# Understanding Information Technology Security Standards Diffusion
## *An Institutional Perspective*

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Abstract: Organizations' dependency on information technology (IT) resources raises concerns over IT confidentiality, integrity, and availability. IT security standards (ITSS) which play a key role in IT security governance, are meant to address those concerns. It is then important for researchers, managers, and policy-makers to understand the reasons for the low levels of ITSS diffusion in organizations. Building on institutional perspective, this study shows that none of the ITSS has yet reached the stage of legitimation that would prompt a widespread diffusion across organizations. Of particular focus is the benchmarking of ISO/IEC 27000 against other more diffused ISO generic standards. Three methodological approaches were used: structured documentation analysis, public secondary data analysis, and informal interviews of experts. This study sensitizes managers and policy-makers to the key role of institutional mechanisms in shaping ITSS diffusion.

# 1 INTRODUCTION

Organizations in modern societies rely heavily on Information Technology (IT) to perform a wide range of activities from basic, and routine operations to highly complex and critical ones. Yet, IT-dependent operations are exposed to IT vulnerabilities and to threats of different kinds. Vulnerabilities refer to weaknesses in one or more parts of an IT system, whereas threats refer to possible dangers directed towards the system (Chang et al. 1999). In recent years, numerous IT-related incidents have been reported by many IT managers: virus incidents (49%), insider abuse of computer systems (44%), and unauthorized access from external sources (29%) (Hu et al. 2011). Current surveys have systematically reported a dramatic increase in cybercrime-related incidents (PwC, 2013; Singleton, 2013).

Organizations try to deal with all these issues through IT security governance which refers to mechanisms, technologies, structures, and policies combined together in order to ensure that the organization's IT assets in all their components such as software and hardware, data and information, and people respond constantly to required levels of availability, confidentiality and integrity (von Solms, 2005). Organizations' dependence on IT makes IT security governance an important issue. By all accounts, IT security standards (ITSS) recognized at industrial, national, or international levels are essential for organizations aiming to effectively implement IT security-related mechanisms, technologies, structures, and policies (Disterer, 2013; Hone and Eloff, 2002).

Given the importance of ITSS, one would expect to find a high rate of ITSS diffusion in organizations. This, however, is not the case: for example, when compared to quality system standards (ISO 9001) and environmental management standards (ISO 14001), certification levels of ITSS (ISO/IEC 27000) are very low. Statistics released by ISO show that while ISO 9001 and ISO 14001 could display respectively 1,101,272 and 285,844 certifications worldwide in 2012, ISO/IEC 27000 was limited to a meager number of 19,577 certifications; that is 1.8% and 6.9% of respectively quality and environmental standards. This means that for 100 firms certified ISO 9000 one finds less than 2 firms with ISO IT security certification, and the ratio is 100 firms certified ISO 14000 for 7 certified ISO 27000. One would argue that the lower diffusion of ISO 27000 is simply due to its being launched later (ISO 9000 was launched

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in 1987, ISO 14000 in 1996, and ISO 27000 in 2005). We will show that this argument does not hold by comparing the respective evolutions of the above-mentioned standards in the first seven years following each ISO launch. More significant are the results of surveys showing that even the level of awareness of ITSS is low. For example, a 2008 survey in the UK showed that only 21% of businesses were aware of ISO 27000 series, and among them, only 30% had the standards fully implemented (Tsohou et al., 2010). The low level of awareness among top managers, including CIO (chief information officers) or CTO (chief technology officers), with regard to "key cornerstones of a strong cyber-security program" is a great concern (PwC, 2013, p. 4).

Considering the utmost importance of IT security in today's business activities, and the important role that ITSS play in ensuring IT security, it is necessary for researchers and practitioners to understand why the diffusion of ITSS in organizations remains low. This leads to our research question: "why the diffusion of IT security standards in organizations is low in spite of their acknowledged importance?"

Justifications one finds in IT security literature to explain this situation are all substantive in nature (Wood and Caldas, 2001); that is based on "rational" reasons for which the implementation of the standard would be deemed impossible or inappropriate. Examples of such substantive reasoning include limitations associated to extant standards (Siponen, 2006a; van Wessel et al., 2011), financial considerations or low incentives (Gillies, 2011). This paper proposes an alternative explanation rooted in institutional theory: based on the analysis of the historical evolution of different ITSS worldwide, we contend that none of them has reached the "stage of legitimation" (Lawrence et al., 2001, p. 627) that would be characterized by a wide diffusion of one or a few of available ITSS across organizations. We analyze in particular statistics of ISO certifications in North America (Canada and USA) in relation to the bulk of registered corporations in the same region. Then, we proceed to a benchmarking of ISO 27000 evolution against the evolution of other ISO generic standards, namely ISO 9000 and ISO 14000. Our results indicate that if nothing is changed with regards to current institutionalization mechanisms, the ITSS diffusion will remain very low. An important implication of this study is to make different stakeholders sensitive to the key role of institutional mechanisms in shaping ITSS diffusion as ITSS are deemed essential to implement sound security measures commensurate with the security challenges of the modern information-dependent economies.

The remainder of this paper is organized as follows: in the theoretical and empirical background of our study, we briefly present the institutional perspective which is the cornerstone of our analysis of the diffusion of ITSS. We then present our methodological approaches; followed by a section devoted to results presentation and analysis which includes the mapping of the broad ITSS historical evolution, the analysis of their institutionalization process, and the benchmarking of ISO 27000 against quality and environment standards. The final two sections will respectively cover the discussion of our results, and our concluding remarks.

# 2 THEORETICAL AND EMPIRICAL BACKGROUND

## 2.1 Institutional Perspective

The diffusion of IT security standards can be analyzed through the lens of institutional theory, according to which external or environmental pressures play a significant role in the diffusion of innovations in organizations. Besides being economic systems driven by the pursuit of economic efficiency and performance, organizations are also social and cultural entities driven by the necessity to meet expectations from their direct and indirect environment, and gain in the process some legitimacy. The notion of legitimacy is central to the institutional theory (Cousins and Robey, 2005): for their survival, organizations need more than production resources (capital, labor), they also need acceptance by informal and formal networks in which they are embedded, and they seek this acceptance (or legitimacy) by adjusting themselves to a number of regulations, norms, practices, values, and beliefs prevalent in those networks.

This tendency of organizations evolving in the same environmental context to adopt the same practices, rules, and norms for the sake of legitimacy is known as institutional isomorphism which can be of coercive, mimetic, or normative nature (DiMaggio and Powell, 1983). The adoption of innovations, such as ITSS, is no exception to this phenomenon. The adoption of an innovation will be qualified as coercive isomorphism whenever it is due to pressures (which can be more or less "gentle") from business partners, relations or regulations; it is referred to as normative isomorphism when it stems from the influence of professional training or communities of key employees or managers; it is labeled as mimetic when it is based on following other organizations seen as models or references, or based on alignment to standardized solutions or common practices generally known as "best practices". These "best practices" can be spread through consultancy or accounting firms. Analyzing the diffusion of the British IT security standard (BS 7799) Backhouse et al. (2006) ruled out coercive forces arguing that there were no laws in the UK making it mandatory for organizations to adopt the standard. However, coercive pressures are more than just laws. They can manifest themselves in forms of "obligatory passage points" which refer to the requirement that an organization "A" complies to a given standard in order to be allowed to do business with an organization "B" (Backhouse et al., 2006, p. 415). As for example, national IT security standards promoted by government agencies have mainly been developed in this spirit for government contractors.

## 2.2 The Concept of Institutional Field

In institutional theory, isomorphic mechanisms operate between organizations belonging to an organizational field, or institutional field (DiMaggio and Powell, 1983; Lawrence et al., 2001), that is a network of organizations that form a recognized area of institutional life due to their area of expertise or activity, or relationships they may have (suppliers, customers, regulatory agencies, competitors, etc.). The study of the diffusion of an innovation with regards to the institutional field allows for the inclusion of all relevant actors or stakeholders in the analysis. Therefore, in the context of ITSS diffusion, it is important to consider the relevant institutional field.

Working from the statistics provided by ISO, previous studies generally analyze the evolution rate of certifications from one year to the next; they point out the increasing pace of ISO 27000, and conclude to its strong diffusion (Disterer, 2013; Tsohou et al., 2010). The numbers of certifications of year n are compared to the number of certifications of year n-1, without any reference to the bulk of organizations that are targeted. Such analysis does not take into account the institutional field and therefore leads to a somewhat misleading conclusion: the high rate of increase observed year after year masks the fact that the ISO 27000 certification remains a marginal phenomenon among potential adopting organizations, even after a period of seven years. The institutionalization of an innovation or practice can only be conceived relative to the field of its potential application, and in the case of generic standards like ITSS, one can assume that all organizations, regardless of their sector, are potential targets. This assumption has been explicitly or implicitly made for other ISO generic standards, ISO 9000 and ISO 14000 (Franceschini et al., 2006; Francceschini et al., 2004; Marimon et al., 2010).

## 2.3 Institutionalization Process and Mechanisms

The institutionalization of an innovation generally follows a process in four main stages labeled innovation, diffusion, legitimation, and deinstitutionalization (Lawrence et al., 2001). The innovation phase refers to the early stage when a new practice or technology emerges and is adopted by few organizations. A parallel can be made between the innovation phase and the pre-institutionalization and theorization stages of institutional change according to Greenwood et al. (2002). The diffusion phase refers to the period when the innovation gains momentum within a field and is extensively adopted by organizations. With the legitimation phase, the innovation reaches the point of saturation and is widely considered as a taken-for-granted practice in organizations (Enrione et al., 2006). Finally, the deinstitutionalization phase is when the innovation loses its legitimacy due to "precipitating jolts" in form of social, technological, or regulatory changes (Greenwood et al., 2002, p. 60).

Analyzing temporal patterns of institutionalization, Lawrence et al. (2001) contend that the pace and stability of any institution hinges on the institutionalization process supporting mechanisms used. The main concepts defined by these authors, as well as the institutionalization mechanisms with their respective temporal effects are presented in Table 1.

Combining the mode of power (episodic vs systemic) exercised by the institutional agent and the relationship of power this agent assumes with regard to targeted actors (object vs subject), Lawrence et al. (2001) offer a much more granular conceptualization as opposed to the general conceptualization proposed by DiMaggio and Powell (1983). Lawrence et al. (2001) identify four mechanisms of institutionalization: influence, force, discipline, and domination. With influence-based mechanisms, the institutionalization process is slow and the resulting institutions less stable; a force-based institutionalization is very fast but less stable; a discipline-based institutionalization is characterized by a slow pace and a high stability, while a fast pace and a high stability are related to a domination-based institutionalization. The authors also explore two combinations of mechanisms: the combination of influence and discipline-based mechanisms results in a medium pace and a high stability institutionalization, while the combination of force and domination-based mechanisms yields a very fast pace and a high stability institutionalization.

## 3 METHOD

Three main methods were used for this research, that is structured documentation analysis, public secondary data analysis (statistics), and informal exchanges (e-mails and discussions). The combination of these three methods was necessary to identify the pace of ITSS institutionalization process and to make sense of the actual state of institutionalization.

For mapping the ITSS historical evolution, we analyzed the relevant literature with the aim of identifying instances of institutionalization (Lawrence et al., 2001). This historical approach was necessary as “it is impossible to understand an institution adequately without an understanding of the historical process in which it was produced” (Selznick et al., 1967: in Scott, 1987). Documentation analysis has been previously and successfully used in studies applying institutional theory (Cousins and Robey, 2005; Enrione et al., 2006).

To identify the relevant literature, we used a structured approach for literature review proposed by Webster and Watson (2002). We performed a topic-based search using two major journal databases, the ABI/INFORM Global (ProQuest) and Information Science & Technology Abstracts (ISTA). We applied a cross-combination of search terms. Each of the terms “information security”, “information technology security”, “IT security”, “information system security”, and “IS security” was combined with each of the terms “standard”, “certification” or “certificate”. The search aim was to determine the presence of combined terms in peer-reviewed article titles and abstracts. The original search yielded 84, and 61 articles respectively for ABI/INFORM and ISTA.

Table 1: Concepts and Mechanisms of Institu-tionalization with Associated Temporal Effects (Elaborated from Lawrence et al. 2001).

| *Dimension* | *Type* | *Definition* | |
|---|---|---|---|
| Mode of power | Episodic | Relatively discrete, strategic acts of mobilization initiated by serf-interested actors | |
| | Systemic | Forms of power that work through routine, or through ongoing practices of organizations (e.g. socialization, accreditations, technological systems, insurance and tax regimes) | |
| Relationship to target | Subject | Target of power is assumed to be capable of agency (ability to choose) | |
| | Object | The power does not require choice on the part of its target (actor incapable of choice, or whose choice is irrelevant to the exercise of power) | |
| Temporal dimensions of institutionalization | Pace | Length of time taken for an innovation to become diffused throughout an organizational field | |
| | Stability | Length of time over which an institution remains highly diffused and legitimated | |
| Mechanisms of institutionalization | *Mechanism* | *Combination* | *Result (Pace, Stability)* |
| | Influence | Episodic X Subject | P-, S- |
| | Discipline | Systemic X Subject | P-, S++ |
| | Force | Episodic X Object | P+++, S- |
| | Domination | Systemic X Object | P++, S++ |
| | Combined mechanisms | Influence + Discipline | P+, S++ |
| | | Force + Domination | P+++, S++ |
| Legend. P: Pace; S: Stability; -: Low or Slow; +: Medium; ++: High or Fast; +++: Very Fast | | | |

Based on titles and abstracts analysis, we eliminated duplicates and irrelevant articles, and then conducted a backward search in the citations of already identified articles. At the end of this process we had 17 articles from which we were able to map the ITSS evolution. This analysis was completed by information gathered from documents available through the websites of major international bodies related to IT security standards such as ISO and Information Security Forum (ISF).

The collected documents were read, re-read, and cross-checked. After several iterations, we were able to develop a deep understanding of the historical and spatial background of the ITSS evolution in organizations.

We also analyzed public statistics on ISO generic standards. ISO statistics have been widely used in multiple scholar researches, and are deemed reliable (Marimon et al., 2010). We compared the certification statistics of ISO/IEC 27000 with those of other generic standards (ISO 9000 and ISO 14000) worldwide and in North America (Canada + USA), in order to highlight the relatively slow institutionalization of the security standard. We also compared ISO certification statistics in North America with statistics on registered enterprises from Statistics Canada and the Census Bureau of Statistics of U.S. Businesses (SUSB).

The benchmarking of ISO/IEC 27000 against ISO 9000 and ISO 14000 makes sense for at least three reasons. First of all, the three standards are cross-industrial (generic) in nature: they are referred to as meta-standards (Heras-Saizarbitoria and Boiral, 2013) that can be adopted by organizations regardless of their sector of activity. The second reason is that they all benefit from the international recognition endowed by the brand ISO. The third reason is that while ISO 27000 is relatively recent and its adoption in organizations poorly researched, the adoption of ISO 9000 and to some extent ISO 14000 have been extensively researched and thus offer a solid basis for benchmarking.

Throughout the research process, we maintained informal contacts (through e-mails, by phone and with in person discussions), with three main sources: 4 representatives of certifications bodies in North America (Canada + USA), 2 representatives of statistics agencies (1 in Canada, and 1 in USA), and 2 IT security professionals working for 2 different Canadian manufacturing firms. Informal conversations or interviews have proven to be valuable in complement with other methods (Sarker and Lee, 2002); in our study, they helped make sense of the diffusion patterns found using statistics and documentation analysis.

# 4 RESULTS

## 4.1 Historical Evolution of ITSS

As stated earlier, based on a literature review, we have identified multiple information or ITSS and how they have evolved. Figure 1 presents the ITSS by region of origin, the time of their initial development, their evolution and links with other standards.

The first standard, the Trusted Computer Security Evaluation Criteria (TCSEC), also known as "Orange Book", appeared in 1983 promoted by the US department of defence (von Solms, 1999). A few years later, in 1989, the UK Department of Trade and Industry (UK DTI) published the "User's Code of Practice for Information Security" (Gillies, 2011).

In 1992, the Organization for Economic Co-operation and Development (OECD) published its Guidelines for the Security of Information Systems (Orlowski, 1997). As a means of implementing these OECD guidelines (Ibid), the UK DTI, in 1993, published a "Code of Practice for Security Management" (BS PD 003) which eventually evolved, in 1995, into BS 7799 (Backhouse et al., 2006; von Solms, 1999), considered as the first de jure standard (Smith et al., 2010), and widely spread in the UK, New-Zealand, South-Africa, and Australia (Siponen and Willison, 2009).

In 1996, in a joint effort, ISO and the International Electro-technical Commission (IEC) transformed the BS 7799 into an international standard, the Guidelines for the Management of IT Security - GMITS (ISO/IEC 17799) (Backhouse et al, 2006; Siponen and Willison, 2009) which will become, in 2005, ISO/IEC 27000 (Gillies, 2011).

Meanwhile, in response to the American standards (Abu-Musa, 2002), the European Commission (EC) and the Canadian government issued their own standards, respectively in 1990 and 1993: the Information Technology Security Evaluation Criteria (ITSEC), also known as "White Book" (von Solms, 1999) for the EC, and the Canadian Trusted Computer Product Evaluation Criteria (CTCPEC).

The SSE-CMM (System Security Engineering - Capability Maturity Model), well known in North America, was developed in 1993 under the sponsorship of the US National Security Agency (NSA) in tandem with the International Systems Security Engineering Association (ISSEA) (Siponen and Willison, 2009).

The IT Baseline Protection Manuel is another well known standard. It was first developed in 1996 (von Solms, 1997) by the *German Bundesamt für Sicherheit in der Informationstechnik* (BSI) [German federal agency for security in information technology] and it is, in its 2000 version, a federal

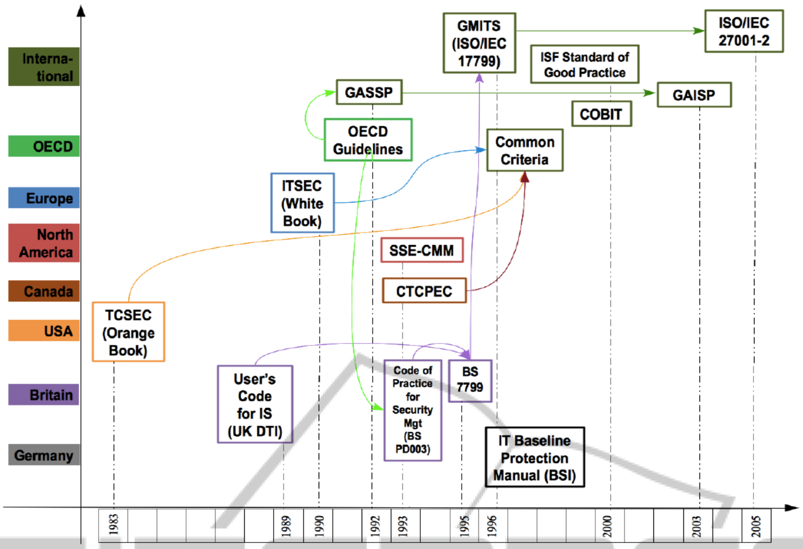


Figure 1: IT Security Standards - Origin, Links, and Evolution.

agency for security in information technology] and it is, in its 2000 version, a nationally recognized standard in Europe (Brooks et al, 2002; Hone and Eloff, 2002).

In 1996, the Common Criteria emerged when three previous standards, the American TCSEC, the European ITSEC, and the Canadian CTCPEC were combined (Whitmore, 2001). The Common Criteria is also recognized as ISO/IEC 15408 (Caceres et al., 2010; Tsohou et al., 2010).

The Generally Accepted Systems Security Principles (GASSP-1992, GASSP-1999), later known as Generally Accepted Information Security Principles (GAISP-2003) (Siponen, 2006a; Siponen, 2006b) is another international standard. Its development was based on OECD principles (Poore, 1999; Siponen and Willison, 2009), and was supported by US Government and the International Information Security Foundation in conjunction with several organizations around the World (Hone and Eloff, 2002; Siponen, 2006b).

There are two other international standards published in 2000 (Hone and Eloff, 2002): the ISF's Standard of Good Practice by the Information Security Forum in 2000, and the Control Objectives for IT and Related Technology (COBIT) developed by the Information Systems Audit and Control Association (ISACA).

## 4.2 Analysis of the General Institutionalization Process of ITSS

From the analysis of the broad IT security standards (ITSS) evolution presented earlier, one can draw some conclusions with regards to the timeline of their development. Three main periods can be clearly identified and labeled:

- The genesis phase or initial development phase (1980-1990): it is in this decade that the first major standards were developed, when integrated IT security frameworks instead of mere checklists were proposed (Siponen, 2006b).
- The proliferation phase (1990-1995): during this relatively short period, other standards appeared and the first major efforts to go beyond the national boundaries took place.
- The internationalization phase (1995-2005): this period is characterized by more effort either to combine national and regional standards into more international standards, or to propose others by international groups.

Statistics from ISO can help us illustrate the stage of the institutionalization process of ITSS. We used ISO/IEC 27000 (which we will refer to from now on as ISO 27000) due to its international status and to the availability of data. We compare statistics on ISO 27000 certifications in North America with statistics on registered corporations which are theoretically potential adopters of the standards.

ISO statistics show that in 2010, Canada and the USA counted respectively 26 and 247 ISO 27000 certifications. Considering that registered enterprises the same year were respectively 2,428,270 and 8,162,808 (from the statistics agencies of both countries), one notes that the diffusion rate of the standard in North America is insignificant (respectively 0.001% and 0.004%). Considering that the low level of ISO 27000 diffusion is largely echoed in prior studies for different ITSS (Gillies, 2011; Tejay and Shoraka, 2011, van Wessel et al., 2011), one would assume that ITSS have not yet reached the diffusion phase on the institutionalization curve (cf. Figure 2). All the above-mentioned periods of ITSS evolution (genesis, proliferation, internationalization) can be considered as different steps of the innovation phase of the traditional institutionalization curve. It is worth noting that sometimes the institutionalization process does not go past the innovation phase. This was the case for example with the "c:cure certification scheme against BS7799 Part 2", an initiative launched in April 1998 in UK and discontinued in 2000 due to low adoption rate (Backhouse et al., 2006, p. 423).

Another conclusion from the analysis of the evolution of ITSS is that, although the internationalization of standards seems to have been a major trend for the last years (no more exclusively national standards have been developed in recent years), many international standards coexist: the internationalization process does not seem to lead to unification of standards, though we do not assume that a unique international ITSS would be preferable, but the question deserves analysis. As political actions, power games, and groups interests play a much more influential role than economic or rational reasons in the process of acquiring an international status (Backhouse et al., 2006), the validity or the legitimacy of maintaining multiple international standards may be questioned with regards to economic or security effectiveness. When viewed from an institutional theory perspective, it is clear that the coexistence of multiple standards indicates that none has yet clearly established its legitimacy over others.

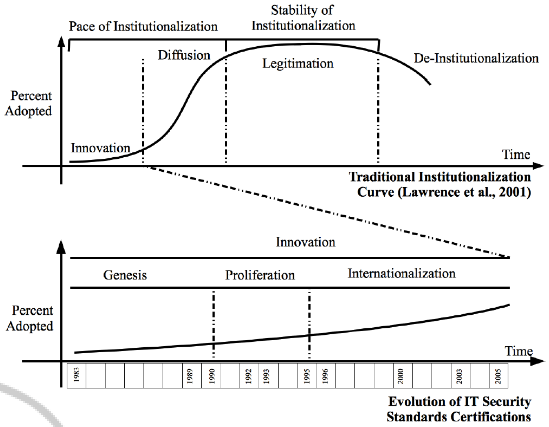
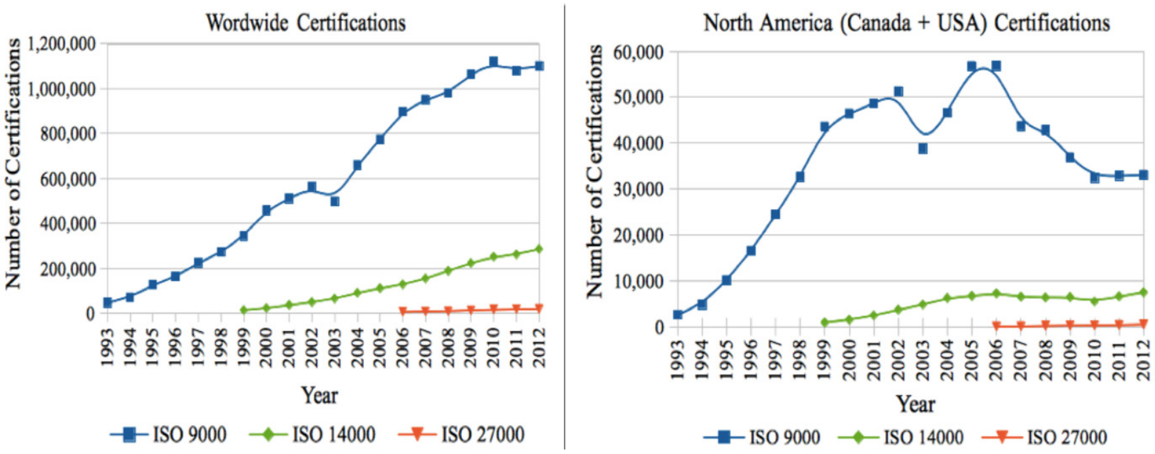


Figure 2: Comparing the Evolution of IT Security Standards Certifications Against the Traditional Institutionalization Curve.

In terms of expectations for the mid- and long-term future of ITSS in general, and for ISO 27000 in particular, we note that as ISO 27000 has been launched years after other generic standards, namely quality (ISO 9000) and environment (ISO 14000) were launched and from which certification statistics are available for much more longer periods, insights from the latter can probably help us understand the former's evolution thus far, and eventually predict its future evolution. As well, there are more scholar studies on ISO 9000 and ISO 14000 than on ISO 27000 (Fomin et al., 2008).

### 4.3 ITSS Diffusion: Benchmarking of ISO Security Standard against ISO Quality and Environment Standards

Based on statistics from ISO, Figure 3 presents the

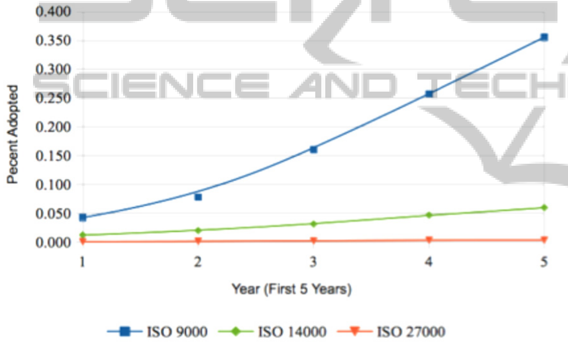


Source: Adapted from ISO Survey 2012.

Figure 3: Evolution of ISO Generic Standards Certifications.

evolution of certifications for the three standards worldwide and in North America. The debuts of ISO 27000 and its evolution rate appear to be more modest compared to ISO 14000, and more so when compared to ISO 9000.

Taking into consideration the institutional field as referred to earlier, we present a portrait of the magnitude in the diffusion of certifications among companies that are potential targets of ISO generic standards. Figure 4 presents the percentage of enterprises certified in North America for each generic standard and for the first 5 years for which ISO statistics are available. The first 5 years statistics for each standard were chosen to take into account the differences of temporal horizon from one standard to another. The first 5 years are respectively and inclusively from 1993 to 1997 (ISO 9000), from 1999 to 2003 (ISO 14000), and from 2006 to 2010 (ISO 27000).



Source: Elaboration of the authors, based on ISO survey 2012 and Enterprises Census from Statistics Canada and The Census Bureau of Statistics of U.S. Businesses (SUSB).

Figure 4: Percentage of Certificates Compared to Registered Corporations in Canada and USA.

From figure 4 we can conclude that:

1). the diffusion of all the three generic standards was low compared to the bulk of enterprises in North America: after the first 5 years the rates of diffusion are 0.36%, 0.06%, and 0.003% respectively for ISO 9000, ISO 14000, and ISO 27000.

2). the IT security standard lags behind the environment standard and far behind the quality standard in terms of diffusion rate within organizations in North America.

However, the above figures should be interpreted with caution. Although ISO generic standards are aimed at organizations of all sectors and all sizes, one would argue that it would be an exaggeration to assume that all registered enterprises are necessarily potential adopters. Indeed, it has been empirically demonstrated for example that the likelihood of ISO 9000 and ISO 14000 adoption increases with the size of organizations, and that the early adopters are mainly large firms (Bodas Freitas and Iizuka, 2012; Pekovic, 2010). As for ISO 27000, its suitability for SMEs has been questioned (Barlette et al., 2008). However, SMEs cannot be ruled out completely when it comes to standards adoption: in its efforts to attract SMEs, ISO published certification guides specifically targeting SMEs for all its generic standards. Considering that the likelihood of ISO certification is low for very small firms which generally are under resources constraints (financial and human) that put them at a disadvantage when it comes to adopting and implementing standards (Pekovic, 2010), it would make sense to analyze ISO standards diffusion taking into account the size of organizations. Unfortunately, such an analysis could not be performed as ISO certification statistics do not provide a breakdown by organization size.

It can also be argued that the differences between the evolution statistics of the three generic standards can be explained by the cumulative effects caused by the lag time between their launch year and the first year for which statistics are available. Indeed, the launch years and the first years of available statistics are respectively 1987 and 1993 for ISO 9000 (6-year lag), 1996 and 1999 for ISO 14000 (3-year lag), 2005 and 2006 for ISO 27000 (1-year lag). So, for ISO 9000, ISO 14000, and ISO 27000 statistics are available from respectively the 7th, 4th, and 2nd years. While it would not be fair to compare available statistics matching the years, given differences of time horizon, one can compare the three standards if, one counts at least 7 years beginning at each launch time (and not at the first year of statistics availability): in Figure 5 we see that ISO 14000 had actually known the fastest growth both worldwide and in North America, while ISO 27000 registered the slowest growth.

The faster growth of ISO 14000 compared to ISO 9000 in their first years of adoption has been attributed to factors related to the genesis of the two standards, but the most important factor advanced is that ISO 9000 success paved the way for ISO 14000 (Marimon, et al., 2011). One would then assume that the diffusion of ISO 27000 would be facilitated by both ISO 9000 and ISO 14000 series previous implementations. The data contradict this assumption: Figure 5 shows that initial growth for ISO 27000 during the 7 first years was lower than the initial growths for the two other generic standards, both worldwide and in North America. This can be explained in two main ways.

The first explanation can be found in statistics. From statistics depicted in Figure 3, we can see that

ISO 27000 was launched at the moment when the other generic standards were about to reach their saturation level (worldwide) or were beginning to decline (North America); the enthusiasm they had originally attracted was beginning to fade, and the brand new ISO series could not but suffer from such a situation. The “de-institutionalization” of standards that could be more or less associated with ISO 27000 is likely to negatively affect the later’s diffusion across organizations.

The second explanation, rooted in institutional theory as it refers to coercive isomorphism, is probably the most significant. We illustrate it by the following quote from one of our respondents, vice-president of one of the certification bodies in North America. When asked how he can explain the differences between the statistics of certifications between the generic standards, he responded:

> “I think the reason is demand by the customers of the certified organizations. Many business to business purchasers were asking their suppliers to be certified in ISO 9001 in the belief it would make them more reliable suppliers. There was less such demand with regard to ISO 14001. I am not aware of any significant B2B demand for ISO 27001”.

## 5 DISCUSSION

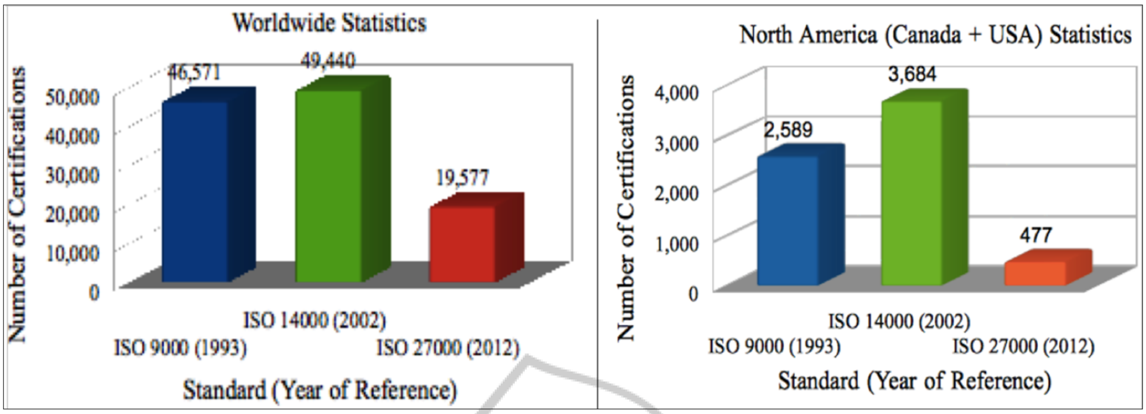
In accordance with the institutional theory, our study contends that the low rate of ITSS diffusion across organizations can be explained with reference to the traditional institutionalization curve of innovations (Lawrence et al., 2001). None of the available international ITSS has yet reached the legitimation phase of institutionalization whereby it would be recognized as a largely agreed upon reference for which most organizations would seek certification. It seems that the bandwagon phenomenon (Abrahamson and Rosenkopf, 1993) - that is the diffusion of an innovation, regardless of its intrinsic merits in terms of efficiency or returns, just because the pressure to adopt it accumulates with the rising number of organizations that have already adopted it - does not yet apply for any of the available IT security standards in general, and ISO 27000 in particular.

We further contend that institutional theory offers an appropriate theoretical framework to analyze ITSS adoption by individual organizations. The highly dynamic nature of IT infrastructure and software industry entails a high level of ambiguity in the assessment of ITSS efficiency or returns, and therefore a certain degree of uncertainty for adopting organizations. Yet, ambiguity surrounding an innovation influences the bandwagon effect (Abrahamson and Rosenkopf, 1993): greater ambiguity leads organizations to found their adoption decision on social considerations as opposed to economic efficiency. In case of uncertainty, organizations tend to succumb to mimetic isomorphic pressures by aligning themselves to standardized solutions or best practices DiMaggio and Powell, 1983). With this in mind, the low levels of ITSS certifications can be interpreted as a reflection of the absence of one or a few standard(s) whose adoption is generally accepted as “best practice” to initiate the cycle of mimetic isomorphism.

Alternatively, one would assume that we are still in the early stages of ITSS diffusion in which organizations (early adopters) are reluctant to adopt the standards considering that the opaqueness about their potential returns is unlikely to be compensated by the magnitude of expected returns (Abrahamson and Rosenkopf, 1993). These two explanations are complementary and in line with institutional theory according to which early adopters of an innovation found their decision on technical analysis while later adopters are mainly swayed by legitimacy pressures (Lawrence et al., 2001).

Any institutional agent promoting an innovation would like to see it diffused and legitimated at a fast pace. He/she would also like to see it remaining legitimate for a long period (stability). The discipline-based mechanisms such as normalization and examination on which certification bodies rely for the diffusion of their IT security standards are clearly not good enough for such a double purpose. They are good for ensuring high stability, but stability concerns come in only when an innovation reaches the legitimation phase: as the pace of institutionalization process with discipline-based mechanisms is slow, the risks that the innovation will never reach the legitimation phase are high. The results of our analysis through the lens of institutional theory show that the future of ITSS in general, and ISO 27000 in particular, does not bode well.

Force-based mechanisms would not either meet the double requirement of fast pace and high stability: they would ensure a fast pace of the institutionalization process of ITSS, and fail to guarantee its high stability. The fast growth of ISO 14000 as reported in the precedent section can be explained by force-based mechanisms of institutionalization such as environmental laws. Such mechanisms need to be regularly activated



Source: Adapted from ISO Survey 2012.

Figure 5: ISO Certifications Numbers 7 Years after the Initial Launch.

(law enforcement) to maintain the commitment of organizations (institutionalization stability). The combined mechanisms (influence and discipline-based mechanisms, and force and domination-mechanisms) described by Lawrence et al. (2001) seem to be the most appropriate for institutional agents promoting the adoption of ITSS.

## 6 IMPLICATIONS AND CONCLUSION

The literature review on ITSS shows discrepancies between theory and practice. A consensus emerges from both scholarly and professional publications that ITSS are important and their implementation necessary to help organizations deal with IT security challenges in the information age. One would then expect high levels of ITSS adoption in modern organizations whose dependency on IT in almost all their activities is tremendous. In reality, however, few organizations have adopted the ITSS available. As a result, many organizations are ill-prepared to meet IT security challenges. We have shown that institutional theory can be mobilized to understand and explain this phenomenon and to devise strategies that will not only prompt the diffusion process (diffusion pace) of ITSS, but also ensure their being embedded in routines and practices of organizations for longer periods (stability).

From a theoretical point of view, this study contributes to the theoretical foundation of research in managerial IS/IT security, a research field that has been thus far largely atheoretical (Björk, 2004). From a practical point of view, considering the diffusion of ITSS through the lens of institutional theory may help any international, national, or industrial entities engaged in or interested by promoting IT security practices in organizations to take appropriate measures. For instance, they would consider adopting institutionalization mechanisms that accelerate the diffusion pace of ITSS and ensure a lasting commitment to those standards.

In line with institutional theory, we have arrived at the conclusion that none of the available ITSS has yet reached the legitimation phase that would make it a taken-for-granted reference for any organization seeking to implement sound IT security practices. Arising from this result, an interesting research avenue would be to explore how does an organization deal with IT security challenges when IT security standards that should serve as references have not yet reached a stable institutional status.

In this study, the analysis of the evolution of one of the major ITSS, namely ISO 27000, in comparison with other generic standards from ISO has provided interesting insights. However, the consideration of other ITSS than ISO 27000 would allow portraying a broader and more complete picture of ITSS diffusion. We analyzed mainly ISO statistics from North America, one of the regions where the diffusion of ISO standards is the lowest. It may be interesting to do the same analysis contrasting regions with different patterns of diffusion such as Europe and developing regions.

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