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A STUDY OF THE BUSINESS VALUE OF IT GENERAL CONTROLS IN CHINA

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ABSTRACT

This paper investigates the business value of IT controls through a study of the four IT general controls (ITGC) processes (Program Development, Program Change, Access to Program and Data, and Computer Operations) in organizations from a business perspective. Through a survey of companies in China that have established and implemented ITGC in compliance with their business regulations in the market, results indicate that program development and program change are the significant dimensions of ITGC that are positively related to the business value of strategic alignment; access to program & data has positive influence to the business value of system security; computer operation is significantly related to the business value of system performance. These have implications for organizations in their IT resources allocation and management for the generation of greater value in business management and business development.

Keywords: IT general controls, business value, value chain, value dials

INTRODUCTION

Business organizations have been increasingly using various computerized information systems (IS) to support and improve the effectiveness and efficiency of their business operations. More importantly, with widespread reliance on IS for business analysis and operations, the accuracy, integrity, and completeness of essential financial and business data processed by IS become critical. In order to ensure these important attributes of business and financial data as well as to increase the transparency of business activities and the benefits for stakeholders, regulations and acts on creating adequate controls and monitoring on IS have been established.

Internal control is a key element of the Foreign Corrupt Practices Act (FCPA) of 1977 and the Sarbanes-Oxley Act of 2002, which requires improvements in the internal control procedures in the United States public corporations. For public companies listed in the U.S. stock exchange market, internal controls at the organizational and transaction levels are mandated. The Sarbanes-Oxley Act 2002 at section 404 (SOX 404) is advocated in many organizations worldwide for establishing more transparent business environments and creating benefits for stakeholders. Since then, more and more organizations are adopting internal control frameworks for their significant business processes. IT controls on IS, thus, have been recognized as an inevitable and critical process in business management as well as IS management. Currently, many state enterprises and foreign joint venture firms in China are going public

in the U.S. and in Hong Kong. In compliance with the requirements of the SEC under the Sarbanes Oxley Act 2002 section 404 and the requirements in the business market, the effectiveness of IT controls are often subjected to be audited by external auditing firms [21] [29] [37].

According to COSO's "Internal Control—Integrated Framework" [8], two broad groupings of information systems control activities are identified: (1) Application controls and (2) General controls [21]. Among these two groups of IT controls mentioned, IT general controls (ITGC) are selected as the target of this study. Whereas IT application controls are embedded in the IS applications as part of the system functions and tools, and that they are more unique according to the developers, ITGC are more general to all software applications. Moreover, ITGC require significant investment in consultants who need to understand both the complex regulatory requirements and the complexity of IT system environments for business. Bearing the cost of implementation and maintenance of ITGC is evitable. It is, therefore, worthwhile for a more in-depth understanding for the investment in ITGC.

IT General Controls

ITGC are the foundation controls embedded in the IT infrastructure services and applications such as operating system, database, and network to ensure they can adequately provide reasonable assurance and support for the IT applications and business processes. ITGC are usually established and customized by the IS management or IS steering committees within the company. According to the "Common Elements of Organizations" of the IT Governance Institute [18], ITGC are "the controls embedded within IT processes that provide a reliable operating environment and to support the effective operation of application controls". ITGC are categorized into four processes:

1. Program Development: Application/program development has two principal components: the acquisition and implementation of new applications. Program Development provides the structure for the identification of automated solutions, system design and implementation, documentation requirements, testing, approvals, project management and oversight requirements, and project risk assessments.
2. Program Change: Application maintenance addresses ongoing change management and the implementation of new releases of system application.
3. Access to Programs and Data: Access controls over programs and data may have greater importance as internal and external connectivity to company networks grow. Access controls can intercept unethical hackers, malicious software, and other intrusion attempts from current and/or former employees to ensure data and program integrity can be maintained.
4. Computer Operations: The Computer operations controls include the definition, acquisition, installation, configuration, integration, and maintenance of the IT infrastructure. Ongoing controls over operations address the day-to-day delivery of information services.

ITGC come with values and benefits to business. In common practice, business value of IT is measured as the rate of return on IT assets, that is, the operating profit of the line of business supported by the particular IT department divided by the total assets of the IT department. Nevertheless, the qualitative benefits should not be neglected. This paper aims to study the qualitative value of some prevalent benefits of ITGC such as improving IS performance in terms of improving the security, reliability, and integrity of data, facilitating the change management process, and lower the risk of fraud. This paper intends to highlight the importance of ITGC to organizations from the business perspective. ITGC should be perceived as, not only an IS management interest but also, a business management interest.

THEORETICAL DEVELOPMENT

Value chain activities of IT organization

The Value Chain [28] in its original sense was defined as a sequence of value-enhancing activities. In its simplest form, raw materials are formed into components, which are assembled into final products, distributed, sold, and serviced. However, it can also put a stranglehold on innovation at a time when the greatest opportunities for value creation in a linear view. To apply the concept of value chain to the study of IT management, Gibson describes the four basic value-chain activities of an IT organization: (1) Planning of applications and of technical infrastructure, (2) Development of applications, (3) Operations or use of developed applications, and (4) Technical service and support of applications [12]. Whereas these basic value-chain IT activities focus on the technical aspects of the IT operations, a close relationship is built up between these technical aspects and the relevant ITGC activities: ITGC are vital internal controls

within the IT organization and environment in preventing and detecting fraud and protecting the organization's resources, both physical (e.g., machinery and property) and intangible (e.g., reputation or intellectual property such as trademarks), to ensure positive business value could be generated [8] (Figure 1).

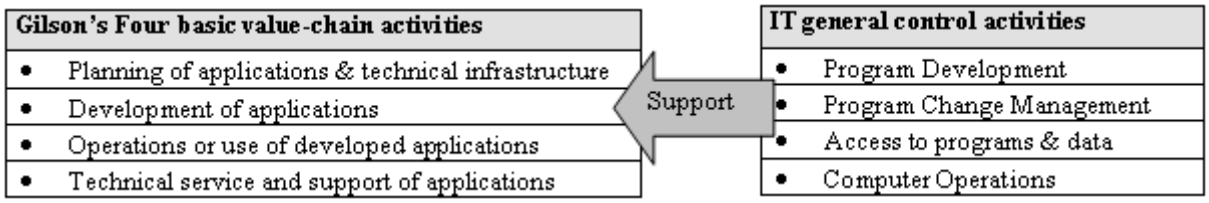

Figure 1: Relationship between ITGC and Gibson's four basic value-chain activities

Recently, the term value grid has been developed to highlight the fact that competition in the value chain has been shifting away from the strict linear view defined by the traditional 'value chain' model [27]. The grid approach allows firms to think and move beyond immediately recognizable opportunities and across industry lines. The advantages of the value-grid framework are to allow companies' management to strategize and coordinate operations. Common non-linear value chain strategies include influencing demand, managing system change, modifying information access, managing risk, seizing value, integrating value, creating new value propositions, exploiting value chains across tiers, pursuing pinch-point mapping, and defining demand enablers. Figure 2 depicts that the linear value chain is supported by IS while IS are actually supported by the IT control activities that help controlling risk and improving security, performance as well as reliability of systems and data. This is then an example of a multi-direction value chain: while supporting Porter's value chain, there is a new dimension – IT control processes, particularly ITGC. Though ITGC are indirectly generating the revenue ($), Porter's value chain activities cannot stand alone without their support.

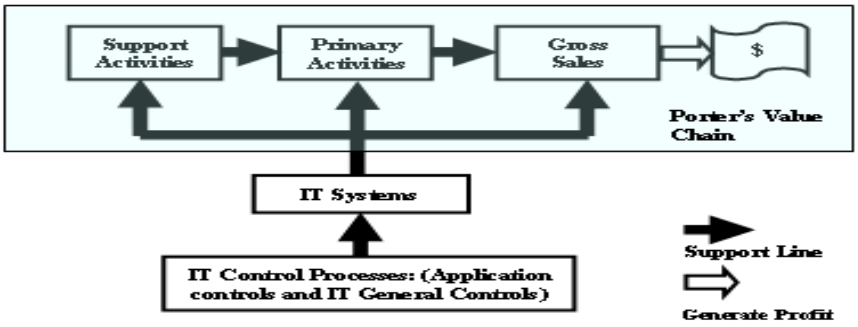

Figure 2: Business value chain supported by IS and their control processes.

To such an extent, the control and monitoring of IS is crucial. IS are not solely the IT alone that provides operations and incurring values for businesses. IT consists of the sequence of processes that create value: dreaming up a solution, building that solution, and then delivering the solution as a service that meets the business need or capitalizes on the business opportunity [10]. ITGC, as a supporting foundation for IS, play a critical role in assuring the generation of positive business value.

Business value dials

What may be the business values of ITGC? Curley argues that the performance of an IT value chain (including ITGC processes) is ultimately measured by the business value it delivers [10]. He defines business value as the benefit for business units and the enterprise as a whole which is usually presented in the financial achievement (e.g. return on investment). In order to measure the tangible and intangible values driven by the

IT value chain, Curley developed a series of different indicators called value dials. The value dials represent a broad range agenda for the IT organization in delivering agile, high quality, creative, productive, and efficient solutions, which in turn deliver business value and competitive advantage to the firm. Examples of some indicators include direct contribution to the organization's market position or revenue, deliverables/results that support solving customer business needs and challenges, customer cost savings or financial benefits, and technology investment that advance the industry.

Sward further advocates the concept of Curley. Sward regards that business value dials represent the common language for identifying the value IT solutions deliver [32]. Business value dials provide common definitions, context, and focus on where IT solutions are delivering value. They provide a framework for IT professionals to understand how to quantify the business benefits of IT. Using the business value dials as a language, IT organizations can more effectively communicate the value they deliver through IT solutions. This approach helps to put IT into the proper perspectives of business problems, the necessary business and financial modeling, and the necessary discussions for making a good business decision. To define business value dials, organizations need to know what is seen as valuable through the eyes of end-users as well as internal and external customers of IT. Sward suggests that IT managers should think differently about how they evaluate successful IT investments (Figure 3).

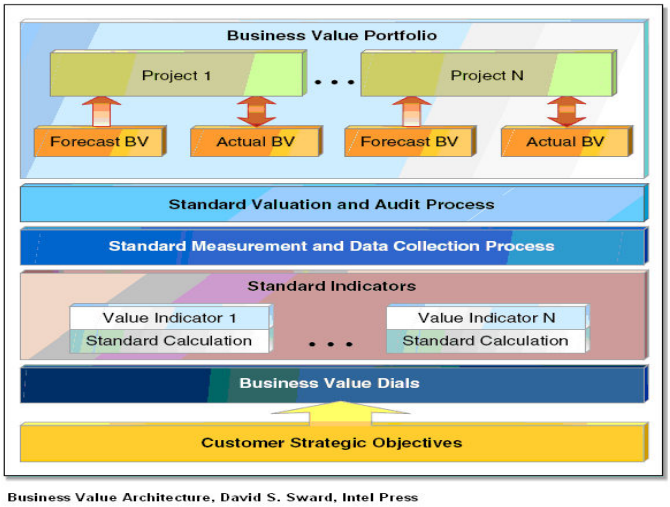

Figure 3: Business Value Architecture

Business value dials form a framework for measurement activities associated with assessing the value of IT projects or IT processes. Examples of business value dials include customer need, business and technical risks, strategic alignment, revenue potential, level of investment required, the innovation and learning that an investment generates, and user productivity. Along these lines, Intel Corporation developed a set of value dials that map to their customer strategic objectives: reduce/remove user errors, remove the activity a user performs, reduce the time it takes to complete an activity, reduce time to proficiency for an activity, and restructure the nature of the activity to eliminate all or a portion of the activity.

Sward has been working with the Intel team and has successfully and practically defined a set of business dials. In the article, "Measuring IT Success at the Bottom Line" [33], Sward and the Intel team, through the adoption of the Business Value Architecture (Figure 3), have demonstrated that IT is able to deliver significant business value of more than USD5.5 billion. This represents a growth in business value of more than 33 percent year over year. To bring in more insight to the understanding of the business value of IT control processes and more specifically ITGC, the value dials practically defined and adopted by Sward and the Intel Corporation (e.g. business and technical risks, strategic alignment, user productivity and etc.) have been adopted as important references for the framework development in this research.

Research model

In constructing the research model for the study of the business value of ITGC, two different sets of variables (independent and dependent variables) have developed. As for the independent variables, four ITGC processes (program development, program change, access to program/data, and computer operations) have been chosen. Each of these ITGC processes were broken down into sub-processes according to their nature (Table 1).

Table 1: ITGC Process and Sub-Process (independent variables)

ITGC processes	Variable Name	Sub Variable Name	Constructs of ITGC Sub Processes
Program Development	PD	PD1	Process of policies & procedures for program development
		PD2	Process of project initiation (project planning, scope definition, & approval requirements)
		PD3	Process of analysis & design, including business & technical specifications
		PD4	Process of software/hardware package selection procedures
		PD5	Process of development, testing & quality assurance
		PD6	Process of data conversion
		PD7	Process of "go-live" procedures
		PD8	Process of development, user & technical documentation, & training
PD = PD1 + PD2 + PD3 + PD4 + PD5 +PD6 + PD7 + PD8			
Program Change	PC	PC1	Process of policies & procedures for program change
		PC2	Process of change specification, authorization & tracking
		PC3	Process of change construction, including development environments & source code controls
		PC4	Process of change testing & quality assurance
		PC5	Process of change authorization to live environment
		PC6	Process of change for users, technical documentation, & training
PC = PC1 + PC2 + PC3 + PC4 + PC5 + PC6			
Access to Programs and Data	APD	APD1	Process of policies & procedures for access
		APD2	Process of organization & management for access
		APD3	Process of application security administration
		APD4	Process of database security administration
		APD5	Process of operating system security administration
		APD6	Process of internal network security -LAN, wireless
		APD7	Process of physical security
APD = APD1 + APD2 + APD3+ APD4 + APD5+APD6 + APD7			
Computer Operations	CO	CO1	Process of policies & procedures for computer operations
		CO2	Process of organization & management for computer operations
		CO3	Process of scheduling & batch processing
		CO4	Process of backup management
		CO5	Process of recovery procedures from operational failure
CO = CO1 + CO2 + CO3 + CO4 + CO5			

Further to the construction of the independent variables, a set of dependent variables are here introduced. Adopting the business values dials of Sward and the Intel Corporation, three most important value dials are adopted in this research: (1) strategic alignment, (2) user productivity, and (3) business and technical risks. There are also other values dials currently practicing in Intel Corporation, e.g. customer needs, revenue potential, level of investment required, etc. but because they are not directly related to the effectiveness of ITGC activities, they are not adopted in this research.

From the three selected value dials, further interpretations are developed as the dependent variables:

1. Strategic Alignment (SA): The alignment of IS development as well as ITGC to the business plan of the organization are important to ensure

that the goals and objectives of the overall business is met, particularly in a cost effective manner. Although business value of IT and strategic alignment are often treated as separate issues [6], researchers have linked both issues by arguing that organizations' inability to realize sufficient value from IT investments is due in part to an absence of strategic alignment [14] [39]. Consistent with previous research on strategic choice [7], prior studies have portrayed the "content" of alignment as a series of intersecting and mutually consistent choice across four processes comprising business strategy, IT strategy, organizational infrastructure and processes, and IT infrastructure and processes. Various researchers have also highlighted the potential benefits from adopting a process-oriented perspective on IT business value [1] [9]. It has been argued that the impacts of IT investment and IT strategic alignment should be measured at lower operational process levels within the organization since this is typically the level at which the technology is implemented [3]. Although executives are skeptical of the payoffs of IT investment due to its difficulties in achieving tangible benefits [38], Tallon et al. provide evidence that corporations with clear strategic goals for IT could achieve higher levels of strategic alignment, therefore higher IT business value [35] [36].

Henderson and Venkatraman argue that the difficulty to realize value from IT investments is firstly due to the lack of alignment between the business and IT strategy of the organizations, and secondly due to the lack of a dynamic administrative process to ensure continuous alignment between the business and IT domains [14]. They then describe four dominant alignment perspectives towards the analytic alignment of business and IT, and they are 1) Strategy Execution, 2) Technology Potential, 3) Competitive Potential and 4) Service Level. To proceed to the investigation of the business value of strategic alignment brought by ITGC, three IT business value (BV) indicators for strategic alignment are here established from the four domains of Henderson and Venkatraman (Table 2).

Table 2: BV1 Strategic Alignment

Variable ID	**BV1: Strategic Alignment (SA)**
SA1	IT systems and capabilities impact new products and services, influence the key attributes of business strategies, as well as develop new forms of relationships internally and externally.
SA2	The IT resources are effectively used and the resources are responsive to the growing and fast-changing demands of the end user population.
SA3	IT systems meet the expectations of users. The system and supporting infrastructure are designed or implemented under procedures outlined in the organization goal and objective.
SA = SA1 + SA2 + SA3	

2. System Performances (SP): Improving system performance and, in turn, user productivity, may create business value and benefits [30]. System performances can help to create business value and the benefits including faster application response time, improved staff collaboration, productivity and flexibility, increased infrastructure agility at reduced costs and lower bandwidth costs. Three IT business value indicators for system performance are established: (1) fast response time, (2) better business infrastructure agility and (3) staff collaboration, productivity and flexibility (Table 3).

Table 3: BV2 System Performance (SP)

Variable ID	BV2: System Performances (SP)
SP1	Application / systems have fast response times that fully satisfy the needs of end users and customers
SP2	IT systems can help and improve business infrastructure agility at reduced costs with high throughput.
SP3	Organization's application / system can always help to improve staff collaboration, productivity and flexibility
SP = SP1 + SP2 + SP3	

3. System/Information Security (SS): Improved system security can help organizations to minimize business and technical risks from unauthorized or illegal access to business sensitive data [16]. Information system security refers to the availability, confidentiality, and integrity of systems and information controlled by the IT department or management according to the definition of international standard, SO/IEC 27001 "Information technology — Security techniques — Information security management systems — Requirements" [17]. Strong IT controls are positively associated with higher levels of these three security objectives because the controls help to ensure that the processes are followed correctly. Research shows that significant savings can be made [5]. Adequate securities measures help ensure that an organization stays in line with the demands of legislation as well as industry specific regulations. The Sarbanes Oxley Act, the Basel II Accord, and the European Human Rights Act, among others, all require a degree of security for compliance. Hayes suggests that security enhances profit, security reduces costs in excess of its expense, and security is a differentiator [13]. Business organizations require security for their own operations and for their interactions with customers and partners [15]. Thus, three IT business value indicators are established to collect data for the chrematistics of security: (1) confidentiality, (2) integrity and (3) availability (Table 4).

Table 4: BV3 System / Information Security (SS)

Variable ID	BV3: System / Information Security (SS)
SS1	Organization stays in line with the demands of legislation as well as industry specific regulations and there is no potential business interruptions caused by incidents stemming from security events.
SS2	IT systems and infrastructures are operated and supported the validity of business transactions and enhanced the data integrity.
SS3	IT systems and IS infrastructure are always available for supporting the business processes.
SS = SS1 + SS2 + SS3	

Based on the different variables identified, the following hypotheses and conceptual research model were developed:

H1: Certain ITGC processes (Program Development, Program Change, Access to Program and Data, and Computer Operations) have positive influence on the value dial "Strategic Alignment".

H2: Certain ITGC processes (Program Development, Program Change, Access to Program and Data, and Computer Operations) have positive influence on the value dial "System Performance".

H3: Certain ITGC processes (Program Development, Program Change, Access to Program and Data, and

Computer Operations) have positive influence on the value dial "System/Information Security".

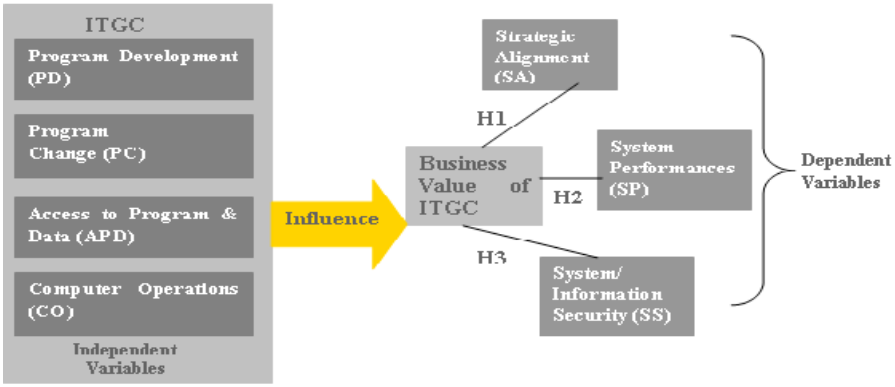

Figure 4: Conceptual research model

RESEARCH METHODOLOGY

Development of measures and data collection

In this study, questionnaire was adopted as the survey instrument. The unit of analysis was the relationship between ITGC and business value. To better evaluate the ITGC processes, each main ITGC processes are broken down into sub-processes (Table 1) according to their process nature. The breakdowns of ITGC processes into sub-processes are taken reference from the Appendix C of "IT Control Objectives for Sarbanes-Oxley, 2nd Edition" [18]. Furthermore, based on the characteristics of the three value dials (Strategic Alignment, System Performance, and System Security), the respective value indicators with the impacting areas are illustrated in Table 2, 3, and 4.

With the research framework, a questionnaire was developed. In this research, a 5-point Likert scale was adopted for measuring the IT business value presented in the questionnaire, with '1' meaning 'No Value' to '5' meaning "Very High Value". The survey instrument was subsequently refined through extensive pre-testing with a group of nine IT professional who have been working in world best 500 companies. The time required to complete the questionnaire is recorded to determine whether it is appropriate. This group was also asked to evaluate whether the items could fully represent the proposed business values to ITGC processes and whether there are ambiguities and/or poor wording. These procedures help to ensure the validity of the measured items. With the confirmation of the validity of the questionnaire by the group, the questionnaires were sent out to each respondent via email.

Respondents and sample profile

This survey was conducted in China with companies listed in any stock exchange market that were obliged to the Sarbanes-Oxley Act 2002. Companies listed in the Shanghai and Shenzhen Stock Exchange (China) were excluded because they were not obliged to implement the IT control framework to inline with the global standard in US, Japan, UK, or HK. The targeted respondents of the survey were IT managers, network/system administrators, and IT security officers. The targeted respondents were required to have years of working experiences in IT area and deep knowledge in their companies' IT environment and IT processes.

In the survey, 41 questionnaires had been distributed and 30 valid samples returned. The response rate, therefore, is 73%. Table 5 shows the respondents' profile. It shows that the survey respondents were professionals in the IT industry. All respondents were highly creditable and their ideas were considered to be representative because only the IT professional with strong working experiences in the field were selected. All respondents are highly educated with hands-on experience in IT management and IT operation (i.e. more than 86% respondents have at least 8 year working experiences or above). Most of them were professional engineers and managers related to IT management or operation area. All respondents were working or have worked in creditable organizations with well-developed IT systems and infrastructures. Thus, it would be considered that the data collected is highly reliable. From the respondent profiles,

it shows that 53% of surveyed respondents are located in Beijing and the rest in other provinces of China. As considering Beijing as the cultural, political, and economic center of China, many well-known foreign companies, joint ventures, and China State Owned Enterprises have chosen Beijing as their headquarters for business operations and IT management. Other cities where respondents of this research were located were Wuhan, Chengdu, Qingdao, Dalian, Guangzhao, etc.

Table 5: Respondent Profiles (N=30)

Title of Respondent	**Frequency**	**Percent**	**Cumulative Percent**
Senior IT Manager/ Director	3	10%	10
IT Manager	6	20%	30
System Engineer, IT Administrator	21	70%	100
Location of Respondent	**Frequency**	**Percent**	**Cumulative Percent**
Beijing	16	53%	53
Other provinces of China	14	47%	100
Year of IT Experiences	**Frequency**	**Percent**	**Cumulative Percent**
3-5 years	4	13.3%	13.3
6 – 8 years	16	53.3%	66.6
More 8 years	10	33.3%	100
Education level	**Frequency**	**Percent**	**Cumulative Percent**
Bachelor	20	67%	67
Master (or above)	10	33%	100

ANALYSIS AND RESULTS

Reliability analysis

The data set was examined for reliability by using Cronbach's alpha. The values of Cronbach's alpha, mean, and standard deviation for each factor are listed in Table 6. All the Cronbach's alpha values are above the acceptance level of 0.7 and thus, the reliability of the constructs is high [26].

Table 6: Reliability analysis of the constructs

Factors	**Number of Items**	**Mean**	**Std. Deviation**	**Reliability (Cronbach's alpha)**
PD	8	2.846	0.64132	0.939
PC	6	3.056	0.61640	0.926
APD	7	3.157	0.83075	0.961
CO	5	2.493	0.72156	0.956
SA	3	3.044	0.61733	0.860
SP	3	2.70	0.77484	0.975
SS	3	3.233	0.79341	0.945

Means, standard deviations, and correlations

Table 6 also shows the means and standard deviations of the constructs. Since each factor has been measured by more than one item, the mean of each factor is calculated as well. As a 5-point Likert scale was adopted in the questionnaire, the respondents showed a general medium level ("3") of ITGC process. All factors

are significantly correlated with one another at 0.01-level of significance. Gauch's criteria on closeness of correlation describes that if absolute value of correlation is equal or higher than 0.5, the relationship is considered strong; if it is between 0.3 and 0.5, it is a moderate relationship; if it is below 0.3, it is regarded as a weak relationship [11]. Based on Gauch criteria, the dependent and independent variables have strong positive correlation with SA (0.860), SP (0.975) and SS 0(.945). Table 6 also shows that the independent variables are strongly correlated with PD (0.939), PC 0(.926), APD (0.961), and CO (0.956).

Tests for the hypotheses

Results of the regression analysis on SA

H1: Certain ITGC activities (PD, PC, APD, CO) have positive influence on the value dial "Strategic Alignment" (SA)

The first regression was designed to test the effect of PD, PC, APD, and CO on SA. As shown in Table 7, the results of the regression model provide strong support for the predictive power of PD and PC on SA. General regression model is found highly significant (p-value = 0.000) with F-value 30.629 and this result provides evidence about the predictive power of PD and PC. The standardized coefficient of PD (0.699) and PC (0.570) indicate that PD and PC are positively, albeit moderately predict SA with a t-value of 8.451 and 6.551 respectively. Both independent variables (PD and PC) are significant in this model. Adjusted R2 represented 80.3 percent of the variance in SA which also shows that PD and PC have strong influence on SA. Logically, it makes sense because the control activities of PD and PC are basically helping the IT organization to manage the development and change of IS according to the demands from business, which are driven by management. The end result is the series of system development and change that are aligned with organization goals and objectives. Thus, H1 is supported. APD and CO are excluded because the p value is greater than 0.01 and they are considered not significant to the dependent variable, SA.

Table 7: Regression results of ITGC processes on System Alignment (SA)

Independent Var.	Unstandardized		Standardized Beta	t-value	Sig.
	Coefficients	Std. Error			
PD	0.673	0.080	0.699	8.451	0.000
PC	0.570	0.087	0.570	6.551	0.000
R^2	0.831				
Adjusted R^2	0.803				
F-value	30.629				0.000
Excluded Var.					
APD	-0.069	0.072	-0.093	-0.953	0.350
CO	0.048	0.082	0.056	0.583	0.565

Results of the regression analysis on SP

H2: Certain ITGC activities (PD, PC, APD, and CO) have positive influence on the value dial "System Performance" (SP)

The second regression was to test the effects of PD, PC, APD, and CO on SP. Testing results of H2 indicate that CO is significantly related to SP (p-value = 0.000; F-value = 92.236) as illustrated in Table 8. With the standardized coefficient of 0.972, CO is positively related to SP with t-value of 16.627, hence, the relationship proposed in H2 is supported. It is reasonable that with higher Computer Operations (CO), higher System Performance (SP) could be achieved. Thus, statistical result of this survey is logical and reasonable. On the other hand, PD, PC and APD are excluded because the p value is greater than 0.01 and they are considered not significant to the dependent variable of SA.

Table 8: Regression results of ITGC processes on System Performance (SP)

Independent Var.	Unstandardized		Standardized Beta	t-value	Sig.
	Coefficients	Std. Error			
CO	1.044	0.063	0.972	16.627	0.000
R^2	0.937				
Adjusted R^2	0.927				
F-value	92.236				0.000
Excluded Var.					
PD	0.001	0.061	0.001	0.020	0.984
PC	-0.096	0.067	-0.076	-1.437	0.163
APD	0.048	0.056	0.051	0.862	0.397

Results of the regression analysis on SS

H3: Certain ITGC activities (PD, PC, APD and CO) have positive influence on the value dial "Systems Security" (SS)

The third regression was to test the effects of PD, PC, APD, and CO on SS. The regression results depict in Table 9 show that APD is significant at $p<0.01$. From the regression results, the R2 is 0.945, which means around 94.5% of attitude can be explained by this hypothesis. All other three independent variables (Program Development, Program Change, and Computer Operations) are not significant in this test. According to the industry best practice, the objective of APD activities is to improve the security standard across organization. In particular, the main objectives of APD activities are to ensure that accessing to system resources and data is authenticated and authorized as per organizational policy, to maintain the effectiveness of authentication and access mechanisms (e.g., regular password changes, password policies, structure & usage), to authenticate all users uniquely to systems to support the validity of transactions, and to ensure that physical facilities of the organization are equipped with adequate physical security controls to prevent/detect unauthorized access to significant system hardware/facilities and sensitive areas. It, thus, explains the reasonableness of the relatively high R2 value. Hence, it agrees with the finding that the variance adjusted R2 (94.5%) is relatively high and that APD possesses high explaining power to SS. Therefore, H3 is supported.

Table 9: Regression results of ITGC processes on System Performance (SS)

Independent Var.	Unstandardized		Standardized Beta	t-value	Sig.
	Coefficients	Std. Error			
APD	0.948	0.053	0.993	17.948	0.000
R^2	0.945				
Adjusted R^2	0.937				
F-value	107.990				0.000
Excluded Var.					
PD	0.125	0.058	0.101	2.153	0.041
PC	-0.003	0.064	-0.003	-0.054	0.957
APD	0.054	0.060	0.049	0.902	0.376

FINDINGS AND IMPLICATIONS

Findings

H1: Program Development and Program Change → Strategic Alignment

In this research, the processes of Program Development and Program Change are found to be two important factors influencing Strategic Alignment. This suggests that strategic alignment of IT processes and systems to an organization's objective depends on the correct and adequate controls in the area of program development and program change processes. In other words, the results of this research suggest that Strategic Alignment of IS with the business plan is dependent on how IT development is planned, implemented, changed, and monitor. H1 is supported. The results also imply that appropriate coordination and communication between ITGC processes may allow a higher level of strategic fit between business and IS development. This also agrees with the findings from other researches [20] [34] [35] that if organizations have clear IT strategic goals, they can achieve higher levels of strategic alignment with business strategy, and, therefore, represents higher IT business value.

H2: Computer Operations → System Performance

The results show that Computer Operations is an important predictor of System Performance. Computer Operations within IT general control processes influences IS. This result is consistent with a recent study conducted by the IT Process Institute, funded by the Institute of Internal Auditors Research Foundation, which finds that IT controls improve the performance of a range of key IT operating processes [19].The results also tell us that organizations may need to consider the computer operation control process in order to generate higher system performance. H2 is supported.

H3: Access to Program/Data → System Security

The results of this study confirm the significant effects of Access to Program/Data on System Security. The results reveal that System Security is influenced by Access to Program/Data within the IT general control process. One reason why organization uses and implements the access controls to program/data is because system security is important to IS and, in turn, the whole organization. The confidentiality, integrity, and availability of the IS are very essential to organizations.

Study implications and recommendations

The role of IT in enabling business functions is, in fact, more important today than ever before. And the role of IT in driving business innovation — enabling differentiating capabilities that can create competitive advantages in the marketplace — is reaching paramount importance [15]. This research provides insight into the factors that influence the business values of IT. The research results are applicable to organizations in China as the data were collected in China. However, as some of the respondents are from the joint ventures and western organizations which are located in China, it may also imply that the research results may also be applicable to other countries.

Based on the research results, some implications for practice are derived. Firstly, it shows that the ITGC have their influences on business values and they are not solely the processes created for the purpose in compliance with required external regulations. This result agrees with that of other studies which investigate the business value of IT [23] [24]. Secondly, organizations are recommended to have adequate program development and program change control processes to be in place in order to ensure that their change or development on applications or systems to be strategically aligned with their organizations' goals and objectives. The management of organizations should provide directions for implementing IT controls and processes. Third, every organization should focus on the improvement of the access to program/data control processes to improve the security level of accessing organization's applications, and more importantly their data stored in the IS. This is because, nowadays, security to IS is one of the critical concerns for protecting software, information, and data from illegal access, damage to data integrity, and availability. Forth, it is recommended that organizations should have computer operation control processes in place to improve the overall IS performance. The findings of this study illustrate that computer operation controls can improve IT performance. This belief motivates IT executives to reframe the resources allocation decisions. Fifth, organizations are suggested to reposition the relationship of IT department with IT audit. IT audit can help bridge the gap between external requirements and enterprise risk assessments with IT operating processes and procedures. In addition, IT leaders should take an active role in developing IT controls so that positive performance could be achieved as well as meeting the risk reduction objectives. An IT audit team may help to verify that the designed procedures and controls are correctly implemented throughout the organization in order to achieve improved performance. Finally, the value management process of IT controls is not easy to attain. But once IT control process is viewed together with, and in terms of, business, it becomes easier for management to identify the business value. Organizations are suggested to manage their business processes with IT tools and ensure that appropriate IT control processes are in place to achieve maximum business benefits.

Contributions of research

This study has some contributions to theory and practice. From the theoretical perspective, many studies have examined the effect of information technology on business value [28]. This research is extending such studies by examining whether implementing best practices in IT service management, specifically IT controls, affect business value. Few papers have examined the importance of IT general control (ITGC) processes in organizations. Hence, this research extends the study of business value to IT general controls. Next, most academic studies who explored the different aspects of IT controls have employed case-study methods [31] or have been predominantly descriptive [2] [22]. In this research, a questionnaire survey approach is adopted which allows quantitative data to be collected and analyzed [4]. This study has also built a research model to study the business value of IT general control process. The test results show that there is correlation between IT general control processes and certain business values.

From a practical perspective, this research allows organizations to assess their efforts in managing IT resources. IT business value dials proposed in this research provide organizations with guidance on the implementation of IT general controls to increase business value. The research results also show the actual breakdown of the four ITGC processes (i.e. Program Development, Program Change, Access to Program and Data, and Computer Operations) and their causal relationship. It implies that if adequate IT general controls are in place, positive influence on business value could be achieved.

Limitations and future research

There are some limitations in this study. First, as the respondents and their organizations were drawn from China, the unique environmental, regulatory, and culture elements for managing and operating IT processes may exert certain influences on the research results. These unique factors that were not put into consideration may bring out deviations if this study is to be carried out in other countries. The sample size of this study may have also built in limitation to this research. It is believed that a larger sample may generate more convincing and generalized output. However, it is also due to the special cultural factor in China that data collection in large organizations and particularly regarding their IS practice and management has never been an easy task. Next, as this research is basically a quantitative study, formal interviews may be considered to be a supplement to improve the qualitative aspect of the analysis. Also, a group discussion session to discuss the overall results could provide valuable information to better understand the phenomena of IT business value. Whereas some inconsistent results are found from different respondents due to the fact that different IT project may have different levels of IT business value generated, more researches may be conducted in the future to validate the identified

relationship in this study and to provide a more realistic picture of the level of IT business value to the organization. Finally, only three IT business value dials (i.e. Strategic Alignment, System Performance, and System Security) for studying the IT general control processes were selected in this research. In future research, more business value dials for IT controls could be considered.

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