Digital Broadband and Open Innovation: First Insights in Information Technologies Sector

Banda ancha digital e Innovación abierta: Primeras Impresiones en el Sector de Tecnologías de la Información

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Abstract

Purpose. The study is aimed to disclose how Digital Broadband (DBD) is affecting the practice of Open Innovation (OIN) in the Information Technologies Sector of Metropolitan Zone of Guadalajara, Mexico (ITSZMG) to achieve a model, for the improvement of relationships.

Methodology. It is a descriptive, exploratory, correlational, cross-sectional, qualitative-quantitative research. As a qualitative study, it is based on a deep literature review after which, we used Delphi Panel with Analytic Hierarchy Process (AHP), determining our main factors: DBD (1 factor/6 variables/43 indicators) and OIN (3 factors/23 variables/161 indicators) in a questionnaire.

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Likert scale, involving 600 ITSZMG specialists at 200 SMEs. The survey was on the period of September-December 2016. As a quantitative study, we applied Confirmatory Factor Analysis using EQS 6.2 software.

- The value of this study, is to propose a generalized model involving the relationship between DBD-OIN for ITSZMG, and identify the underlying variables and their relationships to make suggestions about how to be more innovative, among the firms in the sector.
- Final results: 5/6 DBD variables have significant positive effect on 18/23 OIN variables. This implies opportunities to develop the model.
- Conclusions: We obtained an empirical model capable of identifying its own DBD-OIN relationships in order to be, a more innovative firm in the ITSZMG.

Keywords: Digital Broadband; Open Innovation; Information Technologies; Mexico
Resumen

Objetivo. El estudio está orientado a descubrir cómo la Banda Ancha Digital (DBD) está afectando la práctica de la Innovación Abierta (OIN) en el Sector de las tecnologías de Información de la Zona Metropolitana de Guadalajara, México (ITSZMG), para lograr un modelo que mejore sus relaciones.

Metodología. Es una investigación descriptiva, exploratoria, correlacional, transversal, cualitativa-cuantitativa. Como investigación cualitativa, se basó en una amplia revisión de la literatura tras la cual, se usó el Panel Delphi en conjunto con el Proceso de Análisis Jerárquico (AHP), determinando nuestros principales factores: DBD (1 factor/6 variables/43 indicadores) y OIN (3 factores/ 23 variables/ 161 indicadores), en un cuestionario en escala de Likert, involucrando a 600 especialistas en 200 firmas Pyme de la IITSZMG. El levantamiento de datos fue en el periodo de Septiembre-Diciembre 2016. Como investigación cuantitativa, se aplicó Análisis Factorial Confirmatorio, usando el software EQS 6.2.

El valor del estudio, es el proponer un modelo generalizado involucrando las relaciones entre DBD-OIN para la IITSZMG, e identificar las variables subyacentes y sus relaciones para realizar recomendaciones sobre cómo ser más innovador, entre las firmas en el sector.

Los resultados finales: 5/6 variables del DBD, tuvieron un efecto positivo sobre 18/23 variables de la OIN. Esto significa oportunidades de desarrollo del modelo.

Conclusiones: Obtuvimos un modelo empírico capaz de identificar sus propias relaciones DBD-OIN para lograr ser, una firma de mayor innovación abierta en la IITSZMG.

Palabras Clave: Banda Ancha Digital; Innovación Abierta; Tecnologías de Información; México.
**Introduction**

Jalisco, Mexico, has the most representative cluster of Information Technologies Sector located into the Metropolitan Zone of Guadalajara, Mexico (ITSMZG), headquarters of the Mexico’s ‘Ciudad Creativa Digital’. The ITSMZG has around 200 IT Firms that export 2,000 million USD annually on high value-added service and generate 20,000 jobs in the state (Economista, 2016). At the same time, Mexico has a Digital Broadband (DBD) recent policy, available since 2013, with 2015 data ranking reports (ITU-UNESCO, 2016) for instance: Fixed-Broadband Subscriptions per 100 inhabitants, ranked in the place 52/138 among other issues; all these data are considered a great opportunity to develop the OIN factor. The DBD even increases the promotion of innovations in small and medium enterprises (SMEs) and the productivity with significant savings by reducing the transaction costs. We remind that the SMEs in Mexico are the main source of jobs because they’re representing the 99.8% of all companies in Mexico, which generates 52% of gross domestic product and 72% of jobs in the country.

**Problem, research question and rationale of the study**

We have two remarkable factors, firstly the ITSZMG that is characterized as a sector with advanced OIN practices and secondly the DBD that is considered by the Mexican government as a support and guarantee for its development (Estrategia Digital, 2013). Thus, we determined as a problem, to propose a construct that involves the relationship between the OIN and the DBD, determining and analyzing all the determinant factors related in order to improve all the process of OIN based on DBD to be adapted and applied in the ITSZMG.

So, our research question is posed as: what is the relationship between DBD on OIN in ITSMZG? The rationale of the study is due the ITSMZG interest to know how the main factors of DBD are influencing the OIN process, to identify the weak relationships and to do several suggestions about reinforcement of such relationships proposed, for improvement of the model.

The Specific Research Questions (SRQ) are:

**SRQ1. What are the variables proposed for the general conceptual model?**

**SRQ2. What are the relationships of these variables?**

**SRQ3. What are the most relevant variables of the model?**
Searching the variables of the construct

The subjects under study were all the 600 ITSMZG specialists, including: SME CEOs (120), back office/ front office managers (120), software designers (120), professors (120) and directors of business consultant firms (120) all of them grouped in the cluster.

To achieve the proposal of variables of the construct, we went through a literature review of more than 40 papers about models regarding the OIN and SMEs, selecting the main factors, variables and indicators of each one, and listed in a matrix table per author. See Table 1.

Table 1. Authors and variables related with the OIN Factor

| Number | Author | Variables Identified |
|--------|--------|----------------------|
| 1      | OECD (2003) | (1) LSP; (2) T&M; (3) P&S; (4) COM |
| 3      | Asakawa y Sawada. (2010) | (4) COM |
| 8      | West & Bogers (2014) | |
| 7      | Mejia-Trejo et al. (2013) | |
| 15     | Chatenier et al. (2010) | |
| 1      | OECD (2003) | (5) INC |
| 4      | Allarakha et al. (2010) | |
| 8      | West & Bogers (2014) | (6) KC&A |
| 6      | Goglio-Primard, y Crespin –Mazet (2014) | (7) PKMG |
| 9      | Keup y Gassman (2009) | |
| 10     | Parmented (2010) | |
| 11     | Lichtenthaler (2015) | (8) OIO |
| 12     | Chien-Tzu y Wan Fen (2014) | |
| 13     | Beckman et al. (2004) | |
| 12     | Chien-Tzu y Wan Fen (2014) | |
| 14     | EIRMA (2003) | (9) MKS |
| 2      | OECD (2008c) | |
| 16     | Osterwalder y Pigneur, (2010) | |
| 38     | Saebi & Foss (2013) | |
| 2      | OECD (2008c) | (10) VP |
| 17     | Chesbrough (2003) | |
| 16     | Osterwalder y Pigneur, (2010) | |
| Reference                                                                 | Page |
|--------------------------------------------------------------------------|------|
| [19] Von Hippel (2005)                                                   |      |
| [17] Chesbrough (2003)                                                  |      |
| [20] Van der Borgh et al. (2012)                                        |      |
| [16] Osterwalder y Pigneur, (2010)                                      |      |
| [2] OECD (2008c)                                                        | (11) |
| [21] Rayna y Styriukova (2014);                                         | CRM  |
| [16] Osterwalder y Pigneur, (2010);                                     |      |
| [2] OECD (2008c)                                                        |      |
| [17] Chesbrough (2003)                                                  | (13) |
| [25] Chesbrough y Teece (2002)                                          | RIPR |
| [30] Chesbrough, y Kardon – Crowter, (2006)                             |      |
| [16] Osterwalder y Pigneur, (2010)                                      |      |
| [22] Gassman (2006);                                                    |      |
| [3] Asakawa y Sawada. (2010)                                            |      |
| [16] Osterwalder y Pigneur, (2010)                                      |      |
| [2] OECD (2008c)                                                        |      |
| [23] Enkel et al. (2009)                                                | (15) |
| [24] Schwaag (2006)                                                     | KYA  |
| [25] Chesbrough y Teece (2002)                                          |      |
| [16] Osterwalder y Pigneur, (2010)                                      |      |
| [26] Remneland-Wikhamn y Knights, D. (2012)                             |      |
| [16] Osterwalder y Pigneur, (2010);                                     |      |
| [2] OECD (2008c)                                                        |      |
| [22] Gassman (2006)                                                     | (17) |
| [27] Etzkowitz y Leydesdorff, (1995)                                    | PTS  |
| [28] Tidd (2006)                                                        |      |
| [29] Miller et al. (2016)                                               |      |
| [17] Chesbrough (2003)                                                  |      |
| [40] Hopkins et al. (2011)                                              |      |
| [30] Chesbrough, y Kardon – Crowter, (2006)                             |      |
| [31] Cohen et al. (2002)                                                |      |
| [3] Asakawa y Sawada. (2010)                                            |      |
| [32] Rohrbeck, et al. (2009)                                            |      |
| [39] Yun-Hwa & Kuang-Peng H. (2010)                                    |      |
| [2] OECD (2008c)                                                        |      |

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We proceeded to summarize variables vs authors to prepare the account of academic vision. See Table 2.
Table 2. Variables representing the OIN underlying factor

| ID | Variables | Authors numbered as the Table 1 | TOTAL Frequency |
|----|-----------|---------------------------------|-----------------|
|    |           | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 | |
| 1  | LSP       | X X X X                         | 4               |
| 2  | T&M       | X X X X                         | 4               |
| 3  | P&S       | X X X X                         | 4               |
| 4  | COM       | X X X X X                      | 5               |
| 5  | INC       | X X X                          | 3               |
| 6  | KC&A      | X X X                         | 4               |
| 7  | PKMG      | X X X                         | 3               |
| 8  | OIO       | X X X                          | 4               |
| 9  | MKS       | X X                           | 3               |
| 10 | VP        | X X X                         | 4               |
| 11 | CRM       | X X                           | 3               |
| 12 | CHN       | X                             | 1               |
| 13 | RIPR      | X                             | 2               |
| 14 | KYR       | X X                           | 3               |
| 15 | KYA       | X X X                         | 3               |
| 16 | CST       | X                             | 1               |
| 17 | PTS       | X X                           | 3               |
| 18 | TEC       | X                             | 1               |
| 19 | STR       | X X                           | 2               |
| 20 | NWE       | X                             | 2               |
| 21 | POBM      | X X X                         | 3               |
| 22 | RSK       | X                             | 1               |
| 23 | OIEC      | X X                           | 3               |
| 24 | TIEC      | X X                           | 2               |
| 25 | GOV       | X X                           | 2               |
| 26 | PIEC      | X X X                         | 3               |
Table 2 (cont.). Variables representing the OIN underlying factor

| ID | Variable(s) | Authors numbered as the Table 1 | TOTAL |
|----|-------------|---------------------------------|-------|
|    |             |                                 |       |
| 1  | LSP         |                                 | 4     |
| 2  | T&M         |                                 | 4     |
| 3  | P&S         |                                 | 4     |
| 4  | COM         |                                 | 5     |
| 5  | INC         |                                 | 3     |
| 6  | KC&A        |                                 | 4     |
| 7  | PKMG        |                                 | 3     |
| 8  | OIO         |                                 | 4     |
| 9  | MKS         | X                               | 4     |
| 10 | VP          |                                 | 4     |
| 11 | CRM         |                                 | 3     |
| 12 | CHN         |                                 | 1     |
| 13 | RIPR        | X                               | 4     |
| 14 | KYR         |                                 | 3     |
| 15 | KYA         | X                               | 4     |
| 16 | CST         | X                               | 2     |
| 17 | PTS         | X                               | 6     |
| 18 | TEC         | X                               | 3     |
| 19 | STR         | X                               | 5     |
| 20 | NEW         |                                 | 2     |
| 21 | POBM        |                                 | 3     |
| 22 | RSK         | X                               | 3     |
| 23 | OIEC        | X                               | 7     |
| 24 | TIEC        | X                               | 4     |
| 25 | GOV         |                                 | 2     |
| 26 | PIEC        |                                 | 3     |

After this, we proceeded to the qualitative analysis of this research applying focus group with Delphi Panel and Analytic Hierarchy Process (AHP, Saaty, 1997) to 6 ITSMZG specialists, in the following proportion: (SME CEOs: 1; back office/ front office managers: 1; software designers: ...)
and professors: 3 as an academic vision) focusing on everyone’s attention and experience, in order to ask for some suggestions to get the best grouping of factors and variables and the best names to associate them to the OIN and DBD construct. The results were, for the OIN factor: Knowledge Management (KMG), Open Business Models (OBM), and Innovation Ecosystem (IEC). See Table 3.

Table 3.- Focus Group by Delphi Panel and AHP to determine the main groups of Variables of OIN

| Objective ID | Name of the factor suggested by expert vision for grouping of variables | Variables | Frequency | % | AHP weighing as expert vision (%) | % Difference (Academic Vision-Empirical vision) |
|--------------|-----------------------------------------------------------------|-----------|-----------|---|---------------------------------|-----------------------------------------------|
| 1            | KMG                                                             | LSP       | 4         | 4.26 | 6.9                            | -2.64                                         |
|              |                                                                 | T&M       | 4         | 4.26 | 6.8                            | -2.54                                         |
|              |                                                                 | P&S       | 4         | 4.26 | 5.4                            | -1.14                                         |
|              |                                                                 | COM       | 5         | 5.32 | 5.4                            | -0.08                                         |
| 4            |                                                                 | INC       | 3         | 3.19 | 5                              | -1.81                                         |
| 5            |                                                                 | KC&A      | 4         | 4.26 | 4.9                            | -0.64                                         |
| 6            |                                                                 | PKMG      | 3         | 3.19 | 2.9                            | 0.29                                          |
| 7            |                                                                 | OIO       | 4         | 4.26 | 5.2                            | -0.94                                         |
| 8            |                                                                 | MKS       | 4         | 4.26 | 4.6                            | -0.34                                         |
| 9            |                                                                 | VP        | 4         | 4.26 | 4.7                            | -0.44                                         |
| 10           |                                                                 | CRM       | 3         | 3.19 | 4.6                            | -1.41                                         |
| 11           |                                                                 | CHN       | 1         | 1.06 | 4.5                            | -3.44                                         |
| 12           |                                                                 | RIPR      | 4         | 4.26 | 4.9                            | -0.64                                         |
| 13           |                                                                 | KYR       | 3         | 3.19 | 4.2                            | -1.01                                         |
| 14           |                                                                 | KYA       | 4         | 4.26 | 4.8                            | -0.54                                         |
| 15           |                                                                 | CST       | 2         | 2.13 | 3.9                            | -1.77                                         |
| 16           |                                                                 | PTS       | 6         | 6.38 | 2.1                            | 4.28                                          |
| 17           |                                                                 | TEC       | 3         | 3.19 | 3                              | 0.19                                          |
| 18           |                                                                 | STR       | 5         | 5.32 | 2                              | 3.32                                          |
| 19           |                                                                 | NWE       | 2         | 2.13 | 2.3                            | -0.17                                         |
Finally, we used the same procedure for DBD variables, with results showed as: User (USR), Access (AXS), Network (NET), Regulation (REG), Cost & Benefits (C&B), QoS (Quality of Service). See Table 4.

Table 4.- Panel Delphi and AHP to determine the main group of Variables of DBD

| Objective | DIGITAL BROADBAND (DBD) FACTOR | AHP HEIGHING |
|-----------|--------------------------------|--------------|
| ID | Variable | | |
| 1 | USR. User | 0.2 |
| 2 | AXS. Access | 0.2 |
| 3 | NET. Network | 0.2 |
| 4 | REG. Regulation | 0.15 |
| 5 | C&B. Costs-Benefits | 0.16 |
| 6 | QoS. Quality of service | 0.09 |
| TOTAL | | 1.000 |

Thereby, we proceeded to explain every single factor and variable to determine our general conceptual model of OIN, through the literature review. For practical analysis, we excluded the PKMG, POBM and PIEC dimensions due, these are performance key dimensions of each variable. Hence, we proceeded to explain each of these factors and variables to determine our general conceptual model of OIN and DBD, through deep literature review.

Literature review

The OIN is defined as “a distributed innovation process based on purposively managed knowledge flows across organizational boundaries” (Chesbrough & Bogers, 2014). But, how is affected in the digital era? One of the insights, is the DBD, defined by the OECD (2008a) as: “typically used to denote an Internet connection with download speeds faster than traditional dial-up connections.
and it is a key driver of economic growth and national competitiveness (Kim, et al.,2010). So, our model proposed here consists in:

**Knowledge Management (KMG)**

According the OECD (2003): “*It covers any intentional and systematic process or practice of acquiring, capturing, sharing, and using productive knowledge, wherever it resides, to enhance learning and performance in organizations*”. Hence, we propose a model based on a strong leadership (LSP) of its members (OECD, 2003; Mejía-Trejo et al., 2013) able to establish different mechanisms of communications (COM) to transmit the explicit and tacit knowledge, including training the personnel and mentoring the apprentices (T&M) with policies and strategies (P&S) about rewards and incentives to the personnel (INC) in inbound and outbound knowledge frontiers of the Firm (OECD, 2003; Asakawa et al., 2010; Hughes & Wareham, 2010; West & Bogers 2014). For a best knowledge capture and acquisition (KC&A) (Gassman & Enkel, 2004; OECD 2003; Goglio-Primard, & Crespin –Mazet, 2014; Keup & Gassman, 2009), the incentives to the personnel are recommended (OECD, 2003; Allarakhia et al., 2010).

Therefore, our hypothesis is:

**H1.** The Higher level of DBD, the higher level of KMG in OIN of ITSMZG

**Open Business Model (OBM)**

We consider the Osterwalder & Pigneur (2010) definition of business model: “*A business model describes the rationale of how an organization creates, delivers, and captures value*” So, with the increased adoption of open innovation practices, “open business models” have emerged as a new design theme (Chesbrough, 2007; Chesbrough, 2007). Therefore, we propose an OBM concept associated with KMG necessary to potentiate the OI Orientation (OIO) by the definition of exploring it, as the experimenting with new alternatives and/or exploiting it, as the refining and extending of the existing knowledge (Chien-Tzu & Wan Fen, 2014,) and what kind of driver is using, such as: the purchase of technology, licensing, purchase of technology, etc. (OECD, 2008b).

The market segmentation (MKS) as basis to define the services and products specialized to offer to the customer (Osterwalder & Pigneur, 2010) and it represents the opportunity to analyze,
different applications of the technology besides the current market such as the discovering and developing new markets or for licensing other Firm’s Market (OECD, 2008b; Chesbrough 2003). The value proposition (VP) is the core of any business, so it should be emphasized in different forms, such as: branding, performance, newness, etc. (Osterwalder & Pigneur, 2010; Mejía-Trejo et al., 2013) and make the user a source of innovation to create value, as a tool to capture value (Chesbrough 2003). The customer relationship management (CRM) as a tool, must be applied in different channels (CHN) (own & partners), in all its different forms, such as: personal service, automated-service, self-service, etc. (Osterwalder & Pigneur, 2010; OECD, 2008b) emphasizing the co-creation (Rayna & Styriukova, 2014) in network. The revenues streams (RIPR) represent a great chance, for the organizations based on de intellectual property rights (IPR) protection as: patents, trademarks and copyrights, for commercializing them using patent pools or cross-licensing portfolios, for instance (OECD, 2008b).

   The key resources (KYR) must be recognized (Osterwalder & Pigneur, 2010) involving tangible (buildings, infrastructure, labs, etc) and intangible (data, information, talent personnel, etc.) assets. The Key Activities (KYA) mainly the R&D network, turns out to be more productive based on absorptive capacity features, knowledge and technology (OECD, 2008b). The minimum of the costs (CST), like fixed-cost, variable-cost, economy-scale, economy-scope, etc. (Remneland-Wikhamn & Knights, D. 2012).

   The Partnerships (PTS) represents a solid base to do business, involving the relationship University-Government-Organization-Society (Quadruple Helix) (OECD, 2008b, Miller et al., 2016 ). The technology (TEC), due its capacity to incorporate it in an external or internal way to the organization and aimed to the current or different markets (Chesbrough, 2003).The strategy (STR) applied in different ways: Market-Based Innovation; Crowd-Based Innovation Strategies or Collaborative Innovation; Network-Based Innovation Strategies (Gassmann et al.2010) according different final goals to implement, such as: improvement of revenues, performance, competitive advantage, or even more, ensure the secrecy, etc. (OECD, 2008b). Finally, the new entrepreneurship (NWE) successfully achieved are a good indicator of any OBM, such as the spin-in, spin-out and spin-off in certain period. (Mejía-Trejo, 2017)

   Hence, our hypothesis:

   H2. The higher level of DBD, the higher level of OBM in OIN of ITSIZMGG
Innovation Ecosystem (IEC)

It is considered as: “a network of interconnected organizations, organized around a focal firm or a platform, and incorporating both production and use side participants, and focusing on the development of new value through innovation” (Autio & Thomas, 2014). This IEC in our model is proposed with the next elements to analyze: Types of risk (RSK) such as: cost, the infringement litigation with other companies in a similar and/or different product markets, etc. (OECD, 2008b). The opportunities (OIEC), based on: the potential on how well knowledge flows and the system is connected, a greater sense of urgency for internal groups to act on ideas or technology (OECD, 2008b; Lichtenthaler 2009). The threats (TIEC) such as: the extra costs of managing co-operation with external partners, the lack of control, the potentially opportunistic behavior of partners, (Goglio-Primard, & Crespin –Mazet, 2014), the adverse impact of flexibility, overdependence of partners, etc. (Lichtenthaler 2009). A system of governance (GOV) capable to be elected and recognized, as a key factor for applying the principles of behavioral rules that support and regulate all the transactions by mean of written rules, the process of election of central governance, establishing roles and responsibilities to take decisions, etc.

Our hypothesis:
H3. The higher level of DBD higher level of IEC in OIN of ITSMZG

Digital Broadband (DBD).

One of the insights, is the DBD, defined by the OECD (2008c) as: “typically used to denote an Internet connection with download speeds faster than traditional dial-up connections (at 64 kbit/s)” and it is a key driver of economic growth and national competitiveness (OECD, 2008c; Kim, et al., 2010; Rohrbeck et al. 2009). So, our model proposed here, consists of:

The user (USR), as one of the most important and powerful agent in our conceptual model, because it is an active element involving: surveillance for security/privacy based on protocols and standards, the empowerment of SMEs and users by DBD, the tendency of users with evolving skills to create contents with diversity and new habits in the consumer, (OECD, 2008a; Bianchi et al. 2010) to find out a major communication in your IEC, major communication with the government,
etc. increasing the needs of DBD (Wunsch-Vincent & Vickery (2007); Müller-Seitz.& Reger, 2009; OECD, 2006), taking and planning competitive advantage (Kim et al.2010;OECD, 2008b).

About access (AXS), as the ability to connect the backbone network of the telecom operator by mean to use the last mile (wire an non-wireless) (OECD,2008b; Kim et al. 2010) specially asking about Internet: coverage, flexibility, time, speed, cost-benefits ratio, technologies, type of device (fixed and/or mobile).According the network (NET), as the transmission media characterized by: interoperability, speed, connection, with minimum errors (OECD, 2008b; Kim, 2010). The best practices of regulation (REG) by the government (and associations), such as: the actions balance the interests of suppliers and users, protection of IPR about new contents, the promotion of competition in digital model business (OECD, 2006; Biggs & Kelly, 2006), research & science, education, culture, health, lower prices, etc. providing the greatest benefits for users in different markets, introducing new technologies for access to the net and the universal broadband services (OECD, 2006; Biggs & Kelly, 2006; Sing&Raja (2008). It is a fact about the relation cost per benefits (C&B) increases with regulation and low prices showing in DBD: subscriptions, the network readiness, best offerings of services, etc. (Horrigan & Duggan , 2015; ITU-UNESCO, 2016) with high quality of service standards (QoS) and service level agreements (Kim et al.,2010).

Therefore, our hypothesis:

H4. The higher level of DBD, the higher level of OIN of ITSMZG

Hence, we proposed the general conceptual model (see Scheme 1)
Scheme 1. General Conceptual Model

VARIABLES
- LSP
- T&M
- P&S
- COM
- INC
- KC&A
- OIO
- MKS
- VP
- CRM
- CHN
- RIPR
- KYR
- KYA
- CST
- PTS
- STR
- TEC
- NWE
- RSK
- OIEC
- TIEC
- GOV

FACTORS
- USR
- AXS
- NET
- REG
- C&B
- QoS

Source: Own.
Notes: LSP.-Leadership ; T&M.-Training and Mentoring; P&S.- Policies and Strategies; COM.-Communication ; INC.-Incentives ; KC&A.-Knowledge capture & acquisition; OIO.-Open Innovation Orientation; MKS.-Market Segmentation ; VP.-Value Proposition; CRM.-Customer Relationship; CHN.-Channels of Distribution; RIPC.-Revenue Streams for Intellectual Property Rights; KPR.-Key Resources; KYA.-Key Activities; CST.- Cost ; PTS.-Partnership; TEC.-Technology ; STR.-Strategy; NWE.-New Entrepreneurships. RSK.-Risk; OIEC.-Opportunities of Innovation Ecosystem ; TIEC.-Threats of Innovation Ecosystem; GOV.-Governance; DBD.-Digital Broadband; USR.-User; AXS.-Access. NET.-Network; REG.-Regulation; C&B.-Cost & Benefits; QoS.-Quality of Service

And the Final Questionnaire (see Table 5)

Table 5. Final Questionnaire

| OPEN INNOVATION Factor (OIN) Factor | Knowledge Management (KMG) Factor | Author(s) |
|-------------------------------------|-----------------------------------|-----------|
| Variables                           | Indicator                         |           |
| (1) LSP                             | KM practices were a responsibility of managers and executives | OECD (2003); Asakawa et al. (2010); Hughes & Wareham (2010); West & Bogers (2014); Mejia-Trejo et al. (2013) |
|                                    | KM practices were explicit criteria for assessing worker performance |           |
|                                    | KM practices were a responsibility of non-management workers |           |
|                                    | KM practices were responsibility of the KMO |           |
| (2) T&M                             | Firm encouraged experienced workers to transfer their knowledge to new or less experienced workers |           |
|                                    | Firm provided informal training related to KM |           |
|                                    | Firm encouraged workers to continue their education by reimbursing tuition fees for successfully completed work-related courses |           |
|                                    | Firm offered off-site training to workers in order to keep skills current |           |
|                                    | Firm provided formal training related to KM practices |           |
|                                    | Firm used formal mentoring practices, including apprenticeships |           |
| (3) P&S                             | Policies or programs intended to improve worker retention | OECD 2003 |
|                                    | Values system or culture intended to promote knowledge sharing |           |
|                                    | It’s written KM (internal-external) policy or strategy |           |
| (4) COM                             | Workers is sharing knowledge with written documentation |           |
|                                    | Workers is sharing knowledge by regularly updating all the databases of their projects |           |
|                                    | Workers is sharing knowledge in collaborative work in virtual teams |           |
| (5) INC                             | Knowledge sharing is rewarded with monetary incentives | OECD(2003); Allarakhia et al. (2010) |
|                                    | Knowledge sharing is rewarded with non-monetary incentives | OECD (2008c); Frost (2001) |
|                                    | You have a reward system to support the flow of know how between units external or dual embeddedness |           |
| (6) KC&A                            | You have a source of external knowledge based on: partnerships with external parties (alliances, joint ventures, joint development, acquisition or sale of knowledge (contract, R&D, licensing), corporate venturing (equity investments in university spin offs or in venture capital investment funds) etc.) | Gassman & Enkel (2004); OECD (2003); Keup |
|                                    | You have a source of internal knowledge based on: in house innovations |           |
| Variables | Indicator | Author(s) |
|-----------|-----------|-----------|
| (7) OIO   | 22.- Your OBM is oriented more exploration in innovation | Beckman et al. (2004); Chien-Tzu & Wan Fen (2014) |
|           | 23.- Your OBM is oriented more to exploitation in innovation | |
|           | 24.- Your OBM in open innovation mode is based on: purchase of technology | EIRMA (2003); OECD (2008c) |
|           | 25.- Your OBM in open innovation mode is based on: joint venturing and alliances | |
|           | 26.- Your OBM in open innovation mode is based on: joint development | |
|           | 27.- Your OBM in open innovation mode is based on: contract R&D | |
|           | 28.- Your OBM in open innovation mode is based on: licensing | |
|           | 29.- Your OBM in open innovation mode is based on: collaborations with universities | |
|           | 30.- Your OBM in open innovation mode is based on: equity in university spin off’s | |
|           | 31.- Your OBM in open innovation mode is based on: equity in venture capital investment funds | |
|           | 32.- Your OBM in open innovation mode is based on: purchase of technology | |
| (8) MKS   | 33.- Your OBM determines the real needs of its consumers, classifying them on: mass market | Osterwalder & Pigneur, (2010) |
|           | 34.- Your OBM determines the real needs of its consumers, classifying them on: niche market | |
|           | 35.- Your OBM determines the real needs of its consumers, classifying them on: segmented | |
|           | 36.- Your OBM determines the real needs of its consumers, classifying them on: diversified | |
|           | 37.- Your OBM determines the real needs of its consumers, classifying them on: multisided platforms-markets | |
|           | 38.- Your OBM is only focused and makes surveillance on your current market | OECD (2008c); Chesbrough (2003); Chesbrough (2006) |
|           | 39.- Your OBM only makes surveillance for discovering and developing new markets | |
|           | 40.- Your OBM only makes surveillance for licensing other Firm’s Market | |
| (9) VP    | 41.- Your OBM offers VP through newness | Osterwalder & Pigneur, (2010) |
|           | 42.- Your OBM offers VP through performance | |
|           | 43.- Your OBM offers VP through customization | |
|           | 44.- Your OBM offers VP through design | |
|           | 45.- Your OBM offers VP through brand | |
|           | 46.- Your OBM offers VP through price | |
|           | 47.- Your OBM offers VP through cost reduction | |
|           | 48.- Your OBM offers VP through risk reduction | |
|           | 49.- Your OBM offers VP through accessibility, | |
|           | 50.- Your OBM offers VP through convenience/usability | |
|           | 51.- Your OBM lead the VP based on User Innovation (Create Value) as a tool of Open Innovation (Capture Value) | Von Hippel (2005); Chesbrough (2003); Van der Borgh et al. (2012) |
| (10)CRM | 52.- Your OBM is seeking to deliver requirements to your consumers by: personal assistance  
53.- Your OBM is seeking to deliver requirements to your consumers by: dedicated personal assistance  
54.- Your OBM is seeking to deliver requirements to your consumers by: self service  
55.- Your OBM is seeking to deliver requirements to your consumers by: automated service  
56.- Your OBM is seeking to deliver requirements to your consumers by: communities  
57. Your OBM is seeking to deliver requirements to your consumers by: co-creation  

| (11)CHN | 58.- Your OBM seeking to be very closed to the delivery of the services to your customers by own channels  
59.- Your OBM seeking to be very closed to the delivery of the services to your customers by partner channels  

| (12)RIPR | 60.- Your OBM applies revenue stream of IPR by mean of: financial assets licensing and/or building a Intellectual Capital Portfolio to exploitation  
61.- Your OBM applies revenue stream of IPR by mean of: usage fee  
62.- Your OBM applies revenue stream of IPR by mean of: subscription fees  
63.- Your OBM applies revenue stream of IPR by mean of: lending/renting/leasing  
64.- Your OBM applies revenue stream of IPR by mean of: licensing  
65.- Your OBM applies revenue stream of IPR by mean of: brokerage fee  
66.- Your OBM applies revenue stream of IPR by mean of: advertising  
67.- Your OBM applies revenue stream of IP by mean of: trade secrets  
68.- Your OBM to facilitate the revenue stream makes patent pools  
69.- Your OBM to facilitate the revenue stream makes cross-licensing  

| (13)KYR | 70.- Your OBM use all yours: physical key resources (buildings, labs, sites, network etc.)  
71.- Your OBM use all yours: intellectual key resources (relationships, databases, information systems, etc.)  
72.- Your OBM use all yours: human key resources (its personnel)  
73.- Your OBM use all yours: financial key resources  
74.- Your OBM considers the rapid shift of industry and technology borders, to pose new business models  
75.- Your OBM considers the knowledge as a factor of competitive advantage.  
76.- Your OBM considers that a more interdisciplinary cross border research more partnership for innovation  

| (14)KYA | 77.- Your OBM uses all yours: production key activities  
78.- Your OBM uses all yours: problem solving key activities  
79.- Your OBM uses all yours: platform network key activities  
80.- Your OBM use all yours R&D located under cluster and networks innovation systems with geographical proximity because the spillovers often occur by this.  

Osterwalder & Pigneur, (2010); OECD (2008c)  
Rayna & Styriukova (2014); Osterwalder & Pigneur, (2010)  
Osterwalder & Pigneur, (2010); OECD (2008c)  
OECD (2008c)  
Osterwalder & Pigneur, (2010)  
Gassman (2006); Asakawa et al. (2010)  
OECD (2008c); Bathelt et al. (2004); Enkel et al.(2009); Whelan, et al. (2010)
81.- Your OBM making activities for a great awareness to invest in own R&D because the importance of absorptive capacity

82.- Your OBM making activities for R&D investments in other countries, because is more the available the pool of scientist, clusters and academic institutes, than the near to markets and production facilities

83.- Your OBM attracting technology sourcing mainly, in locating the R&D activities outside the home country, and the geographic dispersion a means of knowledge creation rather than knowledge diffusion

84.- Your OBM attracting the share of codified information and co-ordination of activities among different parties because is easier for innovations that can be pursued independently (autonomous innovation).

85.- Your OBM making activities to have benefits only realized in conjunction with complementary innovations. Your product lifecycle is long. Less attractive

86.- Your OBM minimizes your cost through: cost-driven

87.- Your OBM minimizes your cost through: value-driven

88.- Your OBM minimizes your cost through: fixed costs

89.- Your OBM minimizes your cost through: variable costs,

90.- Your OBM minimizes your cost through: economies of scale

91.- Your OBM minimizes your cost through: economies of scope

92.- Your OBM seeking partners to support: optimization and economy of scale global industries results, powerful standards and dominant designs. (Globalisation)

93.- Your OBM seeking partners to support: reduction of risk and uncertainty, and acquisition of particular resources and activities

94.- Your OBM seeking partners to support: new developments in and around their industry owing is based on an industry characterized by rather short technology life cycles

95.- Your OBM seeking external partners (suppliers, customers, universities, etc.) even in a cross countries, in an innovation ecosystem.

96.- Your OBM seeking the relation amongst: University-Industry-Government (the triple helix) because the collaborative innovation activities stimulates innovation; even more you’re considering the social aspect (quaduple helix) benefits

97.- Your OBM seeking use venturing to find external partners for commercializing innovations that are not used internally (divestment, spin-out, spin-off)

98.- You’re implementing internal technology for your current market

99.- You’re implementing internal technology for the new markets

100.- You’re implementing internal technology for another Firm’s market

101.- You’re implementing internal/external venture handling technology to your current market
| Step | Description |
|------|-------------|
| 102. | You’re implementing internal/external venture handling technology to the new markets |
| 103. | You’re implementing internal/external venture handling technology to the other Firm’s Market |
| 104. | You’re implementing external technology insourcing to your current market |
| 105. | You’re implementing external technology insourcing to the new markets |
| 106. | You’re implementing external technology insourcing to the other Firm’s market |
| 107. | You’re implementing external technology for your current market |
| 108. | You’re implementing external technology for the new markets |
| 109. | You’re implementing external technology for other Firm’s market |
| 110. | You’re on permanent looking for external technology to bring to the company |
| 111. | You’re on permanent surveillance for IPR of other technologies |
| 112. | You’re implementing technology opportunistically |
| 113. | You’re implementing technology in formal and systematic way. |
| 114. | You’re implementing alternatives technologies |
| 115. | You’re implementing technologies with enough incentives |
| 116. | You’re implementing technologies to address an incremental product improvement |
| 117. | You’re implementing more proven technologies than new ones |
| 118. | You’re implementing more proven technologies more than trying to develop entirely new |
| 119. | You’re implementing external technologies because they represent more benefits |
| 120. | You’re implementing internal technologies because they represent more benefits |

| Step | Description |
|------|-------------|
| 121. | Your OBM is designed on Efficiency-Centric Open Business Model; hence you pose Market-Based Innovation Strategies |
| 122. | Your OBM is designed on User-Centric Open Business Model; hence you pose Crowd-Based Innovation Strategies |
| 123. | Your OBM is designed on Collaborative Open Business Model; hence you pose Collaborative Innovation Strategies |
| 124. | Your OBM is designed on Open Platform Business Model; hence you pose Network-Based Innovation Strategies |

| Step | Description |
|------|-------------|
| 125. | Your strategy to do IPR protection registration is due: preventing copy |
| 126. | Your strategy to do IPR protection registration is due: preventing other companies from patenting (e.g. prevent blocking) |
| 127. | Your strategy to do IPR registration is due: prevent lawsuits |
| 128. | Your strategy to do a IPR protection registration is due: to use for negotiations |
| 129. | Your strategy to do a IPR registration is due: the enhance of reputation |
| 130. | Your strategy to do a IPR registration is due: to generate licensing revenue |
| 131. | Your strategy to do IPR protection registration is due: to measure the performance |
| 132. | Your strategy to do IPR protection registration is due: to get competitive advantage |
| 133. | Your strategy to protect your IPR is based entirely by the industrial trade secrecy |

| Step | Description |
|------|-------------|
| 134. | You’ve got spin in as: an investment in technology start-ups (e.g. university spin off’s) |
| 135. | You’ve got spin out as: divesting internally developed technologies relates to the inside-out aspect of open innovation |
| 136. | You’ve got spin off as: the company no longer maintains a stake in the project/company. |

### Innovation Ecosystem (IEC) Factor

*Chesbrough, & Kardon – Crowter, (2006)*

*Saebi & Foss (2013)*; Gassmann et al.2010); Hopkins et al. (2011)

*Cohen et al. (2002); Asakawa et al. (2010)*

*Rohrbeck, et al. (2009.)*

*OECD (2008c)*

*OECD (2008c)*

*OECD (2008c)*
| Variable | Indicator | Author(s) |
|----------|-----------|-----------|
| (20) RSK | You avoid the risk of costs using innovation intermediaries | OECD (2008c); Sieg et al. (2010) |
|          | Your management of the creation of cross-licensing agreements involving the exchange of two or more patent portfolios to allow mutual use of patents by multiple patent holders in order to avoid risk of patent infringement | |
|          | Your innovation network considers the theft of IPR as the most important risk to global open innovation networks even with external partners that may later become competitors | |
|          | Your innovation network involves similar companies that focus on tactical innovation issues where the success depends on their ability to share experience, disclose information and develop trust and transparency | Tidd (2006) |
|          | Your innovation network involves collaboration between companies from a single industry or adjacent industries that co-operate to explore and create new products and processes | |
|          | Your innovation network involves collaboration between companies from different industries that co-operate to explore and create new products and processes, where sharing of information and risk | |
|          | Your innovation network involves heterogeneous companies that focus on tactical innovation issues where the success depends on their ability to share experience, disclose information and develop trust and transparency | Tidd (2006) |
|          | You’ve got open innovation network opportunity from recognizing the potential of innovation depends on how well knowledge flows | OECD (2008c); Bathelt et al. (2004) |
|          | You’ve got open innovation network benefits from recognizing to be a part of an innovation ecosystem that influences your national or regional innovation system | Lundvall, (1992); Nelson (1993) |
|          | You’ve got open innovation network benefits from maximizing the transference of tacit knowledge residing in national innovation system | Bathelt, et al. (2004) |
|          | You’ve got open innovation network benefits from the ability to leverage R&D developed outside | OECD (2008c) |
|          | You’ve got open innovation network benefits from extended reach and capability for new ideas and technologies and create value through the knowledge | Van der Borgh, et al. (2012); Fichter (2009); Lichtenthaler (2009) |
|          | You’ve got open innovation network benefits from: the opportunity to refocus some internal resources on finding, screening and managing implementation; | OECD (2008c); Fichter (2009); Goglio-Primard, & Crespin – Mazet (2014) |
|          | You’ve got open innovation network benefits from: the improved payback on internal R&D through sales or licensing of otherwise unused intellectual property; | |
|          | You’ve got open innovation network benefits from: a greater sense of urgency for internal groups to act on ideas or technology; | |
|          | You’ve got open innovation network benefits from: the ability to conduct strategic experiments with less risk | |
|          | You’ve got open innovation network benefits from: over time, the opportunity to create a more innovative culture | |
You've perceived or experienced open innovation network threats from: the extra costs of managing co-operation with external partners.

You've perceived or experienced open innovation network threats from: the lack of control.

You've perceived or experienced open innovation network threats from: the adverse impact of flexibility.

You've got perceived or experienced open innovation network threats from: the overdependence on external parties.

You've got perceived or experienced open innovation network threats from: the potentially opportunistic behavior of partners.

You recognize the need to have written rules to exchange the information in the innovation ecosystem.

You participate in the election of central governance system.

You participate in the development of operating procedures, that include standards for collecting, storing, and sharing data.

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### DIGITAL BROADBAND (DBD) Factor

| Variables | Indicator | Author(s) |
|-----------|-----------|-----------|
| (1)USR    | As user, you’re on permanent surveillance of security & privacy of protocols & standards that support the DBD of your innovation ecosystem. | OECD (2008a); Bianchi et al. (2010) |
|           | As user, you consider that SMEs tend to be empowered by the DBD enabling them to compete with larger firms in an increasing number of markets and purchase services they previously could not afford. | OECD (2003); OECD (2008a); Wunsch-Vincent & Vickery (2007); Müller-Seitz & Reger (2009) |
|           | As user, you consider that is also more likely to have multiple business links, and multiple links with broadband technology improve labour productivity. Firms with a high broadband equipped labour share have higher productivity. | OECD (2008a) |
|           | As user you’re prone to use open source very often to create web sites, blogs, podcasting, virtual communities, digital arts, apps, etc., facilitating the user-driven innovation to create new content; in other words, they are user-innovators and collectively develop new products (Create Value or democratizing the innovation) | |
|           | As user, you consider that the DBD enables technologies and platforms, products and services, skills and jobs continue to emerge, bringing about new and increasingly user-driven ways of consuming, producing and innovating | OECD (2008a) |
|           | As user, you consider the broadband tend to get user-autonomy, increasing participation diversity. These result in lower entry barriers, distribution costs and user costs and greater diversity of works as digital shelf space is almost limitless. | OECD (2008a) |
|           | As user, you have high skills of your personnel to use DBD | OECD (2006) |
|           | As user, you appreciate that content is creating new user habits and a shift in focus from ‘customer’ to ‘user. Digital technologies enable individuals to create and use their own digital content and create social, cultural, and/or economic value for themselves, their communities, or their country. | |
|           | As user, you’re finding out what is going on in your innovation ecosystem | Kim et al. (2010) |
|           | As user, you’re communicating with internal/external providers and/or partners | |
|   |   |
|---|---|
|11.| As user, you’re finding out all news about its core research |
|12.| As user, you’re sharing your views with others about key issues |
|13.| As user, you’re communicating with government officials about issues |
|14.| As user, you’re improving your own infrastructure and/or the last mile network |
|15.| As user, you realized that Internet connections are increasingly available as an important option for users. |
|16.| About Internet access increases user flexibility in time and location of use, it can be expected to add additional benefits over and above those from fixed location Internet access |
|17.| As access in the last mile you appreciate an excellent coverage, time and speed of digital access technologies (fibre, DSL, WIMAX, LTE, PLC, UMTS HSPA, etc.) of your telecom operator |
|18.| As access, the PC is the most important device used to connect to the network |
|19.| As access, the notebook is the most important device used to connect to the network |
|20.| As access, the smartphone, tablets and mobile are the most important devices used to connect to the network |
|21.| As network, the interoperability of broadband services and applications on various networks and platforms is of increasing importance as users ask for the same products over different platforms. |
|22.| As network speeds, you appreciate a correct average speed (User’s general perception of the average level of Internet communication speed and service delay) |
|23.| As network speeds, you appreciate a correct variation in speed (User’s general perception of the variation of service speed (jitter, zapping delay, etc.)) |
|24.| As a network connection, you appreciate a correct connection availability (Availability of channels and/or ports designated to a specific service request) |
|25.| As a network connection, you appreciate a correct connection stability (How well the connection is maintained without reconfiguring the user’s network environment) |
|26.| You appreciate about best practices of regulation in your country that business and regulatory environments are balanced: the interests of suppliers and users, in areas such as the protection of intellectual property rights and digital rights management without disadvantaging innovative e-business models; |
|27.| You appreciate about best practices of regulation in your country theew content types created by network users also receives increasing government attention, through public sector information for commercial re-use, research & science, education, culture, health |
|28.| You appreciate about best practices of regulation in your country the regulatory frameworks that balance the interests of suppliers and users, in areas such as the protection of intellectual property rights, and digital rights management without disadvantaging innovative e-business models. |
|29.| You appreciate about best practices of regulation in your country, promoting the competition. Multiple play can increase competition, lower prices, and drive growth—but can only begin in markets with low entry barriers. Regulatory frameworks that establish level competitive playing fields will thus provide the greatest benefits for users. |
|30.| You appreciate about best practices of regulation in your country, relying more on market forces. Regulation should move toward allowing innovation and competition on a level playing field, then step back from intervening unless there are market failures. |
|31.| You appreciate about best practices of regulation in your country, allowing new technologies to contribute everything they have to offer. Service providers should be allowed to fully use their networks and reduce costs—increasing business viability and making markets more efficient. |
|32.| You appreciate about best practices of regulation in your country, promoting the competition. Multiple play can increase competition, lower prices, and drive growth—but can only begin in markets with low entry barriers. Regulatory frameworks that establish level competitive playing fields will thus provide the greatest benefits for users. |
| (5)C&B                       | (6)QoS                                      |
|-----------------------------|---------------------------------------------|
| 33.-You appreciate about best practices of regulation in your country a tendency to get universal service based on broadband | 39.-As a user experience, you’ve got a remarkable profitability of your broadband service DBD to create and keep on a solid business and innovation ecosystem. |
| 34.-About the monthly cost of broadband subscription, is too expensive | 40.-As a user experience, you’ve got a remarkable sustainability of your broadband service DBD to create and keep on a solid business and innovation ecosystem. |
| 35.-About the cost, you have other options for internet access out of business less expensive | 41.-As a user experience, you’ve got a remarkable affordability of your broadband service DBD to create and keep on a solid business and innovation ecosystem. |
| 36.-About maintenance costs of the internal infrastructure, is too expensive | 42.-As QoS, service error rate has a correct frequency of disconnections, service failure or degradation due to extensive packet loss (packet loss ratio), number of retransmissions, lack of responses, etc. |
| 37.-About cost, the tablets and smartphones do everything online that you need, less expensive | 43.-As a QoS you have a correct Service Level Agreement for your innovation ecosystem. |
| 38.-About the cost, the service neither is available or speed is unacceptable | |

Source: own

Notes: LSP.-Leadership; T&M.-Training and Mentoring; P&S.- Policies and Strategies; COM.-Communication; INC.-Incentives; KC&A.-Knowledge capture & acquisition; OIO.-Open Innovation Orientation; MKS.-Market Segmentation; VP.-Value Proposition; CRM.-Customer Relationship; CHN.-Channels of Distribution; RIPR.-Revenue Streams for Intellectual Property Rights; KYR.-Key Resources; KYA.-Key Activities; CST.- Cost; PTS.-Partnership; TEC.-Technology; STR.-Strategy; NWE.-New Entrepreneurships; RSK.-Risk; OIEC.-Opportunities of Innovation Ecosystem; TIEC.-Threats of Innovation Ecosystem; GOV.-Governance; DBD.-Digital Broadband; USR.-User; AXS.-Access; NET.-Network; REG.-Regulation; C&B.-Cost & Benefits; QoS.-Quality of Service

Methodology

We started the study involving 600 ITSZMG specialists (including: SME CEOs (120), back office/front office managers (120), software designers (120), professors (120) and directors of business consultant firms (120) at 200 SMEs all of them grouped in the cluster “Ciudad Creativa Digital) during the period of September-December 2016. The data collection was made through the support of a previous agreement (type: triple helix) among the ITSZMG-PROSOFT (Programa para el Desarrollo de la Industria del Software y la Innovación.)-University of Guadalajara. The participants were distributed firstly, in the AHP-Delphi Focus Group, and secondly, in different seminar panels to do the survey of data in four modules: KMG, OBM, IEC and DBD.

We made the quantitative analysis of the research, in order to evaluate the reliability and validity of the measurement scales, using Confirmatory Factor Analysis (CFA) with the maximum likelihood method in EQS 6.2 software (Byrne, 2006). Similarly, the reliability of the proposed measurement scales is evaluated from Cronbach’s alpha coefficient and the composed reliability index (CRI) (Bagozzi & Yi, 1988). All the values from the scale exceeded the recommended level
of 0.7 for Cronbach’s alpha as well as the CRI that provides an evidence of confidence that justifies
the internal reliability of the scales (Hair et al., 2014). Accordingly, other methods of estimation
were used when it is assumed that the normality is present. For this, we followed the suggestions
from Chou, et al. (1991) and Hu, et al. (1992) for the correction of the estimation model used. In
this way, the robust statistics (Satorra & Bentler, 1988) will be used to provide a better evidence
of the statistical adjustments.

The adjustments used, were: the Normalized Adjustment Index (NFI), Not-Normalized
Adjustment Index (NNFI), Comparative Adjustment Index (CFI) and the Root Mean Square of
Error Approximation (RMSEA) (Byrne, 2006; Hair et al., 2014). The NFI, NNFI and CFI values
between 0.80 and 0.89 represent a reasonable adjustment (Segars & Grover, 1993), and a value that
is equal or higher to 0.90 is an evidence of a good fit (Byrne, 2006). The RMSEA values that are
inferior to 0.080 are acceptable (Hair et al., 2014). The CFA results are presented in Table 6

Table 6. Internal Consistence and Convergent Validity Evidence of the Theoretical Model

| Factors | Variables | Factor Loading>0.6 (a) | Robust t-Value | Average Factor Loading | Cronbach’s Alpha>=0.7 (b) | CRI>0.7 (b) | AVE>0.5 (c) |
|---------|-----------|------------------------|----------------|-----------------------|------------------------|-------------|-------------|
| KMG     | LSP       | 0.957***               | 1.000a         | 0.747                 | 0.758                  | 0.887       | 0.824       |
|         | T&M       | 0.682***               | 10.235         |                       |                        |             |             |
|         | P&S       | 0.702**                | 11.367         |                       |                        |             |             |
|         | COM       | 0.892***               | 13.339         |                       |                        |             |             |
|         | INC       | 0.570***               | 10.074         |                       |                        |             |             |
|         | KC&A      | 0.677***               | 11.206         |                       |                        |             |             |
| OIN     | OIO       | 0.602***               | 1.000a         | 0.708                 | 0.720                  | 0.931       | 0.878       |
|         | MKS       | 0.785***               | 9.855          |                       |                        |             |             |
|         | VP        | 0.890***               | 10.398         |                       |                        |             |             |
|         | CRM       | 0.952***               | 9.710          |                       |                        |             |             |
|         | CHN       | 0.892***               | 9.863          |                       |                        |             |             |
|         | RIPR      | 0.590***               | 11.224         |                       |                        |             |             |
|         | KYR       | 0.665***               | 12.345         |                       |                        |             |             |
|         | KYA       | 0.654***               | 9.212          |                       |                        |             |             |
### Table: Correlation Coefficients and Standardized Factor Loadings

|       | CST      | PTS      | STR      | TEC      | NWE      | RSK      | OIEC     | TIEC     | GOV      | USR      | AXS      | NET      | REG      | C&B      | QoS      |
|-------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CST   | 0.602*** |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| PTS   |          | 0.777*** |          |          |          |          |          |          |          |          |          |          |          |          |          |
| STR   |          |          | 0.579*** |          |          |          |          |          |          |          |          |          |          |          |          |
| TEC   |          |          |          | 0.645*** |          |          |          |          |          |          |          |          |          |          |          |
| NWE   |          |          |          |          | 0.567*** |          |          |          |          |          |          |          |          |          |          |
| RSK   |          |          |          |          |          | 0.500*** |          |          |          |          |          |          |          |          |          |
| OIEC  |          |          |          |          |          |          | 0.902*** |          |          |          |          |          |          |          |          |
| TIEC  |          |          |          |          |          |          |          | 0.704*** |          |          |          |          |          |          |          |
| GOV   |          |          |          |          |          |          |          |          | 0.698*** |          |          |          |          |          |          |
| USR   |          |          |          |          |          |          |          |          |          | 0.786*** |          |          |          |          |          |
| AXS   |          |          |          |          |          |          |          |          |          |          | 0.887*** |          |          |          |          |
| NET   |          |          |          |          |          |          |          |          |          |          |          | 0.897*** |          |          |          |
| REG   |          |          |          |          |          |          |          |          |          |          |          |          | 0.602*** |          |          |
| C&B   |          |          |          |          |          |          |          |          |          |          |          |          |          | 0.789*** |          |
| QoS   |          |          |          |          |          |          |          |          |          |          |          |          |          |          | 0.580*** |

**Results:** $(S-BX^2) = 453.672; \text{df} = 112; p < 0.000; NFI = 0.825; NNFI = 0.895; CFI = 0.883; RMSEA = 0.019

**Conclusion:** The relationship among KMG, OBM and IEC factors and variables have good adjustment and a good fit to the data.

**Notes:**
(a). Parameters constrained to the value in the identification process; *** = $p < 0.0$, (Bagozzi & Yi, 1988).
(b).- According Hair et al. (2014)
(c).- Average Variance Extracted (AVE), according (Fornell & Larcker, 1981).

**Conclusion:** These values indicate that there are enough evidence of convergent validity and reliability, which justifies the internal reliability of the scales (Hair et al., 2014).

**Source:** Own

The theoretical model provides a good fit of data $(S-BX^2 = 453.672; \text{df} = 405; p < 0.000; \text{NFI} = 0.825; \text{NNFI} = 0.895; \text{CFI} = 0.883; \text{RMSEA} = 0.019)$. As evidence of the convergent validity, the results from the CFA indicate that all the items of the related factors are significant $(p < 0.001)$, the size of all the standardized factorial loads are superior to 0.60 (Bagozzi & Yi, 1988) and the average of the standardized factorial loads of every factor exceed without any problems the value of 0.70 (Hair et al., 2014). Finally, the average variance extracted (AVE) was calculated for every pair of constructs, which results in an AVE that is superior to the 0.50 (Fornell and Larcker, 1981).

In regard to the evidence of discriminant validity, the measurement is given in the following ways:
1.- With a confidentiality interval of 95%, none of the individual elements of the latent factors from correlation matrix contain the value 1.0 (Anderson & Gerbing, 1988).
2.- The variance extracted between each pair of constructs is superior to its corresponding AVE (Fornell & Larcker, 1981). See Table 7.

Table 7. Discriminant Validity Measuring of the Theoretical Model

| Factors | KMG     | OBM       | IEC     | DBD     |
|---------|---------|-----------|---------|---------|
| KMG     | 0.824   | 0.073     | 0.116   | 0.185   |
| OBM     | 0.130-0.410 | 0.878     | 0.336   | 0.160   |
| IEC     | 0.180-0.500 | 0.440-0.720 | 0.682   | 0.423   |
| DBD     | 0.330-0.530 | 0.340-0.460 | 0.590-0.710 | 0.835   |

Note: The diagonal represents the AVE, whereas above the diagonal part presents the Variance (the correlation squared). Below the diagonal, is shown the correlation estimation of the factors with a confidence interval of 95%.
Source: Own

Based on these criteria, it can be concluded that the different measurements used in this paper show enough evidence of reliability as well as convergent and discriminant validity.

Results

In order to prove the hypotheses, a structural equations modeling with EQS 6.2 software by means of CFA of second order was applied (Byrne, 2006) and the theoretical model was analyzed to prove the structure of the model and to get the results that could allow the contrast of the established hypotheses. The nomological validity of the theoretical model was analyzed by the chi-square performance test in which the theoretical model was compared with the measurement model. The results indicate that there are significant differences of the theoretical model are good in the explanation of the relations observed between the latent constructs (Anderson & Gerbing, 1988). See Table 8.
### Table 8. Structural Equation Modeling Results from the Theoretical Model

| Hypotheses                                                                 | Path   | Standardized path Coefficients | Robust t-Value |
|---------------------------------------------------------------------------|--------|--------------------------------|----------------|
| **H1.** The higher level of DBD, the higher level of KMG in OIN of ITSMZG. The model has significant positive effect. | DBD→KMG | 0.599***                      | 4.229          |
| **H2.** The higher level of DBD, the higher level of OBM in OIN of ITSMZG. The model has significant positive effect. | DBD→OBM | 0.556***                      | 3.987          |
| **H3.** The higher level of DBD, the higher level of IEC in OIN of ITSMZG. The model has significant positive effect. | DBD→IEC | 0.654***                      | 6.417          |
| **H4.** The higher level of DBD, higher level of OIN of ITSMZG              | DBD→OIN | 0.670***                      | 7.087          |

Results: $S^2-\text{BX2}=566.20$; $df = 210$; $p < 0.000$; $\text{NFI} = 0.810$; $\text{NNFI} = 0.820$; $\text{CFI} = 0.899$; $\text{RMSEA} = 0.069$.

Note: *** = $p < 0.01$. Conclusion: The model has significant positive effect among the Factors

Source: Own

### Discussion

Mexico is an emerging country and all the best practices about DBD on OIN by the specialist in ITSMZG, are still with insufficient awareness of their practice or even more, they are still ignored. Hence, the importance of this study to identify the strength and weak relationships to determine a general conceptual model able to predict the best correlations and to improve the model. According the final results showed in Table 4 (only the factor loading > 0.6):

1. There are important issues to consider as a result of the visions comparison: academics vs. experts (See Table 3). For instance, OIEC is cited as 7.45% importance of academics vision vs. 2% of experts’ vision (5.45 as % difference amongst them). Revising the case of PTS with 6.38% importance of academics vision vs. 2.1% importance of experts’ vision (4.28 as % difference amongst them). Other similar case is the variable CHN with 1.06% importance of academic version vs. 4.5% importance of experts’ vision (-3.44 as % difference amongst them). Thus, we obtained the three main variables with higher academic differences and chances to be developed in the final OIN to be more practical to the experts’ vision.

2. The main influences of the DBD on OIN practices in the ITSMZG showed positive effects for KMG factor such as the leadership (LSP), as the most important variable applied because there was a great awareness in the knowledge management practices and the communication of this (COM). This is a result of how workers are on training and mentoring (T&M) programs with
policies and strategies (P&S) to promote the knowledge capture and acquisition (KC&A). However, it’s important to be developed (factor loading <0.6), the promotion of incentive programs (INC) supported in reward systems to reinforce the flow of know how between units.

3. The main influences of the DBD on OIN practices in the ITSMZG showed positive effects for OBM factor in the open innovation orientation (OIN) due it is just starting in some new activities, such as: the purchase of technology, joint venturing and alliances. The market segmentation (MKS), is a real practice of needs detection of their consumers with a permanent surveillance of the current and potential market and the constant revision of the value proposition (VP) to create it through the user as a tool to capture value, reinforcing the customer relationship (CRM) to be close of them through several branches of distribution (CHN) including own channels and/or partner channels. Therefore, exist a permanent awareness to optimize the key activities (KYA) and the key resources (KYR) resulting in a remarkable reduction of costs (CST). The partnership, (PTS) is a key factor of the OBM because the reduction of risk and uncertainty, acquisition of particular resources and activities mainly the quadruple helix relationship. The technology (TEC) is a strategic resource due the importance of how is acquired and implemented, based on a market point of view and the internal/external resources. However, it’s important to be developed (factor loading <0.6), the revenues for intellectual property rights (RIPR) because the lack of clear policies of how to get revenues for commercializing, and the link with strategy (STR) to protect the IPR to get competitive advantage. Finally, is necessary to improve the new entrepreneurships (NWE) indicator, as the ability to get: spin in, spin out and/or spin off businesses.

4. The main influences of the DBD on OIN practices in the ITSMZG showed positive effects for IEC factor in the opportunities of innovation ecosystem (OIEC), where the benefits are from several issues, such as: how well knowledge flows to influence their national or regional innovation system or how to create value through the knowledge, among others. The threats of innovation ecosystem (TIEC) are affecting the perception or experience of the open innovation network threats from: the extra costs of managing co-operation with external partners; the lack of control; the adverse impact of flexibility, etc. The governance (GOV) is well done applied in the exchange of information for the innovation ecosystem, recognizing both, the OIEC and TIEC just in time, for planning the actions in advance.
However, it’s important to be developed (factor loading <0.6), the risk (RSK) as a variable for warning of how avoid the risk of costs using innovation intermediaries; management of the creation of cross-licensing agreements, etc.

5. For DBD, due the firms are on permanent surveillance of security, privacy of protocols and standards, the user (USR) becomes in the main beneficiary. Firms with a high broadband equipped labor share, have higher productivity. The results are lower entry barriers, and lower distribution costs to the final user. Digital technologies enable individuals to create and use their own digital content and create social, cultural, and/or economic value for themselves, their communities, or their country, improving their own infrastructure (the last mile network). The Internet connections are increasing the demand of availability as an important option for users, and therefore, is increasingly the importance of the access (AXS), with user flexibility in time and location of use, depending of speed of digital access technologies (fiber optics, DSL, WIMAX, LTE, PLC, UMTS HSPA, etc.) from their telecom operators to several different devices that are connected to the network, such as: PC, notebook, the smartphone, tablets and/or other mobile devices.

There are two important consequences: one of these, is that network (NET) must be adequate for the interoperability of broadband services and applications in several platforms to provide a correct average speed, speed variation and availability of connection and stability with compliance of all the regulations and policies (REG) and allowing finally, the competition promotion, lower prices, trusting more on market forces. The second one, are the costs & benefits (C&B) for using the DBD for instance, the monthly cost of broadband subscription or maintenance cost of the internal infrastructure.

However it’s important to be developed (factor loading <0.6), the quality of service (QoS), as a remarkable profitability to be improved in sustainability and affordability of their DBD service to create and keep a solid business and innovation ecosystem; service error rate, service failure or degradation due to extensive packet loss, number of retransmissions, lack of responses, etc.

Despite all above mentioned, 5/6 DBD factors have positive effect on 18/23 OIN factors.
Conclusion

Hence, we concluded the following important issues:

1. The results of the study are important and useful for the ITSMZG specialists, because the purpose of the OIN-DBD model is to identify weak relationships, as opportunities to make suggestions on reinforcing such identified relationships, for model improvement.

2. Regarding the Specific Research Question (SRQ1). What are the variables proposed for the general conceptual model? It was applied the literature review and proposed the general conceptual model showed in the Scheme 1 and the final questionnaire (see Table 5), based on AHP and Delphi techniques. This allowed us to obtain an academic and expert vision, with a great opportunity to identify and conciliate the importance of the variables among these visions, into the factors of OIN-DBD model, to do improvements on it.

3. About the Specific Research Question (SRQ2). What are the relationships of these variables? the findings with Confirmatory Factor Analysis (CFA), reveal the most important factors interacting with factors loading >0.6 (see Table 6). This study concluded in a proposition of DBD-OIN general conceptual model with the relationship of USR-AXS-NET-REG-C&B-QoS representing the DBD underlying factor affecting the KMG-OBM-IEC representing the OIN underlying factor.

4. The Specific Research Question (SRQ3). What are the most relevant variables of the model? It is showed in the same Table 6 that leadership (LSP) in knowledge management (KMG), is the most important variable in the empirical model. So, it represents to the ITSMZG an indicator very desirable to maintain, but not the only one into the model.

5. Our hypotheses (H):

   - **H1.** Higher level of DBD higher level of KMG in OIN of ITSMZG.
   - **H2.** Higher level of DBD higher level of OBM in OIN of ITSMZG.
   - **H3.** Higher level of DBD higher level of IEC in OIN of ITSMZG.
   - **H4.** Higher level of DBD higher level of OIN of ITSMZG.

   Showed in Table 8, each one of them with significant positive effect among the factors confirms our general conceptual model.

6. Therefore, our suggestions for ITSMZG to reinforce the weakness relationships revealed in
this current study (low factor loading levels $\leq 0.6$, see Table 6), are showed in the discussion section, such as INC (0.570), RIPR (0.590), STR (0.579), NEW (0.567), RSK (0.500), QoS (0.580).

So, concluding in a practical contribution, we can say that: incentives to the personnel, revenues for intellectual property rights, strategy, new entrepreneurship, risk in the open innovation, they are must be improved, for future studies of the ITSMZG Managers.

For other hand, as a knowledge contribution, we can say that with the use of structural equation modeling we are able to propose a OIN-DBD model, enough to identifying the own underlying relationships to improve such model.

7. The limitations of this study are that customers, suppliers, etc. of the ITSMZG specialists were not questioned. Therefore, other studies could include them, and even more, from other regions of the country.

8. For future studies, we recommend the use of variable reduction techniques, such as exploratory factor analysis such as the Varimax main component method, was suggested as a refinement of the model.
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