge that escapes to speech. Between these two types of knowledge (tacit knowledge and explicit knowledge), Ambrosini and Bowman (2001) have proposed two other intermediate categories having different degrees of formalization. The first corresponds to knowledge which, in a lack of an articulation effort from the firm's members, becomes tacit over time. The second concerns knowledge which could be articulated using metaphors or storytelling.

Sternberg et al. (2000) argued that tacit knowledge is procedural, practically useful, is acquired with little or no environmental support, is fundamentally individual(Taylor 2007) and is acquired through experience and action(Griffith and Hoppner2013), especially first-hand experience (McAdam et al. 2007). A working definition of tacit knowledge has been proposed by McAdam et al. (2007). For them, tacit knowledge is that knowledge which is: (1) developed from direct experience and action (Li-Weiand Lin 2013), (2) highly pragmatic and specific-context (Nonaka 1994; Sternberg 1994), (3) difficult to articulate and to formalize (Polanyi 1962), and (4) shared through interaction between individuals and transferred experience (McAdam et al. 2007).

Edvinsson and Sullivan (1996) have assimilated intellectual capital into the knowledge that has value for the firm. Thus, this valuable knowledge is separated into two components: human resources and intellectual assets. Human resources are defined as the collective capabilities of employees to resolve customer's problems. They are considered a set of tacit knowledge (individual know-how), the routines carried inside men's brains, skills, and the creativity to develop products. Szulanski and Jensen (2004, quoted in Ranucci and Souder 2015) have argued that knowledge resides in firm-specific routines and that routines relating to tacit knowledge are fundamentally distinct from those relating to explicit knowledge (Boisot 1998, quoted in Ranucciand Souder 2015). Therefore, tacit knowledge and explicit knowledge are fundamentally different based on the different firm-specific routines. The second component (the intellectual asset) is considered a codified or explicit knowledge. It is a set of physical, tangible, or codified descriptions of a specific knowledge allowing the company to claim rights.

Hubert (1996) argues that tacit knowledge takes a different form in each segment of the intellectual capital of a company. At the level of human capital, tacit knowledge is the mentality of individuals, their assumptions, prejudices, values, and beliefs. As client capital, individual and collective mindsets of clients shape their perception of the value provided by particular goods or services. At the level of the structural capital, the collective mentality of the members of the organization shapes culture, including its standards and values.

In order to achieve the goal of this paper, the authors define tacit knowledge as an intangible resource. It is a valuable, rare, inimitable, and non-substitutable resource. This definition is very close to Barney's definition.

Individual versus Collective-Tacit Knowledge

After presenting the tacit and explicit dimensions of knowledge, the authors will present its degree of aggregation by distinguishing its individual and collective dimensions. The degree of aggregation of knowledge is that which differentiates between individual and collective knowledge. The aggregation's aspect depends on the interesting controversy between those who

consider knowledge to be personal and those who consider it to be exclusively collective. Thus, the authors propose successively the work of Polanyi (1975) and Wittgenstein (1958).

From an ontological point of view, Polanyi (1975) states that knowledge is essentially "personal" and the property of an individual that exists through behaviors, attitudes, and experiences. This knowledge is applied naturally when performing specific tasks. According to Polanyi's epistemology (1975), knowledge can only be "tacit" and its combination with the ontological dimension (individual) gives rise to the "embodied knowledge" based on the terminology of Cabrera and Cabrera (2002). This is in opposition to "embrained knowledge" (individual-explicit knowledge) which depends on abstract theoretical reasoning (knowing). The "embodied knowledge" is based on the practical experience (doing). Polanyi (1962) focuses on the practical, individual, and action oriented knowledge (Tsoukas 2002). This knowledge is a particular knowledge and only becomes relevant in a specific-context (Barley, 1996). Its generation cannot be separated from its application (Lam 2000). For Ravetz (1971), tacit knowledge is naturally individual. That is why it is difficult both to express and to communicate.

From Cook and Brown's epistemology (1999) (i.e., the comprehension of the nature of knowledge is considered the property of the human being) the "individual-tacit knowledge" called "Skills" in the terminology of Cook and Brown (1999), is this knowledge possessed by individuals and which describes how to use concepts, rules, and equations. In contrast, individual-explicit knowledge corresponds to all an individual can know, learn, and be explicit about (e.g., concepts, rules, and equations which are typically presented explicitly and are known and used by individuals).

In contrast to Polanyi (1975), Wittgenstein (1958) argues that knowledge is fundamentally collective. The authors have demonstrated previously that knowledge is not static and is fundamentally linked to action. Thereby, knowledge is not personal because action is only possible in a particular context (i.e., the organization), in the presence of stimulant actors. Moreover, those actors must have the capability to exert a judgment in order to generate any knowledge. Hence, the collective dimension of knowledge is underlying and reveals the concept of "collective mind" discussed by Weik and Roberts (1993) who claim that individuals guide their actions from within a social system of common actions interconnected, acquired and accepted. The collective knowledge is that which is accumulated by the organization's members, and is based on the experiences and objectives of the organization (Lyles and Schwenk 1992; Zander and Kogut 1995).

From an epistemological point of view, the collective knowledge could be "tacit" or "explicit." For Cabrera and Cabrera (2002), the collective-tacit knowledge (or "Encultured and embedded knowledge") is the result of the interaction between persons belonging to an organization or to a particular community (Leonard and Sensiper 1998).As for the epistemology of possession of Cook and Brown (1999), the collective-tacit knowledge is called "Genres" which are defined as the meaning or the useful signification of the artifacts given by a group. Although they cannot be explicitly learned, they may have an explicit counterpart as a label or a trade name. The genres could be physical (technologies or products) or social (how to do things). In opposition to collective-tacit knowledge, Cook and Brown (1999) give the appellation of "stories" to collective-explicit knowledge. This kind of collective knowledge is used, expressed and transferred inside the group. It includes stories, metaphors, and phrases which have useful significances in a specific work team.

The knowledge management literature emphasizes tacit knowledge is anchored in individuals who form the communities of practices or the social communities (Alveson and Karreman 2001). Thus, tacit knowledge must be identified in these communities of practices and shared within the firm in order to build knowledge capital and reach a level for sustainable competitive advantage. That is to say, tacit knowledge and communities of practices are related. In fact, the first belongs to, and circulates through, the second. The communities of practice exert a lever effect on the tacit knowledge of the firm. As McDermott (1999) has argued, to enhance

the knowledge of the firm we should focus on the communities that possess it and the persons who use it. The achievement of this goal, as argued by McDermott (1999, quoted in Alveson and Karreman 2001), is facing four challenges associated with knowledge management: (1) a "technical challenge" to conceive or design human and information systems that make information available and help people to reflect together, (2) a "social challenge" required to develop the communities which share knowledge and maintain diversity, (3) a "management challenge" which concerns the creation of an environment valuing the shared knowledge, and (4) a "personnel challenge" which is the challenge to be open to the ideas of others and share them.

Methods to Measure Tacit Knowledge

The literature review related to the operationalization of tacit knowledge shows that most empirical studies have adopted and used qualitative methods, rather than quantitative methods.

In this section we will present the qualitative and quantitative methods which have been used most often to measure tacit knowledge. We will also present and develop this original quantitative method to operationalize tacit knowledge based on Barney's (1991) V.R.I.N model called: *The V.R.I.N model's method*.

Qualitative Methods

We distinguish four main qualitative approaches: the critical-incident technique (Flanagan 1954; McClelland 1976, quoted in Sternberg et al. 1999); the simulation approach (Frederiken 1966; Frederiken et al. 1957; Bray 1982; Thornton and Byham 1982, quoted in Sternberg et al. 1999); the tacit-knowledge approach (Sternberg et al. 2000); and causal mapping techniques (Ambrosini and Bowman 2001; Ambrosini 2003).

Sternberg et al. (1999), Flanagan (1954), and McClelland (1976) have argued that the critical-incident approach is based on the identification and the description of events (incidents) negatively or positively handled by employees. This approach is a technique employed to identify a set of critical competencies and it is focused "on the behaviors associated with effective performance" (Sternberg et al. 1999, 43).

While the simulation approach and the critical approach are similar in the way that they are based on employee observation to assess behaviors associated with effective performance and job performance, they are also different. In fact, where the former is based on real situations (critical-incident), the latter is based on people observation in simulated job situations needed to reach job performance (Sternberg et al. 1999). Among the forms of a simulation technique, the authors distinguish the in-basket test (Frederiken 1966; Frederiken et al. 1957, quoted in Sternberg et al. 1999) and the assessment center (Bray 1982; Thornton and Byham 1982, quoted in Sternberg et al. 1999).

In order to identify and operationalize tacit knowledge, Sternberg et al. (2000) used the tacit-knowledge approach proposed by Sternberg et al. (1999), which is based on expert-novice differences. Sternberg et al. (2000) have determined that experts hold knowledge that is likely to be tacit. In contrast, they attest that novices have explicit knowledge and little tacit knowledge. While this approach is based on the storytelling of individuals interviewed as with the critical-incident approach, it differs from it. In fact, unlike the tacit-knowledge approach which does not provide respondents with the opportunity to reflect on situations that could be considered from their point of view as a critical situation (or incident), the respondents have to make their choice from amongst a given set of work-related situations (Sternberg et al. 1999). This approach was recommended by Swap et al. (2001, quoted in Taylor 2007) in order to transfer tacit knowledge in the workplace.

Ambrosini (2003) has proposed a conceptualization of knowledge at the organizational level. She argued that the organization's knowledge is incorporated in its tacit routines that are difficult to verbalize, are context specific and are embedded in organizational memory (Taylor, 2007).

Moreover, tacit routines are responsible for the dissemination of tacit knowledge between individuals in an organization. This transmission is insured by the way of thinking and acting, which means through judgment (Ranucci and Souder 2015). In fact, tacit knowledge is the capability to exert a judgment based on an assessment of a context, or theory, or both (Tsoukas and Vladimirou 2001). As Ambrosini and Bowman (2001) have used metaphors or storytelling to articulate tacit knowledge, Ambrosini (2003) have used the causal mapping technique in order to reveal the tacit routines within an organization. This technique is based on a storytelling interview with key individuals in the firm in order to develop a set of success factors (Taylor 2007).

As advanced by Taylor (2007), those qualitative methods (Sternberg et al. 2000; Ambrosini and Bowman 2001; Ambrosini 2003) used to operationalize tacit knowledge expose some weaknesses. All of the criticisms are based on the researcher's capability to interpret whether the routines identified represent tacit knowledge or not (Taylor 2007). Moreover, Ambrosini (2003) conceptualizes tacit knowledge from a collective level, however its operationalization is applied at the individual level. Additionally, both the critical-incident technique and the simulation approach have some limits. With respect to the critical-incident technique, Sternberg et al. (1999) have argued that individuals are not able to determine for themselves which incidents are critical. In terms of the simulation approach, they have asserted that the method is unable to identify which job situation would be suitable for simulation.

Quantitative Methods

The literature has mentioned that most of the empirical studies have used proxies to indirectly measure tacit knowledge. Hitt et al. (2001) have used the total experience of partners in a focal firm (the largest law firms in the United States) as a proxy for specific tacit knowledge and the quality of law school attended by partners as a proxy for the articulable knowledge and the prestige. Those two proxies were used to measure human capital. Berman et al. (2002, quoted in Jackson 2011) have used a proxy to study tacit knowledge within National Basketball Association (NBA) teams. Likewise, the tacit knowledge index (TKI) has also been frequently used as a proxy to indirectly measure tacit knowledge. Thus, Jackson (2011) has developed a sales team specific tacit knowledge index (TKI) and Ryan and O'Connor (2009, quoted in Jackson 2011) have developed a tacit knowledge index in order to study the tacit knowledge endowed to software development teams.

However, the use of proxies to measure the unobservable constructs in general and tacit knowledge in particular is not without risk. First, as argued by Taub et al. (2001, quoted in Jackson 2011, 43) "while a proxy measure might be statistically reliable it is not necessarily a valid indication of success or performance." The second risk in using a proxy to measure tacit knowledge is related to its collective or organizational nature. In fact, according to Ryan and O'Connor (2009, quoted in Jackson 2011, 42–3),"three issues must be addressed when using a proxy to measure tacit knowledge in order to validate the construct: 1) Team tacit knowledge is specific to a functional group and differentiates novices from experts with practical experience; 2) The proxy should measure tacit knowledge owned by all team members for the purpose of determining the shared team-level of tacit knowledge; and 3) The proxy measure can only measure tacit knowledge at the articulated level of abstraction."

The V.R.I.N Model's Method

Knowing that tacit knowledge is considered to be the most important strategic resource by the proponents of the knowledge-based view (Grant 1996; Kogut 2000; Chaminda et al 2007), Tamzini (2015) have advanced and confirmed the assumption according to which tacit

knowledge obeys Barney's V.R.I.N model[1]. In fact, Tamzini (2015, 152) argues that "if we stick strictly to the four criteria (V.R.I.N) developed by Barney (1991) on the one hand, and to the causal ambiguity that depends on tacit, complex and specific aspects of a resource (Grant, 1996) on the other hand; only forms of tacit knowledge of a firm (Polanyi 1962; Nonaka 1999) seem to fulfill these conditions, insofar as they are considered unidentifiable resources (ambiguous), rare, non-substitutable, non-imitable and can be a source of value (Nonaka 1994)."

The empirical research of Tamzini (2015) undertaken in 2012 on a sample of 209 Tunisian ICT firms provides researchers with an empirical framework to appropriately operationalize tacit knowledge. This quantitative method has been based mainly on the verification of the two fundamental assumptions related to the resource-based view and proposed by Barney (1991): "(1) the V.R.I.N model and (2) the nature and sense of the relationship between the three main concepts of the resource-based view (strategic resources, competitive advantage, and performance),taking as an example tacit knowledge as a specific intangible resource which is difficult to identify, to measure and inherently difficult for practitioners to handle (Montgomery 1996; Priem and Butler 2001a)" (Tamzini 2015, 142).

Hence, four confirmations have been advanced by Tamzini (2015) based on an exploratory factor analysis (EFA) performed with SPSS 18.0 and confirmatory factor analysis (CFA) performed with AMOS 16.0: (1) Strategic tacit knowledge is a quadridimensional variable; (2) Dimensions, "Value," "Rarity," "Inimitability," and "Non-Substitutability," and the variable "strategic tacit knowledge" are unidimensional; (3) Competitive advantage is a unidimensional variable; (4) Performance is a unidimensional variable. Tamzini (2015) has also demonstrated that competitive advantage plays a mediating role in the relationship between strategic tacit knowledge and performance.

Following Tamzini (2015) we have used "the V.R.I.N model's method" in order to measure tacit knowledge. In fact, the authors argue for operationalizing the tacit knowledge returns to measure its four dimensions: value, rarity, inimitability, and non-substitutability.

Assumptions

Hence, the authors suggest the following assumptions:

> **Assumption 1**: Tacit knowledge is quadridimensional.
>
> **Assumption 2**: The tacit knowledge dimensions (value, rarity, inimitability, and non-substitutability) are unidimensional.

Thus, the aim of this study is to confirm Tamzini's (2015) previous findings, mainly the fact that tacit knowledge is quadridimensional, that its dimensions are unidimensional, and to confirm the V.R.I.N model of Barney (1991) by focusing only on the operationalization of the four dimensions of the tacit knowledge (without taking into account the relationship between tacit knowledge, competitive advantage, and performance) as Tamzini (2015) had proposed.

[1] According to Barney (1991), the resource-based view has two fundamental assumptions: (1) valuable and rare (scarce) resources could offer to the firm a competitive advantage and (2) these resources which are simultaneously inimitable, difficult to substitute could be considered as a source of sustainable competitive advantage and superior performance. For Barney (1991) these resources could be considered as "strategic" in that way that their possession and their effective deployment in products could provide superior performance to the firm. Barney (1986, 1991) argues that strategic resources must have four dimensions: (1) value, (2) rarity, (3) inimitability, and (4) non-substitutability.

Method

As proposed above this empirical methodology is based on the operationalization of the four dimensions which were advanced and considered by Barney (1991) as attributes of a resource: (1) value, (2) rarity, (3) inimitability, and (4) non-substitutability.

Sample and Survey Administration

The sample for this study consisted of firms operating in the ICT industry in Tunisia. The study was conducted via the professional social network LinkedIn. Of the 370 suitable firms, 207 provided data for this study, a response rate of 55.94 percent.

Measures

In order to achieve the goal of this study, the authors operationalized the four dimensions of tacit knowledge with reference to an existing scale developed by Wiklund and Shepherd (2003) and tested by Tamzini (2015). This scale is composed of eleven indicators (items) and has a five-point Likert-type scale ranging from "Very weak" to "Very strong."1

For each of these measures the survey asks the respondent to indicate his/her agreement. The statement and the items used are:

> Compared to other companies in your industry, does your company have a weak or strong position in terms of: staff with a positive commitment to the company's development, technical expertise, expertise regarding development of products or services, highly productive staff, expertise in marketing, special expertise regarding customer service, special expertise regarding management, innovative markets, staff educated in giving superior customer service, staff who like to contribute with ideas for new products/services, and staff capable of marketing your products/services well. (Wiklund and Shepherd 2003, 1311)

The Cronbach's Alpha for the subscales measuring the four dimensions of tacit knowledge was as follows:

- tacit knowledge's value (alpha = 0.818);
- tacit knowledge's rarity(alpha = 0.807);
- tacit knowledge's inimitability (alpha =0.690);
- tacit knowledge's non-substitutability (alpha = 0.820).

Results

The authors have proceeded with the construction and validation of the measurement scales used, based on an exploratory factor analysis (EFA) performed with SPSS 18.0 and a confirmatory factor analysis (CFA) performed with AMOS 16.0.

Data Analysis

Exploratory Factor Analysis EFA

Exploratory factor analysis is a data-driven technique used when a researcher seeks to reduce the observable data into a set of latent components. Normally, if one has the conviction that the literature is sufficiently advanced on the scale structure, it will be unnecessary to re-identify it using exploratory factor analysis (Akrout 2010).However, in the case of this study, the authors

consider exploratory factor analysis to be an analytical complement. It will confirm the theoretical rigor elaborated on in the literature, and keep the items with a high quality of representation (Communalities).

Exploratory factor analysis (EFA) with varimax rotation was used to verify the four constructs of the conceptual model (see table 1). All retained items have factor loadings higher than 0.5 (Tinsley and Kass 1979; Hair et al. 2006; Carricano and Poujol 2008).

Table 1: Exploratory Factor Analysis of Tacit knowledge constructs

Items	***Factor Loadings***			
	VALE	*RARE*	*INIMI*	*SUBSTI*
VALE1	0.763			
VALE2	0.646			
VALE3	0.763			
VALE4	0.717			
VALE5	0.664			
VALE6	0.674			
VALE7	0.730			
VALE8	0.706			
VALE9	0.715			
VALE10	0.747			
VALE11	0.712			
RARE1		0.580		
RARE4		0.650		
RARE6		0.639		
RARE9		0.754		
RARE10		0.651		
RARE11		0.575		
INIMIT2			0.736	
INIMIT3			0.765	
INIMIT4			0.586	
INIMIT8			0.590	
INIMIT9			0.677	
INIMIT10			0.590	
INIMIT11			0.724	
SUBSTI1				0.730
SUBSTI2				0.548
SUBSTI3				0.678
SUBSTI4				0.682
SUBSTI6				0.684
SUBSTI7				0.657
SUBSTI9				0.761
SUBSTI10				0.727
SUBSTI11				0.774
Reliability Cronbach's α	**0.919**	**0.826**	**0.852**	**0.883**

KMO = 0.872,
Bartlett's Test of Sphericity Approx. Chi Square = 3835.818,
sig. = 0.000,
Total Variance explained=55.689

Through the matrix component after the varimax rotation, the authors detected the various items are on four axes or principal components. Each axis corresponds to a set of items that measure one of the four dimensions of the variable "tacit knowledge." Thus, two confirmations

can be advanced on the results of the exploratory factor analysis: (1) tacit knowledge is quadridimensional and (2) its dimensions (value, rarity, inimitability, and non-substitutability) are unidimensional.

Confirmatory Factor Analysis CFA

In order to confirm these results, the authors have assessed the measurement model represented by Figure 1 as well as the necessary elements to test its validity. The authors have applied in their analysis Structural Equation Modeling, more precisely Confirmatory Factor analysis (CFA) using AMOS 16.0. It is a more powerful technical than EFA, (Harris and Schaubroeck 1990). This technique explains clearly the relationship between items of the same scale (Daly 2007) and provides criteria of appreciation of the measurement model adjustment and the quality of the convergent and discriminant validity (Bagozzi and Philips 1991).

Fit indices were employed to examine the overall fit of the model (see figure 1). Absolute fit indices indicate the capacity of a model to adjust data. The authors, quoted Chi Square testing that should be statistically insignificant (p=0.128) and CMIN/DF less than 2 (CMIN/DF=1.117). The Root Mean Squared Residual Standardized has to be less than 0.05 (RMSEA= 0.029). Goodness of Fit Index and Adjusted Goodness of Fit Index should be greater than 0.9 (GFI=0.945 and AGFI=0,922). Incremental fit indices are used. Normed Fit Index, Tucker-Lewis Indices, and Comparative Fit Indices should have values greater than 0.9 (NFI=0.917, TLI=0,983, CFI=0,986). Finally, parsimonious fit indices such Parsimony Normal Fit Index and Parsimony Goodness Fit Index should have values greater than 0.5 (PNFI=0,734, PGFI=0.662). Moreover, Expected Cross-Validation Index and Asymptotic Information Criterion should be less than values for the saturated and independence Models (ECVI values respectively= 0,829, 1.165, 5.953; AIC values respectively=170.873; 240.000; 1,226.388). Hair (2006) and Unsuchotte (2009) (quoted in Overby and Suvanujasiri 2012) suggested testing some indices as from Structural Equation Modeling.

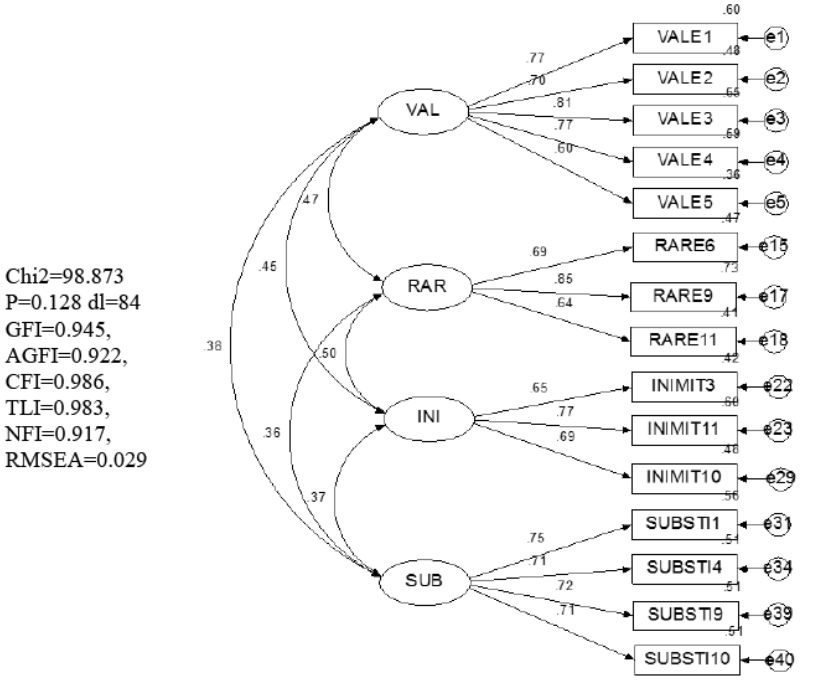

Figure1: Estimation of the measurement model.

Reliability of the Construct

To assess the reliabilities of the four subscales of tacit knowledge, Jöreskog's rho and Cronbach's Alpha were computed for each factor. Acceptable scores for the Jöreskog's rho and Cronbach's Alpha should be higher than 0.70 (Chin 1998, quoted in Demo et al. 2012; Carricano and Poujol 2008).Results are shown in the table below:

Table 2: Reliability of the Construct

Construct	*Jöreskog's rho*	*Cronbach's Alpha*
Value	0.852	0.842
Rarity	0.773	0.761
Inimitability	0.747	0.745
Non-substitutability	0.812	0.814

Construct Validity

"Construct validity is the degree to which a set of measured items actually reflects the theoretical latent construct that those items are supposed to measure" (Hair et al. 2009, quoted in Demo et al. 2012). In this research, the construct validity of the tacit knowledge was examined by evaluating convergent and discriminant validity.

Convergent Validity

Convergent validity is established when the measures of the same construct are correlated (Carricano and Poujol 2008). The Average Variance Extracted (AVE) is a criterion of the convergent validity (see Table 3). Its value should be greater than 0.5.

Table 3: Average Variance Extracted (AVE)

Construct	*Average Variance Extracted (AVE)*
Value	0.538
Rarity	0.536
Inimitability	0.497
Non-substitutability	0.522

Discriminant Validity

As for the discriminant validity, it "indicates the degree to which measures of conceptually distinct constructs differ" (Demo et al. 2012, 409)

In this research, CFA was applied to a selected pair of constructs setting two covariances both with and without, constraint equal to 1. The authors have then calculated the difference between the values of the chi-squares. Statistically significant values of the difference indicate the existence of discriminant validity (Akrout 2010; Demo et al. 2012).For each pair of constructs, a test was conducted, resulting in six tests. Results are shown in Table 4.The authors confirm the discriminant validity.

Table 4: Discriminant Validity Tests

	χ^2	*d.l*	$\Delta\chi^2$	*p*
Val vs RAR				
Without	0.931	19	2.19	0.000
With	3.121	20		
VAL vs INIM				
Without	1.033	19	2.261	0.000
With	3.294	20		
VAL vs SUBS				
Without	1.685	35	1.16	0.000
With	2.845	36		
Rar vs INIM				
Without	2.372	8	3.49	0.000
With	5.862	9		
Rar vs SUBS				
Without	0.922	13	2.59	0.000
With	3.512	14		
INIM vs SUBS				
Without	0.876	13	2.657	0.000
With	3.533	14		

These results show that the subscales are valid and reliable. They have proper psychometric characteristics. Table 5 summarizes the results of the study of the reliability of the four subscales used.

Table 5: Summary of Results for the Validation of Measurement Scales

	Total items before EFA	***Total items after EFA***	***Total of factors retained***	***Total items after CFA***	***Cronbach's Alpha***	***Jöreskog rho***
Value	*11*	*11*	*1*	*5*	*0.842*	*0.852*
Rarity	*11*	*6*	*1*	*3*	*0.761*	*0.773*
Inimitability	*11*	*7*	*1*	*3*	*0.745*	*0.747*
Non-substitutability	*11*	*9*	*1*	*4*	*0.814*	*0.812*

Conclusion

This study focused on the confirmation of Tamzini's (2015) previous findings and the confirmation of the V.R.I.N model of Barney (1991). In fact, the results of this study, conducted in the Tunisian *industry of Information Communication and Technology (ICT)* and proceeded by the adaptation and validation of a set of measurement scales based on an exploratory factor analysis, performed with SPSS 18.0 and confirmatory factor analysis, performed with AMOS 16.0, demonstrate that if tacit knowledge is quadridimensional, its dimensions (value, rarity, inimitability, and non-substitutability) are unidimensional, as argued by Tamzini (2015). Moreover, the authors concluded that tacit knowledge is a strategic resource which has four attributes (value, rarity, inimitability, non-substitutability) and are considered as its constituent dimensions to generate a sustainable competitive advantage and superior performance, as advanced by Barney (1991).

While Tamzini (2015) argues that tacit knowledge value is explained by: Staff with positive commitment to the company's development (VALE 1), expertise regarding development of

products/services (VALE 3) and highly productive staff (VALE 4), we have added two other indicators: technical expertise (VALE 2) and expertise in marketing (VALE 5). That is to say that Tunisian ICT firms which have staff with a positive commitment to the company development, with technical expertise, high productivity, and with expertise in marketing and an expertise regarding development of products/services, would be able to exploit opportunities and/or neutralize threats in its environment (Barney 1991).

The tacit knowledge rarity is explained by the authors based on the following indicators: special expertise regarding customer service (VALE 6), staff educated in giving superior customer service (VALE 9) and staff capable of marketing your products/services well (VALE 11). However, Tamzini (2015) have argued that Tunisian ICT firms, having a staff educated in giving superior customer service (RARE 9), willing to contribute with ideas for new products/services (RARE 10) and being capable of marketing its products/services well (RARE 11), would be able to generate either a higher margin or superior sales volumes starting from a base cost equivalent to that of its competitors (Bowman and Ambrosini 2003).

For the tacit knowledge inimitability and while comparing to Tamzini's (2015) conclusions, we have added another indicator in order to explain it: expertise regarding development of products or services (INIMIT 3). Hence, in Tunisian ICT firms, having a staff that likes to contribute with ideas for new products/services (INIMIT 10), with expertise regarding development of products or services (INIMIT 3) and that is capable of marketing its products/services well (INIMIT 11), would be able to protect its strategic tacit knowledge against imitation attempts.

Finally, to explain the non-substitutability of the tacit knowledge, the authors have suppressed an indicator [staff capable of marketing your products/services well (SUBSTI 11)] and have added two others: staff with a positive commitment to the company's development (VALE 1), highly productive staff (VALE 4). That is to say that Tunisian ICT firms which would have staff with a positive commitment to the company's development (VALE 1), with high productivity (VALE 4), educated in giving superior customer service (SUBSTI 9), and willing to contribute with ideas for new products/services (SUBSTI 10), would be able to possess prohibitively difficult (unsubstitutable) strategic tacit knowledge, which allows it to gain a sustainable competitive advantage and superior performance.

This study confirms that tacit knowledge is a strategic resource from the perspective of the resource-based view (Grant 1996; Kogut 2000; Chaminda et al 2007). It confirms the fact that tacit knowledge has four attributes (value, rarity, inimitability, non-substitutability) as has been advanced by Barney (1986, 1991) and Tamzini (2015). Tamzini (2015) considers these four attributes to be the main dimensions of a strategic resource, which confirm the assumption according to which tacit knowledge conforms to the Barney's (1991) V.R.I.N model and its two fundamental assumptions: (1) valuable and rare (scarce) resources could offer the firm a competitive advantage and (2) these resources which are simultaneously inimitable, and difficult to substitute, could be considered as a source of sustainable competitive advantage and superior performance. For Barney (1991) these resources could be considered as "strategic" in the way that their possession and their effective deployment in products could provide superior performance to the firm.

This study has contributed empirically by giving further support to: (1) the empirical research scarcity, (2) the dominance of the qualitative methods, and (3) the risks for abuse in using proxies to measure tacit knowledge, by providing researchers with an original quantitative method which is built upon Barney's (1991) resource-based view: "*The V.R.I.N model's method*." Hence, this study contributes to the enrichment of the literature related to the operationalization of tacit knowledge.

Moreover, this study contributes by measuring tacit knowledge to confront criticism formulated against the resource-based view, mainly those who consider it "as tautological as it has no empirical criteria (Priem and Butler 2001a) and it lacks a solid empirical basis and a micro

theoretical foundation (Doz 1994). Priem and Butler (2001a) have criticized the assumptions made by Barney (1991) which, according to them, have limitations in terms of strategic management research in that they are descriptive and difficult to use by practitioners" (Tamzini 2015, 142).

Similarly, they argue that the nature of the relationship between resources, competitive advantage, and performance has not been demonstrated, which makes it tautological (Tuan and Yoshi 2010).

In another register of critics formulated against the resource-based view, Montgomery (1996) and Priem and Butler (2001a) argue that the latter only takes into account a minority of resources, those that are more or less easily identifiable and measurable (organizational reputation, organizational capabilities, core competencies, corporate culture, etc.). Whilst some resources such as tacit knowledge that are inherently difficult for practitioners to handle, are excluded from the scope of managerial investigation.

This study offers to managers in general, and to the human resource managers in particular, the opportunity to focus their efforts in developing strategic tacit knowledge which is valuable, rare, and difficult both to imitate and to substitute. This will be done by looking for, targeting, and improving the best set and mix of human resource practices (e.g., training, hiring, rewarding, remuneration). In fact, if one considers the results of this study in terms of the indicators which explain the four attributes (V.R.I.N) of the tacit knowledge of Tunisian ICT firms (see Discussion), their human resource managers could identify the relevant set of the human resource practices which will be able to explain the V.R.I.N attributes of the strategic tacit knowledge and, consequently, the competitiveness of their firms.

The main limitation of this study is the fact that the authors have used a unique scale to measure the four dimensions (V.R.I.N) of strategic tacit knowledge. As Tamzini (2015) has proposed, the authors suggest the development of different subscales for each Tacit knowledge dimensions (V.R.I.N) using either structured interviews or semi-exploratory.

The authors recommend further research in the following areas:

- the human resource practices able to explain the V.R.I.N attributes of strategic tacit knowledge ;
- development of different scales relating to each dimension (V.R.I.N) of tacit knowledge as has been proposed by Tamzini (2015) in order to improve the psychometric quality.

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