

How IT controls improve the control environment

Michele Rubino, Filippo Vitolla and Antonello Garzoni

*Department of Economics and Management, University LUM Jean Monnet,
Casamassima, Italy*

Received 19 April 2016
Revised 16 August 2016
1 September 2016
Accepted 6 September 2016

Abstract

Purpose – The purpose of this paper is to analyze how Information technology (IT) controls influence the control environment's components and the internal control system.

Design/methodology/approach – This paper aims to highlight how IT controls enable to improve the control environment assessment and implementation.

Findings – The analysis indicates that the implementation of the IT controls (IT organizational controls, IT process controls and IT soft variables controls) provides some indications for managers and auditors, who must implement or assess internal control system. A joint use of the three dimensions of IT control contributes to a better assessment of the individual components of the control environment. IT controls help managers to develop the design of the organizational structure and to identify the key processes to achieve the internal control objectives and to mitigate firm's risk.

Practical implications – The examination of three IT control dimensions allows managers to expand their knowledge about these types of controls and change the way they approach technology-based processes and associated risks. This improves the understanding of the key aspects connected to the control environment. The paper provides a list of the relevant activities that affect the three types of IT controls. This is useful for managers to begin to frame the specific controls inside the three dimensions of IT control.

Originality/value – This paper addresses an area of relevance to both practitioners and academics. This analysis focuses on accounting information systems themes and, through the examination of the IT controls, allows a better understanding of the hard and soft elements of the control environment.

Keywords Control environment, Internal control systems, IT organizational controls, IT process controls, IT soft variables controls

Paper type Viewpoint

Introduction

Information technology (IT) is becoming increasingly important within companies which use hardware and software to process business information. Companies invest in IT and adopt IT systems to improve their operations (Chang *et al.*, 2014). Moreover, regulatory and academic literature suggests that IT serves as the foundation of an effective system of internal controls (COSO, 2013; Masli *et al.*, 2011; Li *et al.*, 2012). In fact, IT impacts every aspect of accounting, including financial reporting, managerial accounting, auditing and tax (Bagranoff *et al.*, 2010). Considering that most accounting systems are computerized, accountants should understand how hardware, software and human procedures turn data into decision-useful financial information and how to develop and evaluate internal controls (Simkin *et al.*, 2015). Therefore, it is necessary to understand the activity of control that information system manages to obtain an effective evaluation of the key aspects connected to the internal control system, which is subdivided into five components (control environment, risk assessment, control activities, information and communication and monitoring) designed to give reasonable assurance that the management's control objectives will be achieved (COSO, 2013). The control environment is the key element on which rests the whole internal control system. This component which represents the intangible element of



control includes soft elements such as integrity, ethical values and attitude of top management and hard elements such as organizational structure, assignment of authority and responsibility and human resource policies and procedures, as well as the management philosophy and the competence and professionalism of those working in the company. All these elements highlight the importance that the organization assigns to the control (Graham, 2015).

Although many studies have examined the benefits that IT can provide to the internal control system, only a few of these have focused their attention on the control environment by making a general analysis. Consequently, this paper aims to describe how IT controls influence the control environment and its components. The analysis illustrates the functions performed by the various categories of IT controls, and this improves the awareness of managers and auditors about the importance of this type of controls. Therefore, this paper provides some indications for managers and auditors, who must implement or assess an internal control system.

After a brief introduction, the paper illustrates the existing relationship between IT and the control environment. This is followed by the examination of the impact of IT controls on the control environment components. The use of a graphic model helps to understand how IT controls affect the single component of the control environment. Finally, the paper gives some suggestions for future research and our conclusions.

The influence of information technology on the control environment

The control environment provides the basis on which management determines the design of the internal control system and has an influence on each of the three internal control objectives such as effectiveness and efficiency of operation, reliability of financial reporting and compliance with regulation (COSO, 2013). Hence, a control environment's assessment requires an in-depth understanding of a company's activities, the risks it faces and the controls it has put in place to treat risk exposure. This implies a clear comprehension of business processes, organizational resources, structures, roles and responsibilities (Heise *et al.*, 2014).

According to this perspective, taking into account that IT plays a major role in the development of accounting information systems, by providing the push that drives accounting activities (Vaassen and Hunton, 2009), it should be recognized that every company needs IT controls which ensure that IT management is efficient and effective.

IT plays an important role within the information systems to ensure the timeliness, the reliability and accuracy of the information even considering those relating to the internal control system (Chan, 2000; Weill and Ross, 2004; Haislip *et al.*, 2015). The basic aim of the information system is to collect and process the data and transmit the information to meet the information needs by the people working in the company. The advent of IT has brought many benefits to the design and operation of information systems (March and Smith, 1995; Checkland and Holwell, 1998; Delone and McLean, 2003). Indeed, IT has influenced the manner of execution of duties and business activities by improving the implementation of the information process (Georgakopoulos *et al.*, 1995; Davenport, 2013). IT has also innovated the procedures aimed at collecting, managing and transmitting information by actively contributing to business process re-engineering (Davenport and Short, 1990; Kettinger *et al.*, 1997; Weske, 2012).

Having said that, considering that companies are increasingly dependent on IT applications and that the enterprise resource planning (ERP) system is the most widely adopted IT system among large firms, it can be affirmed that a close relationship exists between the information system and internal control, and that IT influences the control

environment's components. The adoption and implementation of an information system and related IT controls has a direct impact, in the first place, on the hard elements of the control environment and hence on the organizational structure (Pfeffer and Leblebici, 1977; Raymond *et al.*, 1995; Lee *et al.*, 2010), the assignment of authority and responsibility and the definition of human resources policies and practices (Bresnahan *et al.*, 2002). Second, the definition of IT controls also affects soft elements such as integrity, ethical values, attitude of top management and its philosophy (Davis, 1993; Lewis *et al.*, 2003; Simons, 1995). To implement an information system, companies have to make a careful review of the organizational structure starting from the analysis of the criteria by which it is implemented and the division of labor between the different operators. Therefore, from the analysis of the basic components of the organizational structure, i.e. the revision of the tasks and activities, the information system must allow a tracking of the tasks or duties of the individuals and the intermediate components of the organizational structure, which are obtained from the aggregation of the elementary components (Daft and Lengel, 1986; Castro *et al.*, 2002). In addition, the information system should help define the organizational hierarchy and, therefore, the existing relationships between the different units in the firm.

The impact of information technology controls on the control environment components

IT controls represent a distinct category of internal controls, related to information systems, that has been given special attention in professional publications such as COSO and Control Objectives for Information and Related Technologies (COBIT) and also in Auditing Standards enacted by the Public Company Accounting Oversight Board (PCAOB). These controls, which are related to the IT infrastructure and information systems, can be subdivided into IT general controls and IT application controls (Flowerday and Von Solms, 2005; Huang *et al.*, 2011). IT general controls consider policies and procedures that are related to many applications and support the effective functioning of application controls by helping to ensure the continued proper operation of information systems. Usually, IT general controls refer to the relevant controls designed to ensure that an entity's control environment is well managed and applied to all sizes of systems (Chang *et al.*, 2014). These controls apply to mainframe, server and end-user environments, and these commonly include: controls over data center and network operations; system software acquisition, change and maintenance; access security; application system acquisition, development and maintenance; physical security of assets, including adequate safeguards such as secured facilities that allow access to assets and records; and authorization to access computer programs and data files. IT application controls, however, are related to specific computer software applications and individual transactions. These controls, which are based on general controls, include functions within the software application that control the processing of transaction and storage of data (Rubino and Vitolla, 2014a). In other words, IT general controls minimize risk to the overall functioning of the organization's IT systems and infrastructure and to a broad set of applications. Such controls support the application controls and allow smooth operating of the information system (Huang *et al.*, 2011); therefore, their failure would create a pervasive impact on all systems in the entity (ITGI, 2006).

Having said that, it is possible to observe how these two broad groupings of IT controls, in general, ensure the functioning of the information system and how they impact on the control environment. First, it should be noted that the implementation of IT controls affects the design, development, implementation, support and management of the information systems. Therefore, given that the IT general controls mainly affect the management and the development of IT infrastructure related to the information system, it is safe to say that such

controls actively contribute to the redesign of the organizational structure and the associated identification of roles and assignment of responsibility. At the same time, it can be stated that the IT application controls, which guarantee the accuracy, completeness and validity of the data, impact on internal and external company reporting system. However, considering that it is often not easy to create a clear distinction between these two types of IT controls (Moeller, 2010), it is more effective from a conceptual and applicative point of view to analyze these controls on the basis of three IT dimensions:

- (1) organizational controls;
- (2) process controls; and
- (3) soft variables controls.

A detailed list of these three types of controls is shown in [Table I](#).

Information technology organizational controls

IT organizational controls operate on the organizational structure and identify and control the division of labor, the function assigned to organizational units and the relationships existing between them (Jajodia *et al.*, 1997). These controls, which affect both the hardware and software aspects, have a strong impact on the organizational structure as they contribute to their redesign and control of the same (Baroudi and Lucas, 1994). The development of an information system based on IT requires:

- the clear definition and identification of organizational units among which the division of labor is implemented;
- the comprehension and assessment of directives and executive functions assigned to the different units; and
- the comprehension and identification of the existing relations among the different units or the human resources involved in the company.

IT organizational controls have a significant influence on the organizational structure (Daft and Lengel, 1986), which is a key element of the control environment. These controls ensure that the company's organizational configuration choices are aligned with the business goals and especially with those related to the internal control system (Davenport, 2013). The organizational structure must be sufficiently clear and formalized in relation to:

- the assignment of authority and responsibility;
- the identification of formal reporting lines;
- the description of the tasks, ensuring the existence of segregation of duties; and
- the identification of policies and procedures.

Therefore, IT organizational controls starting from the organizational structure consequently also affect the management of human resources activities. The definition of IT controls involves the provision of adequate rules and procedures and the implementation of the segregation of duties that represent an important IT control. In fact, its primary objective is to prevent frauds and errors (Power, 2013). An effective internal control system provides that no single individual should handle all aspects of a transaction from the beginning to the end. This element represents a critical factor in the process of financial reporting, as it is highly emphasized in numerous studies on the issue of internal control weaknesses (Ge and McVay, 2005; Huang, 2009; Boritz *et al.*, 2013). IT organizational controls ensure the segregation of duties, including controls such as management or steering committee review

Table I.
IT control dimensions
and their elements

IT control dimensions	Main elements or aspects that should be monitored by IT controls
IT organizational controls	<ol style="list-style-type: none"> 1. Absence or limited deficiencies in the design and implementation of the organizational structure 2. Definition and identification of organizational units among which is realized the division of labor 3. Identification of formal reporting lines 4. Description of the tasks 5. Developing policies, procedures, rules, guidelines, procedures, limits or other protocols for directing the work and processes of employees and departments/units. These controls can include setting rules or procedures for financial transactions, employee behaviour and specific practices for all or individual business unit 6. Comprehension and assessment of directives and executive functions assigned to different units 7. Comprehension and identification of the existing relations between the different units or between the human resources involved in the company 8. Adequacy of the segregation of duties. Proper segregation of duties is pursued through the following modes that represent minimal subdivisions of tasks considered critical for the audit. The most affected activities include purchases and sales <ul style="list-style-type: none"> - segregation of the custody business of goods from those of accounting - segregation of custody of assets from those authorization - segregation of operational responsibilities from those of accounting - segregation within IT of the user tasks, programmer, systems analyst and archive manager 9. Proper authorization for all operations. The proper authorization for all operations is pursued through the definition of general or specific authorization procedures: <ul style="list-style-type: none"> - general authorization, i.e. a policy that the organization has to follow with reference to recurring operations of the same species - specific authorization, i.e. a directive to be followed with reference to a single operation and formulated precisely in relation to a specific case
IT process controls	<ol style="list-style-type: none"> 1. Information quality, obtained through the follows information criteria: effectiveness, efficiency, confidentiality, integrity, availability, compliance and reliability 2. Adequate documentation of operational activities. This requires: <ul style="list-style-type: none"> - adequacy of the primary attributes of information. Each data produced or obtained should contain all the basic attributes of information deemed necessary in relation to the specific purpose (prices, quantities, amounts, percentages, dates, codes, etc.) - a greater number of information. The larger size of the information collected and compared in relation to a business aspect allows a more effective control - articulation of the information collected about their origin: physical observation, obtaining information from third parties, internal detection processes. <p>Depending on their origin, the information flow has a different level of reliability</p> <ol style="list-style-type: none"> 3. Adequacy of communication processes. Design appropriate communication processes means to define: <ul style="list-style-type: none"> - content, timing and technical mode of information flow - responsibility for the preparation, storage, transmission, reception of information 4. Informative controls of detail, aimed to verifying the correlation of elementary information object detection in the information system (identify no correlation—exceptions—including information relating to processes of a same transaction) 5. Informative controls of coherence, aimed at verifying the reasonableness of the information aggregates resulting from the detection processes (identify unusual deviations in the results compared to expectations of management) 6. Transaction level controls, which are related to method used for collecting, entering and processing of the elementary information in each phase of an operating cycle 7. Cycle level controls, which relate to the processing mode, update and protection/integrity of the transaction data 8. Proper documentation and recording of transactions. This objective is pursued by observing the following principles: <ul style="list-style-type: none"> - pre-consecutive numbering of documents

(continued)

IT control dimensions	<p>Main elements or aspects that should be monitored by IT controls</p> <ul style="list-style-type: none"> - simplicity (comprehensibility of the data) - predisposition for multiple purposes (to minimize the number of documents in circulation) - quick and easy compiling and preparation <p>9. Physical controls over goods and records. Such controls can be achieved in different ways. For example, through physical inventories, lists of persons authorized to have the information, security service, restrictions on access and adoption of special protection measures, adequate insurance, procedures for the reconstruction of the accounting data</p> <p>10. Independence of the person conducting the inspection</p> <p>11. Balance between roles, responsibilities and authorities</p> <p>12. Balance between roles and responsibilities</p> <p>IT soft variables controls</p> <ol style="list-style-type: none"> 1. Presence of independent administrative bodies by the executive directors (i.e. number of independent and non-executive directors) 2. Date of last update and number of updates made to the code of conduct since its introduction 3. Number of people who have not received the code of conduct 4. Number of people who said they did not know the code of conduct 5. Does management develop a clearly articulated statement of ethical values that is understood at all levels of the organization? In this case, it is possible to observe whether management: <ul style="list-style-type: none"> - updates the code of conduct by occurrence of violation - develops appropriate documentation - makes ethics guidelines readily available and understandable - periodically provides employee updated information relevant to maintaining sound integrity and ethical values 6. Does management implement mechanisms to inform new employees and remind current personnel of the organization's objectives related to integrity and ethics and related corporate values? Check whether management (number and frequency): <ul style="list-style-type: none"> - provides information to new hires emphasizing top management's views about the importance of sound integrity and ethics - provides employees periodically updated information maintaining relevant to sound integrity and ethical values - includes periodic training or other interactive communications to review current and new ethics policies 7. Identification of violations of the code of conduct. When possible violation is identified, management provides circumstances ensuring supportive attitude from all staff members by: <ul style="list-style-type: none"> - making company personnel aware that appropriate investigation and corrective actions have been taken - employee performance reviews - making the ethics guidelines available - intolerance of ethical violations at all levels 8. Adherence to principles of sound integrity and ethical values. Check if: <ul style="list-style-type: none"> - ethics guidelines are readily available and understandable - periodic training or other interactive communications are planned to review current and new ethics policies - periodically requesting formal confirmations from all employees are planned - interactions with suppliers, customers, and other external parties reflect fair and honest dealings 9. Number of training courses provided to staff in the year 10. Attendance of training courses by the human resources covering relevant functions within the company
-----------------------	---

Table I.

and approval of significant new acquisitions, restricting access to system configuration and operating system software, automated reconciliations of data accessed through middleware software and parity bit detection for communications errors. Equally important are the IT organizational controls related to security management and software acquisition, development and maintenance. As indicated above, this type of IT controls affect the redesign of the organizational structure and human resource management influencing the division of labor and the definitions of rules and procedures (Senft and Gallegos, 2009). This, however, also implies the attribution of powers and responsibilities. The assignment of authority and responsibility, realized above all through the applications controls, includes establishing and reporting relationships and authorization protocols, as well as policies that describe appropriate business practices, knowledge and experience of key personnel and resources provided for carrying out duties (COSO, 2004). Having said that, it is possible to affirm that IT organizational controls affect three control environment components: organizational structure, assignment of authority and responsibility and human resource policies and practices.

Information technology process controls

Process management is one of the elements that has characterized IT evolution. Therefore, the presence of IT process controls is an aspect well consolidated in the management of the information system (Laudon and Laudon, 2004). These controls, generally, encompass a wide range of activities, bearing in mind that a company can be seen as a set of interrelated processes. However, if the analysis focuses on the role of information within the company, then the IT process controls help to define and control the informative flows. They concern the communication processes which operate in the company and also the authorization, the execution and the approval of the transactions.

First of all, it should be noted that IT impacts, in the first instance, on the processes that allow to identify and capture a wide range of information and ensure their delivery, thereby raising the quality of their processes (Dewett and Jones, 2001). The IT process controls ensure that information is readily available to facilitate decision-making and to enable human resources to fulfill their responsibilities, including those related to the internal control system. At the same time, such controls ensure effective communication between the various levels of the organizational hierarchy. The communications processes must be reliable even across the organizational structure and in relation to all stakeholders. Accurate, accessible and timely information allows to achieve the internal control objectives (Romney *et al.*, 2006). The quality of the information and communication processes is considered as a primary goal of many IT frameworks. For example, the COBIT framework, which manages IT resources as a set of processes, requires that every single process needs to conform to certain control criteria such as effectiveness, efficiency, confidentiality, integrity, availability, compliance and reliability (Lainhart, 2000; Tuttle and Vandervelde, 2007; Rubino and Vitolla, 2014b).

IT process controls affect the use of the information processes, ensuring the operation of the pre-established organizational structure. The correct use of information implies the existence of tools to clarify what is required of people working in the organization. Therefore, these controls encourage the integration between the organizational structure and the different business processes. Inside the IT process controls, one can also identify controls on detail and on coherence. The former are aimed at verifying the consistency of the detected information. The latter are aimed at verifying the reasonableness of the information resulting from the detection processes. According to Beretta and Pecchiari (2007), often, these two types of controls are further divided into:

- (1) transaction level controls, which are related to the method used for collecting, entering and processing of the elementary information in each phase of an operating cycle; and
- (2) cycle level controls, which are related to the processing mode, the updating and protection/integrity of the transaction data.

On the basis of what has been said, it is clear that IT process controls impact on the organizational structure, the assignment of authority and responsibility and human resource policies and practices (Dakin, 1993; Lengnick-Hall and Moritz, 2003). IT process controls work together with IT organizational controls to ensure the smooth functioning of the entire organization. The definition of rules, policies and procedures is not enough to ensure the achievement of business objectives and those related to the internal control system. It is necessary to clarify what information should be used and how the information flows should be managed by human resources. This makes it possible to verify the achievement of the business objectives and to ensure accountability related to the performed activities, introducing changes if necessary. From this perspective, it may be appropriate to implement IT process controls and those related to the organizational mechanisms that configure key controls in the administrative management of certain acquisition transactions, processing, sales and related cash flows. IT process controls, especially in the internal control perspective, should ensure compliance with the following principles (COSO, 2013):

- avoiding the existence of potential conflicts of interest in both the processes of communication, authorization, execution and approval of transactions;
- proper authorization for all operations;
- proper documentation and recording of transactions;
- physical control of goods and recordings; and
- independent inspections on services provided.

Consequently, IT process controls ensure the information reliability, define the level of adequacy of the documentation related to the business operations and control the manner in which the information is used.

Information technology soft variables controls

The analysis performed has shown that the two types of controls, IT organizational controls and IT process controls, positively affect the hard components of the control environment, helping to improve the organizational structure as a whole, the communication processes and the quality of internal and external reporting. IT soft variables controls are a particular type of IT controls which are aimed at monitoring soft elements, i.e. those not easily influenced and more directly related to the corporate culture; integrity and ethical values, management philosophy and operating style; and commitment to competence (Stubler *et al.*, 2000).

The operating style is the way in which, at different levels of the hierarchical structure, the leaders behave toward subordinates. It is a kind of code of conduct that constitutes a real organizational variable to support the correct operating of the organization. The operating style affects the quality of the internal control system as it affects the corporate management, risk tolerance and the integrity level that is spread throughout the organization (COSO, 2004). The effectiveness of the internal control system is clearly dependent on the integrity and ethical values of the people working in the organization and certainly of those who administer and maintain the monitoring of controls. The top management should commit

itself to enforcing the rules and regulations that constrain business management and has the task of ensuring the effectiveness of the internal control system (Braithwaite, 1982; McMullen, 1996). In this context, the management's ability to transmit and promote, effectively, the sharing of such standards within the organization (Argote *et al.*, 2003), as well as the will to adopt the codes of conduct, is of particular importance.

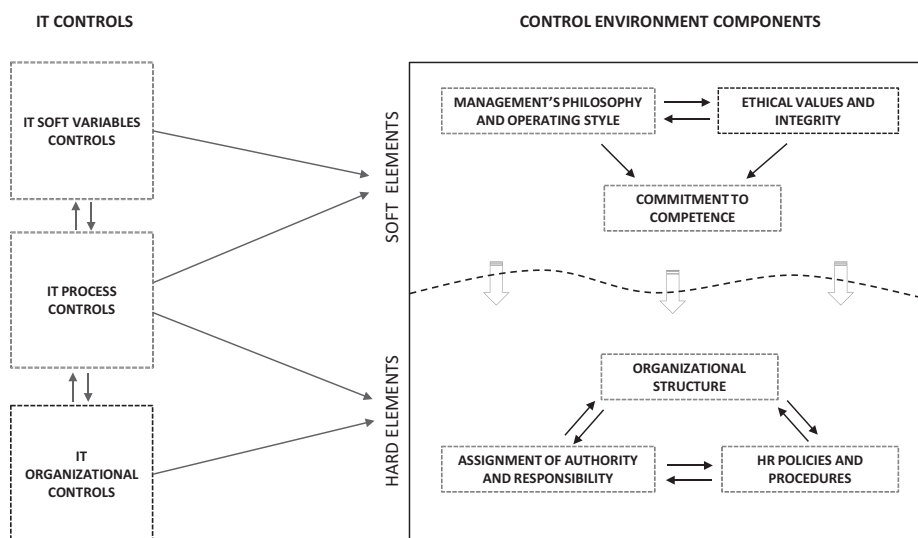
With regard to the examination of the two components of the control environment related to the management's philosophy and operating style and the integrity and ethical values, it can be argued that IT controls cannot directly influence these soft variables, the definition of which is a task for the top management. IT soft variables controls help to monitor some elements related to these soft variables, providing information to top management to make changes if they are considered necessary. Some examples of these types of controls are shown in Table I.

Therefore, IT soft variable controls impact indirectly on the soft components of the control environment and directly on people who have the power to implement their changes. However, a contribution to the improvement of these soft variables is provided by the IT process controls which ensure the dissemination of information and therefore help the knowledge of codes of conduct. At the same time, the IT process controls allow top management to gauge whether the objectives and corporate values are met within the company. This is very important for the institution's risk management activities. In fact, a clear communication and understanding of the business value system facilitates the achievement of the internal control objectives (Soin and Collier, 2013). Furthermore, it should be noted that IT professional culture influences IT's perception of its role with respect to internal controls (Chen *et al.*, 1997). This perception has implications for the internal control environment, as IT culture affects the environment through the manifestation of culture at the individual level. The performance of routine and non-routine tasks is influenced by IT practitioners' shared culture (Cannon and Growe, 2004; Abu-Musa, 2008), and this influences the ethical values. Moreover, the definition of the structure of the information system and related controls reflects the management's philosophy and operating style. The top management, through its activities, provides clear signals to its employees about the importance of internal control. Some top-level managers frequently take significant risks in their new business or product ventures, whereas others are very cautious or conservative. These elements have a considerable influence over a firm's control environment and influence the provision of specific IT controls.

Finally, these specific IT controls also affect the component of the control environment related to commitment to competence. Competence reflects the knowledge and skills needed to perform assigned tasks. The management decides how well these tasks need to be accomplished, weighing the entity's strategy and objectives against plans for their implementation and achievement (COSO, 2013). IT soft variables controls cannot improve the human resources' skills within the company. However, this type of controls allows to determine any gaps or inefficiencies in the organization, stimulating the launch of staff training processes. In addition, IT enables the supply of training activities, and, through IT control processes, it is possible to check the learning levels. Therefore, it can be stated that IT soft variables controls jointly with IT process controls contribute, albeit indirectly, to the improvement of competence level.

The analysis of the three types of IT controls, as shown in Figure 1, indicates that to obtain an effective analysis of the individual components of the control environment, it is appropriate to use IT controls jointly. The most important aspect is related to IT process controls that jointly with IT process controls are able to influence the soft elements of the control environment, which have a significant influence on the remaining hard elements.

Figure 1.
The role of IT controls
in the control
environment
components



Suggestions for future research

Considering that the most widely used internal control framework such as COSO shows some limitations (Huang *et al.*, 2011, Rubino and Vitolla, 2014a), and that various national and international organizations have issued some IT control frameworks, there are many potential research questions that could be addressed in future research. First of all, it would be interesting to extend the research area related to the accounting information system by analyzing, through empirical researches, the benefits that the integration between the two frameworks (one of internal control and the other related to the IT controls) can produce on the control environment. Second, given the great importance assumed by IT control frameworks such as COBIT, Information Technology Infrastructure Library and ISO 20000 and 38500, which provide some useful references to the assessment of IT controls within the organizations (Bin-Abbas and Bakry, 2014), one research opportunity is to study whether there is a correlation between IT control frameworks implementation and improvement of the control environment. Does the level of IT controls improve the implementation and the assessment of the control environment? With the use of empirical research, it would be possible to compare companies that use IT control framework with those that do not use the framework to ascertain in which cases the internal control system and the control environment work better. At the same time for further research, it would be important to identify which IT processes, within the IT control frameworks, have a significant impact on the quality of the control environment.

The relationship between IT controls and auditing is also an important research area. In general, IT controls help auditors better assess the control environment, but it could be interesting to analyze, through a survey, how auditors consider IT controls that affect the soft elements of the control environment. How it can improve IT soft variables controls that affect integrity, ethical values and the attitude of top management?

From the perspective of a business entity, acquiring effective internal control is a complex task. However, the implementation and the assessment of the control environment could be facilitated by adopting one or more proper frameworks. One of the emerging IT framework is COBIT. However, the role of this framework and the related IT controls should be further

investigated. In fact, COBIT 5 integrates three significant but related frameworks covering IT governance and management (COBIT), value generation (Val IT) and risk management (Risk IT). This integration is a major undertaking, and the success of this integration, for example, is not yet clear (De Haes *et al.*, 2013).

Conclusions

Control environment is the attitude toward internal control and control consciousness established and maintained by the management and employees of an organization. This internal control component sets the basis for how risk and control are viewed and addressed by an entity's people, including risk management philosophy and risk appetite, integrity and ethical values and the environment in which they operate (COSO, 2004). Considering that most of companies' failures were the result of weak control environments, any approach to auditing this component should include an assessment of the risks from failure of each individual control environment element and their interaction with each other (IIA, 2011a).

Many studies have focused on this issue. However, this work adopts a different perspective of analysis, because it focuses on the relationships between IT controls and control environment components. The aim of this paper was to describe and explain how the different types of IT controls can improve the implementation of the control environment and its assessment.

The analysis performed provides important managerial implications concerning the control environment assessment. First, the paper enhances the knowledge about the implementation of IT controls on control environment. The examination of IT controls was carried out by splitting these controls to analyze them in view of the structure of the control environment. A simple analysis based on the IT general and application controls would have prevented the understanding of the topic. The assessment of the control environment requires managers and auditors to expand their knowledge of IT controls and change the way they approach technology-based processes and associated risks. IT controls, which help auditors understand the business processes and identify significant risks, should be contextualized in the internal control system. In fact, the distinction between IT organizational controls and IT process control is well suited for the analysis of the internal control system, which consists of an organizational and informative dimension. At the same time, the analysis helps managers and auditors to understand how some of the components of the control environment should be analyzed using also IT processes controls. Components such as the organizational structure, human resources policies and procedures and assignment of authority and responsibility cannot be analyzed only on the basis of the IT organizational controls. In this case, it is necessary to also apply IT process controls to evaluate the aspects concerning information flows. Internal auditors should understand how processes are automated and, generally, how applications facilitate the movement of information in their relationships with interfacing applications (Chaney and Kim, 2007). To verify the correct application of the segregation of duties, it is necessary that auditors possess adequate knowledge of the information flow, considering that it is the content of the information flow that determines the appropriateness of such control. Adequate knowledge of IT controls allows auditors to better assess the control environment and, consequently, to reduce audit risk. This knowledge enables managers to make changes to IT controls to improve the effectiveness of the control environment and to reduce the corporate risk level.

Second, the paper introduces and emphasizes on the role of a third important dimension of IT controls, defined as IT soft variables controls. The soft components of the control environment are crucial in the control system. Indeed, variables such as corporate culture, style of leadership, integrity and ethical values have a significant

influence on the remaining hard components that make up the control environment. Despite these soft components can be regarded as the most powerful controls in any organization, often, they receive little attention by the auditors, as their audit is not very simple. Obtaining reliable information about soft controls is one of the most difficult challenges internal auditors must confront, and it can be quite daunting. (IIA, 2002; IIA, 2011b). From this standpoint, this paper promotes the awareness of managers and auditors about the importance of using IT soft variables controls. At the same time, it should be noted that the assessment of these soft components is more accurate when using jointly IT process controls. The analysis of the soft components of the control environment is achieved through questionnaires, surveys and polls, whose results are monitored by IT process controls that effectively control information flows. One of the most interesting aspects regarding the use of this type of IT controls is represented by the great importance acquired by some IT governance framework. These frameworks are highlighting the importance of IT soft controls, testifying that their use can provide important benefits to companies, including risk management activities (Rubino and Vitolla, 2014c).

Furthermore, the paper provides a list of the relevant activities that affect the three types of IT controls (Table I). This is useful for managers to help them determine the specific controls inside the three dimensions of IT control. The implementation of these controls will be carried out considering specific elements such as company size and type of business. The analysis indicates that all three IT control types are valid and should be used by managers and auditors. A joint use of the three dimensions of IT control contributes to a better assessment of the individual components of the control environment.

IT controls help managers to develop the design of the organizational structure and to identify the key processes to achieve the internal control objectives and to mitigate firm's risk (Devos *et al.*, 2012). For this reason, they have a fundamental role in the control environment. The importance of these IT controls has grown over time following the enactment of Sarbanes-Oxley Act. These controls proved to be very useful for improving the quality of financial reporting. In fact, considering that financial reporting in many entities is based on information systems such as ERP systems, it is clear that IT controls help companies to achieve the objective of internal control. As shown by numerous studies and research, many financial reporting errors are due to the ineffectiveness of the controls related to the accounting documentation, human resources policies and procedures, assignment of authority and responsibility and, in general, inadequate IT controls (Grant *et al.*, 2008; Calderon *et al.*, 2012). Morris (2011), highlights that companies which have implemented ERP systems are less likely to have internal control weaknesses than those characterized by non-ERP control companies. Similar findings have been delivered by Li *et al.* (2012), asserting that in case of an improvement in the IT control quality, also a decrease in forecast errors was noted.

This paper argues that IT controls have considerable influence on the components of the control environment. In a dynamic context, IT controls must also ensure that management is able to use IT effectively to achieve business objectives. IT control alignment represents the degree to which the control environment, control mechanisms, socio-emotional behaviors and control execution are mutually complementary within an IT process (Cram *et al.*, 2016). For this reason, it is possible to observe an IT control classification for the control environment that distinguished traditional and progressive controls. Traditional control environments are characterized by process standardization, established organizational structure, cautious decision-making and internal stability (Kling and Iacono, 1984; Rao *et al.*, 2007). Progressive control environments, instead, are characterized by process flexibility,

technology-intensive initiatives, risk-taking and innovation (Kellogg *et al.*, 2006; Silva and Hirschheim, 2007).

Managers and auditors should try to develop a general awareness of these IT controls. Implementing IT controls is a great opportunity for auditors to improve their knowledge of the company, and for managers, it is a first step toward the implementation of an IT governance framework.

References

- Abu-Musa, A.A. (2008), "Information technology and its implications for internal auditing: an empirical study of Saudi organizations", *Managerial Auditing Journal*, Vol. 23 No. 5, pp. 438-466.
- Argote, L., McEvily, B. and Reagans, R. (2003), "Managing knowledge in organizations: an integrative framework and review of emerging themes", *Management Science*, Vol. 49 No. 4, pp. 571-582.
- Bagranoff, N.A., Simkin, M.G. and Norman, C.S. (2010), *Core Concepts of Accounting Information Systems*, 11th ed., John Wiley & Sons, Hoboken, NJ.
- Baroudi, J. and Lucas, Jr, H.C. (1994), "The role of information technology in organization design", *Journal of Management Information Systems*, Vol. 10 No. 4, pp. 9-23.
- Beretta, S. and Pecchiari, N. (2007), *Analisi e valutazione del sistema di controllo interno. Metodi e tecniche*, Il Sole 24 Ore, Milano.
- Bin-Abbas, H. and Bakry, S.H. (2014), "Assessment of IT governance in organizations: a simple integrated approach", *Computers in Human Behavior*, Vol. 32, pp. 261-267.
- Boritz, J.E., Hayes, L. and Lim, J-H. (2013), "A content analysis of auditors' reports on IT internal control weaknesses: the comparative advantages of an automated approach to control weakness identification", *International Journal of Accounting Information Systems*, Vol. 14 No. 2, pp. 138-163.
- Braithwaite, J. (1982), "Enforced self-regulation: a new strategy for corporate crime control", *Michigan Law Review*, Vol. 80 No. 7, pp. 1466-1507.
- Bresnahan, T.F., Brynjolfsson, E. and Hitt, L.M. (2002), "Information technology, workplace organization and the demand for skilled labor: firm-level evidence", *The Quarterly Journal of Economics*, Vol. 117 No. 1, pp. 339-376.
- Calderon, T.G., Wang, L. and Conrad, E.J. (2012), "Material internal control weakness reporting since the Sarbanes-Oxley Act", *Accounting & Auditing – The CPA Journal*, Vol. 82 No. 8, pp. 19-25.
- Cannon, D.M. and Growe, G.A. (2004), "SOA compliance: will IT sabotage your efforts?", *Journal of Corporate Accounting & Finance*, Vol. 15 No. 5, pp. 31-37.
- Castro, J., Kolp, M. and Mylopoulos, J. (2002), "Towards requirements-driven information systems engineering: the Tropos project", *Information systems*, Vol. 27 No. 6, pp. 365-389.
- Chan, S.L. (2000), "Information technology in business processes", *Business Process Management Journal*, Vol. 6 No. 3, pp. 224-237.
- Chaney, C. and Kim, G. (2007), "The integrated auditor: all internal auditors need to understand core IT control concepts and risks to provide assurance in today's technology-based business world", *Internal Auditor*, Vol. 64 No. 4, pp. 46-52.
- Chang, S.I., Yen, D.C., Chang, I.C. and Jan, D. (2014), "Internal control framework for a compliant ERP system", *Information & Management*, Vol. 51 No. 2, pp. 187-205.
- Checkland, P. and Holwell, S. (1998), *Information, Systems and Information Systems: Making Sense of the Field*, John Wiley & Sons, New York, NY.
- Chen, A.Y., Sawyers, R.B. and Williams, P.F. (1997), "Reinforcing ethical decision making through corporate culture", *Journal of Business Ethics*, Vol. 16 No. 8, pp. 855-865.

- Committee of Sponsoring Organizations of the Treadway Commission (COSO) (2004), *Enterprise Risk Management - Integrated Framework. Executive Summary Framework*, American Institute of Certified Public Accountants (AICPA), Jersey City.
- Committee of Sponsoring Organizations of the Treadway Commission (COSO) (2013), *Internal Control – Integrated Framework*, American Institute of Certified Public Accountants (AICPA), Durham.
- Cram, W.A., Brohman, M.K., Chan, Y.E. and Gallupe, R.B. (2016), "Information systems control alignment: complementary and conflicting systems development controls", *Information & Management*, Vol. 53 No. 2, pp. 183-196.
- Daft, R.L. and Lengel, R.H. (1986), "Organizational information requirements, media richness and structural design", *Management Science*, Vol. 32 No. 5, pp. 554-571.
- Dakin, G. (1993), "Shaping the future: business design through information technology", *Journal of the Operational Research Society*, Vol. 43 No. 9, pp. 1249-1250.
- Davenport, T.H. (2013), *Process Innovation: Reengineering Work Through Information Technology*, Harvard Business Press, Boston, MA.
- Davenport, T.H. and Short, J.E. (1990), "The new industrial engineering: information technology and business process redesign", *Sloan Management Review*, Vol. 31 No. 4, pp. 11-27.
- Davis, F.D. (1993), "User acceptance of information technology: system characteristics, user perceptions and behavioral impacts", *International Journal of Man-machine Studies*, Vol. 38 No. 3, pp. 475-487.
- De Haes, S., Van Grembergen, W. and Debreceny, R.S. (2013), "COBIT 5 and enterprise governance of information technology: building blocks and research opportunities", *Journal of Information Systems*, Vol. 27 No. 1, pp. 307-324.
- Delone, W.H. and McLean, E.R. (2003), "The DeLone and McLean model of information systems success: a ten-year update", *Journal of Management Information Systems*, Vol. 19 No. 4, pp. 9-30.
- Devos, J., Van Landeghem, H. and Deschoolmeester, D. (2012), "Rethinking IT governance for SMEs", *Industrial Management & Data Systems*, Vol. 112 No. 2, pp. 206-223.
- Dewett, T. and Jones, G.R. (2001), "The role of information technology in the organization: a review, model, and assessment", *Journal of Management*, Vol. 27 No. 3, pp. 313-346.
- Flowerday, S. and Von Solms, R. (2005), "Real-time information integrity= system integrity+ data integrity+ continuous assurances", *Computers & Security*, Vol. 24 No. 8, pp. 604-613.
- Ge, W. and McVay, S. (2005), "The disclosure of material weaknesses in internal control after the Sarbanes-Oxley Act", *Accounting Horizons*, Vol. 19 No. 3, pp. 137-158.
- Georgakopoulos, D., Hornick, M. and Sheth, A. (1995), "An overview of workflow management: from process modeling to workflow automation infrastructure", *Distributed and Parallel Databases*, Vol. 3 No. 2, pp. 119-153.
- Graham, L. (2015), *Internal Control Audit and Compliance: Documentation and Testing Under the New COSO Framework*, John Wiley & Sons, Hoboken, NJ.
- Grant, G.H., Miller, K.C. and Alali, F. (2008), "The effect of IT controls on financial reporting", *Managerial Audit Journal*, Vol. 23 No. 8, pp. 803-823.
- Haislip, J.Z., Masli, A., Richardson, V.J. and Watson, M.W. (2015), "External reputational penalties for CEOs and CFOs following information technology material weaknesses", *International Journal of Accounting Information Systems*, Vol. 17, pp. 1-15.
- Heise, D., Strecker, S. and Frank, U. (2014), "ControlML: a domain-specific modeling language in support of assessing internal controls and the internal control system", *International Journal of Accounting Information Systems*, Vol. 15 No. 3, pp. 224-245.

- Huang, H.W. (2009), "Sarbanes-Oxley section 404 compliance. Recent changes in US-traded foreign firms' internal control reporting", *Managerial Auditing Journal*, Vol. 24 No. 6, pp. 584-598.
- Huang, S-M., Hung, W-H., Yen, D.C., Chang, I-C. and Jiang, D. (2011), "Building the evaluation model of the IT general control for CPAs under enterprise risk management", *Decision Support Systems*, Vol. 50 No. 4, pp. 692-701.
- Institute of Internal Auditors (IIA) (2002), "Soft controls. What are the starting points for the internal auditor?", *The Institute of Internal Auditors Netherlands, Discussion Paper*, available at: www.iaa.nl/SiteFiles/Publicaties/IIA_Bro%20A4%20Soft%20Controls%20Engels%2002.pdf (accessed 15 July 2016).
- Institute of Internal Auditors (IIA) (2011a), "IPPF-practice guide. auditing the control environment", *The Institute of Internal Auditors*, available at: www.iaa.org.uk/media/97410/Auditing%20the%20control%20environment.pdf (accessed 15 July 2016).
- Institute of Internal Auditors (IIA) (2011b), "Soft and strong: a best-practice paradox", *Tone at the Top*, no. 50, available at: https://global.theiaa.org/knowledge/public%20documents/tat_march_2011.pdf (accessed 15 July 2016).
- IT Governance Institute (ITGI) (2006), *IT Control Objectives for Sarbanes–Oxley*, 2nd ed., ITGI, Rolling Meadow, IL.
- Jajodia, S., List, W. and McGregor, G.W. (1997), "Integrity and internal control in information systems", *Increasing the Confidence in Information Systems*, Vol. 1, Springer Science + Business Media, Dordrecht.
- Kellogg, K.C., Orlikowski, W.J. and Yates, J. (2006), "Life in the trading zone: structuring coordination across boundaries in post bureaucratic organizations", *Organization Science*, Vol. 17 No. 1, pp. 22-44.
- Kettinger, W.J., Teng, J.T. and Guha, S. (1997), "Business process change: a study of methodologies, techniques, and tools", *MIS Quarterly*, Vol. 21 No. 1, pp. 55-80.
- Kling, R. and Iacono, S. (1984), "The control of information systems developments after implementation", *Communications of the ACM*, Vol. 27 No. 12, pp. 1218-1226.
- Lainhart, IV, J.W. (2000), "COBIT™: a methodology for managing and controlling information and information technology risks and vulnerabilities", *Journal of Information Systems*, Vol. 14, pp. 21-25.
- Laudon, K.C. and Laudon, J.P. (2004), *Management Information Systems: Managing the Digital Firm*, Pearson, Prentice Hall, NJ.
- Lee, D., Lee, S.M., Olson, D.L. and Hwan Chung, S. (2010), "The effect of organizational support on ERP implementation", *Industrial Management & Data Systems*, Vol. 110 No. 2, pp. 269-283.
- Lengnick-Hall, M.L. and Moritz, S. (2003), "The impact of e-HR on the human resource management function", *Journal of Labor Research*, Vol. 24 No. 3, pp. 365-379.
- Lewis, W., Agarwal, R. and Sambamurthy, V. (2003), "Sources of influence on beliefs about information technology use: an empirical study of knowledge workers", *MIS Quarterly*, Vol. 27 No. 4, pp. 657-678.
- Li, C., Peters, G.F., Richardson, V.J. and Watson, M. (2012), "The consequences of information technology control weaknesses on management information systems: the case of Sarbanes–Oxley internal control reports", *MIS Quarterly*, Vol. 36 No. 1, pp. 179-203.
- McMullen, D.A. (1996), "Audit committee performance: an investigation of the consequences associated with audit committees", *Auditing*, Vol. 15 No. 1, pp. 87-103.
- March, S.T. and Smith, G.F. (1995), "Design and natural science research on information technology", *Decision Support Systems*, Vol. 15 No. 4, pp. 251-266.

- Masli, A., Richardson, V.J., Sanchez, J.M. and Smith, R.E. (2011), "The business value of IT: a synthesis and framework of archival research", *Journal of Information Systems*, Vol. 25 No. 2, pp. 81-116.
- Moeller, R.R. (2010), *IT Audit, Control, and Security*, John Wiley & Sons, Hoboken, NJ.
- Morris, J.J. (2011), "The impact of enterprise resource planning (ERP) systems on the effectiveness of internal controls over financial reporting", *Journal of Information Systems*, Vol. 25 No. 1, pp. 129-157.
- Pfeffer, J. and Leblebici, H. (1977), "Information technology and organizational structure", *Pacific Sociological Review*, Vol. 20 No. 2, pp. 241-261.
- Power, M. (2013), "The apparatus of fraud risk", *Accounting, Organizations and Society*, Vol. 38 No. 6, pp. 525-543.
- Rao, M.T., Brown, C.V. and Perkins, W.C. (2007), "Host country resource availability and information system control mechanisms in multinational corporations: an empirical test of resource dependence theory", *Journal of Management Information Systems*, Vol. 23 No. 4, pp. 11-28.
- Raymond, L., Pare, G. and Bergeron, F. (1995), "Matching information technology and organizational structure: an empirical study with implications for performance", *European Journal of Information Systems*, Vol. 4, pp. 3-16.
- Romney, M.B., Steinbart, P.J., Zhang, R. and Xu, G. (2006), *Accounting Information Systems*, Pearson Education, NJ.
- Rubino, M. and Vitolla, F. (2014a), "Internal control over financial reporting: opportunities using the COBIT framework", *Managerial Auditing Journal*, Vol. 29 No. 8, pp. 736-771.
- Rubino, M. and Vitolla, F. (2014b), "IT governance, risk management and internal control system: the role of the COBIT framework", in Tipurić, D. and Mešin, M. (Eds), Proceedings of the 2nd International OFEL Conference on Governance, Management and Entrepreneurship: Inside and Outside of Managerial Mind, Building the Bridges Between Disciplines, *CIRU, Dubrovnik*, pp. 174-188.
- Rubino, M. and Vitolla, F. (2014c), "Corporate governance and the information system: how a framework for IT governance supports ERM", *Corporate Governance*, Vol. 14 No. 3, pp. 320-338.
- Senft, S. and Gallegos, F. (2009), *Information Technology Control and Audit*, CRC Press, Taylor & Francis Group, London.
- Silva, L. and Hirschheim, R. (2007), "Fighting against windmills: strategic information systems and organizational deep structures", *MIS Quarterly*, Vol. 31 No. 2, pp. 327-354.
- Simkin, M.G., Norman, C.S. and Rose, J.M. (2015), *Core Concepts of Accounting Information Systems*, 13th Edition, John Wiley & Sons, Hoboken, NJ.
- Simons, R. (1995), *Levers of Control: How Managers use Innovative Control Systems to Drive Strategic Renewal*, Harvard Business Press, Boston.
- Soin, K. and Collier, P. (2013), "Risk and risk management in management accounting and control", *Management Accounting Research*, Vol. 24 No. 2, pp. 82-87.
- Stubler, W.F., O'Hara, J.M. and Kramer, J. (2000), *Soft Controls: Technical Basis and Human Factors Review Guidance*, Brookhaven National Laboratory, Upton, NY.
- Tuttle, B. and Vandervelde, S.D. (2007), "An empirical examination of CobiT as an internal control framework for information technology", *International Journal of Accounting Information Systems*, Vol. 8 No. 4, pp. 240-263.
- Vaassen, E. and Hunton, J. (2009), "An eclectic approach to accounting information systems", *International Journal of Accounting Information Systems*, Vol. 10 No. 4, pp. 173-176.
- Weill, P. and Ross, J.W. (2004), *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*, Harvard Business School Press, Boston, MA.
- Weske, M. (2012), *Business Process Management Architectures*, Springer, London.

About the authors

Michele Rubino is Assistant Professor at Department of Economics and Management, LUM Jean Monnet University, Casamassima (BA), Italy. He got his PhD in business administration and management at University of Bari, Italy, in 2009. Since 2007, he is the Deputy Director of the Master in Entrepreneurship and Management Consulting and Professor of Accounting and Corporate Governance and Internal Control at the School of Management of the same University. He is also an ISACA (Information Systems Audit and Control Association) Academic Advocate. He has published several papers and books. His current research interests are in the field of the internal control, accounting information systems, corporate social responsibility and SMEs. Michele Rubino can be contacted at: rubino@lum.it

Filippo Vitolla is an Associate Professor of Business Administration at LUM Jean Monnet University, Casamassima (BA), Italy. He completed his, on April 2005, PhD in Business Administration and Management at University of Bari, Italy. Since November 2004, he has also been an Assistant Professor of management control, cost analysis, business strategy for the degree course in Business Administration and also in the master's course provided at the School of Management. His research areas are corporate social responsibility, management control systems, strategic management and risk management. In 2012, he passed the National Qualification for Associate Professor in Business Administration. He has published several papers and books.

Antonello Garzoni is a Full Professor of "Strategic Management" and "International Strategies" at LUM Jean Monnet University, Casamassima (Bari, Italy), where he currently is Vice-Rector for international cooperation. From 2009 to 2011, he has been Dean of the Faculty of Economics. He graduated in Business Administration at Bocconi University in 1993, and obtained a PhD degree in Business Administration and Management at Bocconi University, Milan, in 1999. He is a Professor of "Strategic Management" at Bocconi University, Milano, where he teaches in undergraduate, graduate and executive education courses. He currently is the Academic Co-Director of Global Advanced Management Program from Georgetown University-Esade-Sda Bocconi alliance. His research interests are in the field of strategic management accounting and corporate performance measurement, competitive intelligence, resource-based view of the firm and corporate governance.

For instructions on how to order reprints of this article, please visit our website:

www.emeraldgroupublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.