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Development and Validation of Project Management Constructs of Security Door Access Control Systems: A Pilot Study in Macau

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ABSTRACT: A Security Door Access Control System (SDACS) project involves a number of teams from different organizations with diverse project goals. One of the main challenges of such projects is the lack of a standard approach or common understanding to achieve a common goal among project parties. This research examines various management concerns for SDACS projects, highlights the expected common understanding for project participants, develops the project management constructs, and emphasizes on the resulting value of the project to all participants. A two-stage process of scale development and validation was conducted. First, six generic constructs were identified based on the Security Access Control System Framework. Next, a multi-item scale for each construct was developed with reference to the Result-Oriented Management Framework. Expert judges were invited to conduct manual sorting of the items iteratively until reliability and validity was reached. In the next stage, further refinement and validation were carried out with a synthesized survey instrument and a series of statistical testing followed. The finalized SDACS project management constructs and the related findings help reinforce the importance of a standardized management practice for SDACS projects. The value of this research not only benefits SDACS project managers but everyone who works on the project.

Keywords: Security access control system (SACS); Security door access control system (SDACS); Result-oriented management (ROM); Project management

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1. Introduction

Business organizations have increased their awareness in protecting their assets and providing higher quality security services to their customers as well as business partners (Post & Kingsbury, 1991). The term security management is held to be the management of people, structures, procedures, and systems that provide security protection to organizational assets (Cole, 1993). Security access control system (SACS) is one of the many aspects of security management. SACS controls the processes of access to requested resources/data (Samarati & Vimercati, 2001). It involves all the hardware, software, people, and mechanisms for the protection of an organization's assets and can be categorized into two areas: information security and physical security. Information security typically concerns computer security access and telecommunication security access. Physical security involves surveillance systems, vehicle access systems, elevator systems, infrared systems, and security door access control systems.

Among all the components of SACS, security door access control system (SDACS) deserves special attention. SDACS may not be the most popular, but the complex structure and the vast resources involved make it a complicated one. SDACS is used for controlling access to restricted areas and it also provides a platform for access control staff to monitor entrants' activities, entrance history, system performance, and many types of emergency alarms such as panic alarms in disability rooms, cashier windows, and vibration alarms in computer rooms. SDACS is also integrated with building automation systems that control heating, lighting, closed-circuit television, and other appliances. SDACS allows the protection of assets in restricted areas and assists in monitoring entrances to those areas. The information collected during the monitoring process enables better management of organizational assets.

The technical complexity of the system requires a lot of effort of information technology (IT) engineers who plan and develop the required network configuration, database control, and system maintenance. Aside from that, the administrative department also plays a critical role. For example, designated people are needed (project managers and project teams) to follow up on project development; procurement and finance staff to plan, finance, and purchase necessary equipment; access administrators to assign access right to entrants, and manage access card distribution, door access level and system setting; operational staff to handle daily operations, monitoring and system maintenance. Table 1 lists the participants in a SDACS project. It is common for many SDACS projects to involve quite a large number of participants and this is where the challenge of the project lies. There is a lack of standard or common understanding to achieve a common goal among various project parties; there is no standard format or benchmark for project development, cost control and ongoing operation management in the market which could be followed. Thus, SDACS projects often result as run-away projects. To alleviate the aforementioned problems, there needs to be a result-oriented and value-based project management framework for SDACS projects that highlights the objectives, allows common information-sharing and understanding for all project participants, and emphasizes on the resulting value of the project.

SDACS project parties	Operation tasks
IT team, vendors, department users	Set up servers/client stations
IT team, vendors	Configure network
Vendors, contractors	Install all devices
Access administrator and human resources department	Assign access cards, enroll employees in fingerprint and facial recognition
Vendors, system administrators, constructors	Standardize system information
Operators and staff working on floor	Monitor and check alarms
Access administrator	Assign access levels to employee and operators
Department head, system administrators, contractors	Set up alarm priority and build up graphics
Software and hardware engineer, vendors	Maintain software and hardware systems
Procurement department, finance department, system administrators	Procure additional requests and spare units
Contractors, operations team and system administrators	Keep updating of company development
System users, vendors	Provide training
Department head, legal advisors, system administrators	Perform contract review and update requirement/system development
System administrators	Assess risks regularly
System users, department heads/managers, system administrators	Establish procedures and on-going management

Table 1 SDACS project parties

Another reason for the development of a SDACS project management framework is that the authors have experienced and noticed a number of impaired projects in Macau, a special administrative region of China, where they are working. In the last decade, a great number of hotels, resorts, and casinos were established in Macau. Between 2002 and 2012, the number of hotels and guesthouses increased from 68 to 100, with the total number of guestrooms increasing from 8,869 to 28,643 (Hotels and Similar Establishments Survey 2002-2012, Direcção dos Serviços de Estatística e Censos, Macau). The total number of casinos has also enjoyed a triple increment to 35 casinos as at December 2013 (Gaming Sector Survey, Direcção dos Serviços de Estatística e Censos, Macau). SDACS project is one of the most important IT projects for these organizations. However, due to the lack of experience as well as limited project resources, SDACS projects' outcomes were often not as expected or they resulted in additional time and capital investment. In any case, project parties often become involved in conflicts of all kinds. It is believed that Macau as well as other similar markets may benefit from a standardized SDACS project management approach for improving project quality and success. Based on the challenges, the objectives of this research are summarized as follows:

- to develop a standardized approach for SDACS projects;
- to highlight the importance of result-oriented management to SDACS project participants; and
- to improve stakeholders' communication and satisfaction throughout the project life cycle, i.e., from the initiation of the project to the completion.

To achieve the above objectives, the Security Access Control System (SACS) Framework and the Result-Oriented Management (ROM) Framework were used as references. The SACS framework provides the basic concepts for the development of SDACS project management

constructs. These concepts encompass the mechanisms and technology for the project, the business standards, the management of system installation and maintenance, project cost allocation, the control of access cards, and the ongoing management of the system, which are all the critical components of a SDACS project. The ROM framework offers the required concepts for developing a collaborative project environment that emphasizes on clear project objectives and results. The ROM framework was adopted because it offers benefits not only to the business organizations for the achievement of the projects but also to the workers who contribute to the projects.

2. Literature review

2.1 Security access control system (SACS) framework

As there is no available project management framework which could serve as direct reference for SDACS projects, the York University's SACS Project Framework (York University, 2006) was adopted for reference. SDACS project is one of the two main areas of SACS projects. The elements of a SACS project reflect the essential components of a SDACS project and, thus, the SACS Project Framework suits the research purpose. The framework describes the basic concepts for a SACS project from planning to development. It also highlights the resources needed including equipment, costs, and human resources in the project. In general, the framework outlines the basic constructs for a SACS project as well as the needs for a SDACS project. The framework suggests the following six criteria to bring about successful project outcome:

1. Appropriate mechanisms and technology are adopted.

Due to the rapid development of technology, there is a great choice of appropriate mechanisms and IT for SACS projects. However, various project objectives among project parties as well as user objectives may lead to different preferences. This leads to incompatible technologies, communication problems, loss of project focus, conflicting ideas, and even project failure. SACS project teams should adopt appropriate mechanism and technology in accordance with the goals, work experience, as well as resource systems of the working parties. For instance, project teams, vendors, administrative users, and software and hardware engineers should be involved in the project from its very beginning so that concern and suggestions could bring about consensus on the choice of appropriate mechanisms and technology; project teams may consider the type of mechanism which could suit the premises; administrative users, software and hardware engineers may consider the quantities and requirements of the devices; vendors may provide solutions accordingly.

2. Project output is up to business standards.

A SACS project is intended to protect and secure assets of an organization. However, different organizations may have specific needs and concerns for a project. Market expectations should also be considered because a successful project should not only entertain project sponsors but also end-users and customers. It is, thus, important to identify the needs and concerns of the various parties in the project, examine them, and build acceptable standards based on agreement.

Standards are always important to project participants who need to know and understand what they should do, why they have to do, what is expected, and whether or not the project is worth their effort. Benchmarking may help to identify the required standards.

3. Effective access control installations and ongoing maintenance are applied.

Access control installations and ongoing maintenance should be delivered in the most effective manner. The system software and hardware component of operations includes controls over effective acquisition, installation, configuration, integration and maintenance. Ongoing control involves service-level management, management of third-party services, system availability, system management, operations management, facilities management, and incident/crisis management. System installation and implementation is important for project completion, while ongoing maintenance ensures the implemented system fits organizational expectations and enables the project to succeed. Sound planning for these activities allows smooth implementation as well as risk mitigation.

4. Fair and consistent cost allocation is practiced.

Client organizations and vendors should jointly determine the project scope and budget, and with sign-off by the parties before project initiation. Cost allocation should be done in a fair and consistent manner based on clear criteria to all project parties. According to Guan, Hansen, and Mowen (2008), the involved parties can be categorized into producing departments and supporting departments. Producing departments are directly responsible for creating products or services to be sold to customers; supporting departments provide essential services for the producing departments and are indirectly connected with an organization's services or products. Identifying and categorizing the various types of costs under the two working departments may help project teams and project sponsors to conduct cost allocation in a systematic manner.

5. Access cards are properly controlled.

Access cards are plastic cards with chips or magnetic strips containing encoded data that is read by an electronic device to provide authorized access to restricted or secure areas. These cards are tailor-made and are independent from other card systems or devices (e.g. smartphones or stored value smart cards for electronic payment) so as to assure the reliability of the security system and to avoid problems of having complex systems on a card. The control and distribution of access cards for SACS projects should be managed through a coordinated, multi-level system. Access cards offer the main control over whether internal and external users are allowed access to offices, facilities or buildings. Communication and coordination between control staff and the relevant user departments allows correct information regarding to whom and how access right should be granted. A multiple-level system of controlling ensures no single person can regulate the entire system.

6. Institutional standards of ongoing management are established.

Institutional standards are necessary for the establishment of common understanding, responsibility, and accountability for management tasks. Ongoing controls over operations address the day-to-day delivery of functional responsibilities, overseeing the operations, physical

installations, and access management. Overarching custodial responsibility is usually allocated to different parties in a business; thus, they should execute their responsibilities under clear standards and expectations. Organizations may have to tailor-make these standards according to their resources and with reference to the products and businesses in the market.

The SACS Framework has set out the general criteria for SACS project development. It also highlights the resources required in the project. In a study by Bauer, Cranor, Reeder et al. (2009), the authors discussed the importance of joint effort of multiple parties in the management of a SACS project. A common understanding for expected project goals and results would then be critical for project collaboration. However, there is no information or guideline to support collaboration among project parties in the SACS Framework. As such, the Result-Oriented Management Framework was adopted as another important reference for project collaboration.

2.2 Result-oriented management (ROM) framework

To highlight the expected results of a SDACS project and to identify the information needs for collaboration throughout the project life cycle, reference to business management frameworks is needed. Among the various management frameworks, the Result-Oriented Management (ROM) Framework (Schouten & Beers, 2010) acts as an important reference. ROM emphasizes that all parties should have the same understanding and expectation of their work and have a clear goal to achieve; all agreements must always be "SMART" — Specific, Measurable, Accepted, Relevant, and Traceable. Based on the consensus made and common expectation for their work, workers are free to determine how they want to achieve their targets. Every worker will be assigned tasks with clear responsibilities and objectives.

The ROM framework is based on the idea that workers will work with more enthusiasm and satisfaction if:

- they clearly know what is expected from them;
- they are involved in establishing these expectations;
- they are allowed to determine how they are going to meet these expectations; and
- they can obtain feedback on their performance.

ROM is primarily based on the question of whether all activities will lead to the desired result. The reason of choosing ROM for SDACS projects is that ROM offers the benefits to both the project team as well as to the business, as listed in Table 2. The application of ROM to the study of SDACS projects is expected to develop a more valuable and result-oriented SDACS project management framework so that all participants of SDACS projects could have better direction and understanding towards project success.

Benefits to project teams	Benefits to businesses
Better means adapted to goals	More purposeful and greater chances of success (thanks to clear assignments)
Higher motivation through learning	Better planning and improved harmony between goals and means and between the various goals
More room for personal approach and creativity	Greater learning effect through more resolute analysis and consideration of activities (provided there is follow-up control and assessment)
More objective assessment	Higher motivation through greater involvement and more personal responsibility

Table 2 Benefits of ROM Framework

3. Conceptual diagram and constructs

3.1 Conceptual diagram

With the SACS Framework as a reference for SDACS project management constructs and the ROM Framework as the guideline for project management results, a conceptual diagram for this research is presented in Figure 1. The key issue of this research is to relate the SDACS constructs to better SDACS project development and management.

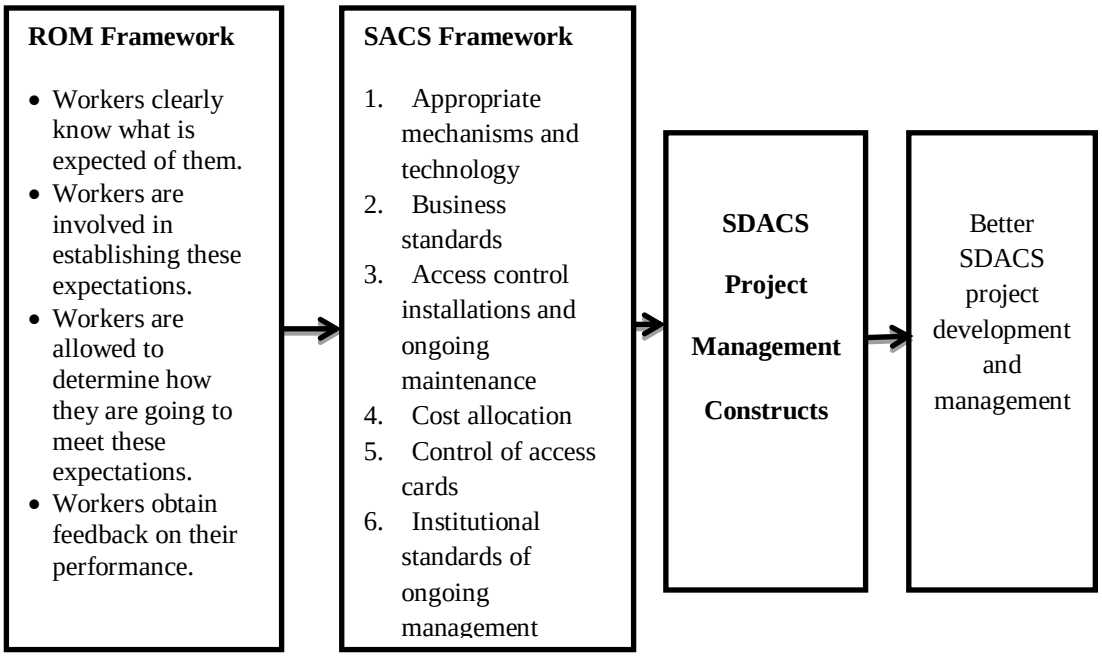

Figure 1 Conceptual diagram

3.2 Proposed research constructs

A list of proposed research constructs for SDACS project development and management is shown in the Appendix. It consists of six constructs and each consists of multi-measuring items.

These six constructs are based on the elements from the SACS Framework. The multi-item measurement scale under each construct is derived from the ideas of the ROM Framework. They are synthesized by the authors through interviews and research they have done as well as from their practical experience. The following shows the number of measurement items in each construct:

1. Appropriate mechanisms and technology (13 items)
2. Business standards (14 items)
3. Access control installations and ongoing maintenance (14 items)
4. Costs allocation (14 items)
5. Control of access cards (14 items)
6. Institutional standards of ongoing management (18 items)

A total of 87 items are presented in the proposed constructs. Validation and refinement of the multi-item scales are important parts of this research as they serve to identify what is appropriate and significant for SDACS projects. The scale development, validation, and refinement processes are discussed in detail in the next section, Scale Development and Validation.

4. Scale development and validation

With reference to a research conducted by Stratman and Roth (2002) on the development of enterprise resources planning constructs, a similar two-stage approach was adopted to bring about the required SDACS project management constructs as well as to refine them. This research was conducted in Macau (SAR), China, which has enjoyed a great development in the hospitality and gaming industry in the last decade. The number of guestrooms and casinos available has more than tripled and has generated a great demand for SDACS. However, limited project resources have led to challenges to SDACS projects. A study conducted in Macau could reveal the management concerns and challenges of such.

4.1 Scale development

First, a portfolio of six main constructs for SDACS project management was identified based on the literature reviewed. The multi-item instrument development methodology (Churchill, 1979) was adopted to further describe each construct. The reason for applying the multi-item scale is that a single-item scale is often impossible to explain the complexity of contemporary business environment. Particularly when studying a project with various business partners, multi-item development methodology allows a thorough consideration of the different perspectives. As a result, a number of measurement items were identified under each construct based on the literature reviewed, unstructured interviews with experienced practitioners, site visits, and the authors' experience (Appendix). Based on such, an initial item pool was generated.

Next, to test whether the item pool was valid and relevant to SDACS projects, the manual item sorting technique (Menor, 2000; Moore & Benbasat, 1991; Segars et al., 1998) was applied. All items were scrambled to create a random list. Expert judges were invited to match the items in the random list to each of the identified constructs until tentative reliability and validity was established. For any leftover items that were not classified, expert judges were asked to identify whether those items were unnecessary or the new constructs were needed. The judges could also suggest any rewording of the constructs and/or items to improve the accuracy of the research. As a result, a new item pool was generated and similar sorting processes repeated until all items

were sorted and no enhancement was made to the constructs and items. The content of this iterative process is illustrated in Figure 2. A total of five rounds of manual sorting were conducted to achieve the expected result.

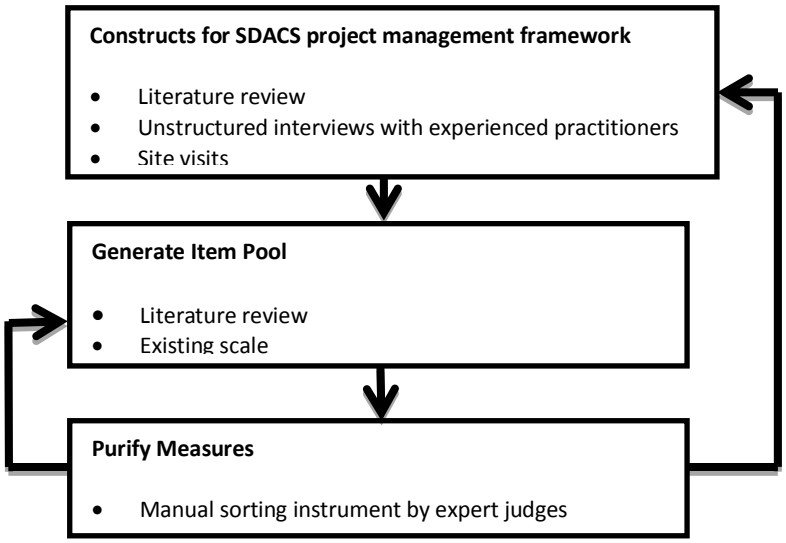

Figure 2 SDACS project management constructs measurement scale development methodology (Stratman & Roth, 2002)

The expert judges who were invited for manual sorting are all experienced practitioners who hold various roles in SDACS projects. Fifteen experts were invited in this stage of scale development and 10 valid responses were collected. The response rate was 67%. Demographic information of the expert judges is presented in Table 3.

Number of Experts	Nationality	Years of Experience in SDACS	Organization	Current Position
1	Portugal	>20	Casino	Senior Management
1	Philippines	>7	Casino	Management
1	Hong Kong, China	>10	Construction	Management
2	Hong Kong, China	>5	Vendor	Management
9	Macau, China	5-10	Casino	Management
1	Macau, China	4	Government	IT

Table 3 Demographic information of expert judges

To further assure the quality of the constructs and expert judgments, two statistical measures were applied: Perreault and Leigh's measure (Perreault & Leigh, 1989) and item placement ratio (Moore & Benbasat, 1991). The Perreault & Leigh statistic measures the degree of agreement between judges or whether it is expected by chance (Stratman & Roth, 2002). A value of 1.0 indicates perfect agreement between judges, while a value of zero indicates that the observed agreement happened only by chance. A value of 0.65 or greater is considered to represent an acceptable level (Moore & Benbasat, 1991). The item placement ratio assesses the reliability of the proposed construct items as well as the validity of them (Stratman & Roth, 2002). The Perreault & Leigh statistic works closely with the item placement ratio — a high degree of inter-judge agreement results in a high percentage of items placed in the target construct. In addition,

Moore and Benbasat (1991) have also pointed out that constructs with a high percentage of correct item placements imply a high degree of construct validity and reliability potential. Generally, an item placement ratio of 0.7 or greater is considered acceptable. Both tests were calculated with Microsoft Excel and the results are presented in Table 4 and Table 5. Five rounds of sorting were conducted to achieve the acceptable level of validity of the generated items and reliability of the proposed measurement scales. Results show that both tests are acceptable.

Judge Pairs	Perreault & Leigh	Judge Pairs	Perreault & Leigh	Judge Pairs	Perreault & Leigh	Judge Pairs	Perreault & Leigh	Judge Pairs	Perreault & Leigh	Judge Pairs	Perreault & Leigh
1-2	0.74	**2-3**	0.76	**3-4**	0.82	**4-5**	0.74	**5-6**	0.74	**6-7**	0.73
1-3	0.86	**2-4**	0.71	**3-5**	0.78	**4-6**	0.77	**5-7**	0.7	**6-8**	0.68
1-4	0.8	**2-5**	0.69	**3-6**	0.83	**4-7**	0.73	**5-8**	0.65	**6-9**	0.81
1-5	0.77	**2-6**	0.73	**3-7**	0.78	**4-8**	0.67	**5-9**	0.77	**6-10**	0.71
1-6	0.81	**2-7**	0.68	**3-8**	0.72	**4-9**	0.8	**5-10**	0.68		
1-7	0.76	**2-8**	0.63	**3-9**	0.86	**4-10**	0.71				
1-8	0.7	**2-9**	0.74	**3-10**	0.75						
1-9	0.84	**2-10**	0.66								
1-10	0.74										
						7-8	0.64	**8-9**	0.7	**9-10**	0.74
						7-9	0.76	**8-10**	0.63		
						7-10	0.68				
Average : 0.74											

Table 4 Pretest inter-judge agreement statistics (Final sorting round, n=5)

	Actual classifications								
SDACS project management constructs (No. items in scale)	**Appropriate mechanisms & technology**	**Business standards**	**Access control installations & ongoing maintenance**	**Costs allocation**	**Control of access cards**	**Institutional standards of ongoing management**	**Not applicable**	**Total**	**Item Placement Ratio**
Appropriate mechanisms & technology (14)	131	23	10	7	3	6	0	180	0.73
Business standards (9)	12	81	3	5	3	6	4	114	0.71
Access control installations & ongoing maintenance (16)	20	16	158	15	0	8	0	217	0.73
Costs allocation (13)	4	11	4	123	0	10	4	156	0.79
Control of access cards (5)	0	0	3	0	48	5	2	58	0.83
Institutional standards of ongoing management (25)	15	49	15	3	4	212	4	302	0.7

Table 5 Pretest item-placement ratios (Final sorting round, n=5)

4.2 Empirical refinement and validation

After the expert sorting, a number of items were suggested to be removed or reallocated. Those items indicated to be "dropped" were believed to be unnecessary in a SDACS project. Those items indicated to be "reallocated to" were recommended to be reallocated to other constructs. Those items indicated to be "retained" were retained in their original constructs as well as added as new items under other constructs. Based on the suggestions from the expert judges, the total number of measurement items has been reduced from 87 to 82. Details of these suggestions from expert judges can be found in the Appendix. The following shows the number of measurement items in each construct:

1. Appropriate mechanisms and technology (14 items)
2. Business standards (9 items)
3. Access control installations and ongoing maintenance (16 items)
4. Costs allocation (13 items)
5. Control of access cards (5 items)
6. Institutional standards of ongoing management (25 items)

To further refine and validate the constructs and items, a research instrument was developed based on the result of the manual sorting (82 management items) as well as the results of Perreault and Leigh's measure and the item placement ratio. Respondents were asked to indicate their level of agreement for each construct item using a 7-point Likert scale of agree/disagree instead of strongly agree/strongly disagree so that bias against extreme responses could be reduced (Pedhazur & Schmelkin, 1991). One of the key issues to study in the survey is to relate the use of SDACS constructs to the perception of better SDACS project development and management. Demographic information of the survey respondents is presented in Table 6. These respondents are all workers of SDACS projects in Macau. As shown in Table 6, the majority of the respondents have less than one year of work experience in SDACS projects. This reflects a high turnover which is also a challenge to SDACS projects. A total of 250 questionnaires were distributed and 162 valid responses were collected. The response rate was 64.8%.

Number of Participants	Nationality	Years of Experience in SDACS	Organization	Current Position
1	Portugal	>20	Casino	Senior Management
1	Philippines	>7	Casino	Management
2	Hong Kong, China	>5	Vendor	Management
1	Hong Kong, China	>10	Construction	Management
9	Macau, China	5-10	Casino	Management
1	Macau, China	4	Government	IT
95	Macau, China	0-1	Casino	Officer
17	Macau, China	1-5	Casino	Supervisor
5	Macau, China	>5	Casino	Management
16	Macau, China	0-1	Casino	Admin
31	Macau, China	0-1	Government	Admin
6	Macau, China	0-1	Bank	Admin
45	Macau, China	0-1	Unknown	Unknown
20	China	0-1	Unknown	Unknown

Table 6 Demographic information of survey respondents

Next, content validity analysis, reliability analysis, and unidimensionality analysis were carried out. For content validity analysis, Churchill (1979) and Pedhazur and Schmelkin (1991) have pointed out that if the scale items form a representative sample of the theoretical domain of construct, the scales will have content validity. As in this research, with an extensive review of literature and the input from expert judges, validity of the construct scales was established.

Reliability analysis and unidimensionality analysis were conducted with SPSS. Churchill (1979) has pointed out that reliability is a necessary condition for scale validity; thus, reliability analysis ensures consistency of the constructs. With composite reliability estimates values greater than 0.7, construct reliability is met (Nunnally, 1978). Overall, the revised scales exhibited excellent reliabilities with estimates of 0.7154 or higher and the Cronbach's alpha with 0.703 or higher which indicates that the constructs are reliable. Unidimensionality analysis intends to find out whether each construct developed in this research is related to a single dimension. Measurement scales are considered to be unidimensional if the items in the scale measure a single construct (Anderson & Gerbing, 1991). The goodness-of-fit index (GFI) was adopted for unidimensionality analysis. The non-normed fit index (NNFI) and comparative fit index (CFI) were also adopted to adjust the bias of small samples (Bentler & Bonett, 1980). They were likely to give a better indication of fit for this research. Scales indexes greater than 0.9 meet the criteria for unidimensionality (Bollen, 1989; Hatcher, 1994). Table 7 lists the fit indices for each of the measurement scales. All scales exhibit fit indices of 0.9 or greater, indicating that they met the criteria for unidimensionality (Bollen, 1989; Hatcher, 1994). For the construct "Control of access cards", since there were only five management factors under two items, no related statistic for this construct was available except the Cronbach Alpha. This is because in order to achieve identifiability, it is necessary to have three constraints to meet the basic requirement of unidimensionality analysis (Bollen, 1989; Hatcher, 1994). Results of the analyses are presented in Tables 7 and 8.

Unidimensionality & Reliability analyses							
Construct Scale	**Items**	**(n)**	**GFI**	**NNFI**	**CFI**	**Composite Reliability**	**Cronbach α**
Appropriate mechanisms & technology	14	162	0.996	1.000	1	0.82	0.84
Business standards	9	162	0.997	1.000	1	0.72	0.7
Access control installations & ongoing maintenance	16	162	0.988	0.973	0.991	0.84	0.86
Costs allocation	13	162	0.999	1.000	1	0.79	0.81
Control of access cards	5	162					0.73
Institutional standards of ongoing management	25	162	0.99	0.987	0.996	0.93	0.91

Table 7 Scale unidimensionality and reliability analyses

Descriptive Analysis						
Construct Scale	**Items**	**(n)**	**Mode**	**Mean**	**Median**	**Standard Deviation**
Appropriate mechanisms & technology	14	162	7	4.746	4	1.92
Business standards	9	162	6	4.726	4	1.94
Access control installations & ongoing maintenance	16	162	7	4.815	4	1.91
Costs allocation	13	162	7	4.816	4	1.90
Control of access cards	5	162	6	5.085	4	1.72
Institutional standards of ongoing management	25	162	7	4.792	4	1.92

Table 8 Descriptive analysis of measurement scale and items

5. Conclusion

5.1 Findings and implications

In addition to the refinement and validation of the project management constructs, a number of interesting issues were identified which pointed out the challenges to SDACS projects and particularly in Macau.

Costs of developing and maintaining SDACS projects are high. It is shown in the final constructs that cost concerns as well as the business and ongoing management standards of SDACS are the interests of top management but little do they show on other issues. Two reasons can be inferred: (1) this is perhaps due to the technical nature of the project. Top management are not interested in the technical details; they prefer to have such details handled by technical experts or project managers; (2) such phenomenon is common in Macau because there are many such projects under development which requires flexibility to respond to changes and to meet project deadlines. Delegation becomes commonplace. It turns out that, to a certain extent, there is a sacrifice between project control and flexibility. However, it does not imply that top management should keep them away from that. Prior IS research has pointed out that top management support is one of the critical factors for project success (Ang & Teo, 1997; Kanter, 1983). To gain a better understanding of the project, top management may seek assistance from their IT specialists. Commitment in deciding on project mechanism and allocation of resources (Holland & Light, 1999), financing the project (Lam, 2005), and coordinating project efforts (Cooper & Zmud, 1990) are some forms of support top management could offer.

Due to the huge investment in SDACS projects, the service life is expected to be over a decade. Proper functioning of the system is a must for business operations. As such, appropriate management procedures must be in place to ensure good functioning. That is why 11 items were added to the construct "Institutional standards of ongoing management". As for the case in

Macau, great attention to institutional standards of ongoing management of SDACS is also a result of regulatory requirement. To satisfy the project return and operation needs as well as to respond to external mandatory requirements, it is therefore of crucial importance that great attention is paid to the establishment of standards of on-going management.

As shown in the final constructs (Appendix), 9 out of 14 management factors were dropped in the construct "Control of access cards". Firstly, SDACS project workers, though active participants in the development process, are not expected to be involved in the development of standards of access card control. As explained by the experts, this separation of development and operation responsibilities can avoid security loopholes. The usual practice is that when the system is implemented, a selected group of workers who are not part of the project team involved in the management process are assigned to manage the access cards. Of course, this dedicated team of access control staff has information and guidelines to follow as different client organizations have their own approach for their control process. Project managers sometimes act as consultants in this issue. That is why little emphasis of control of access cards is placed in the constructs. Or is it only such a case in Macau, the authors have also studied the experience from projects in Las Vegas, USA, where similar circumstances exist. But the project teams in Las Vegas, which are known to be more experienced, exerted more influence in designing the control of access cards.

Another outstanding element presented in the final constructs is the critical role of communication throughout the project development life cycle. Among all those 18 items that were suggested to be dropped by the expert judges, only one item was related to periodic meetings under the construct Costs Allocation. It is believed that close monitoring plus on-demand reporting/meetings would be sufficient to allow project teams to learn about the project progress. This relieves the project teams from excessive meeting schedules. Periodic meetings are needed not only for information sharing but also to keep the various project parties focused and energized (Miles, 2010), to build commitment to the project, and to establish trust among project parties (Ramsing, 2009). Risk mitigation is another result of effective communication.

The SDACS project management constructs are developed based on the SACS Framework which is under the discipline of IT. It is expected that the SDACS project management constructs are applicable to other SACS projects or IT projects which require a high level of collaboration. The constructs emphasize on clear project tasks and objectives that enable project teams to communicate and collaborate on common understanding. Where various project parties are involved which increases project complexity, a result-oriented mechanism which enhances communication and understanding as well as leading to stakeholder satisfaction is critical to project success.

5.2 Limitations and future research

Although this research was carefully prepared, a number of limitations and shortcomings were still noted. First, the sample size of the expert group may not be large enough to represent the majority of the market. A future research with a larger expert group shall be conducted. Second, as the research was conducted only in Macau, the information collected might not represent the needs and concerns of SDACS projects in other markets where environmental variables may have a high influence on project requirements. Future research comparing SDACS project

management concerns in different markets under different cultural environments shall uncover valuable insight for SDACS projects. Third, the majority of survey respondents have less than one year of work experience in SDACS projects. Should experience be considered a critical input into the research, future studies with more experienced workers may yield more reliable output. Fourth, the size of the survey and the number of valid responses pose another major concern regarding the accuracy and reliability of the analysis. Future research with a bigger sample size may increase the research reliability and accuracy. Last but not the least, the SDACS project management constructs cover all the core items of SDACS projects and are able to pinpoint specific areas of project interest. They may also act as a foundation for further studies into SDACS or SACS projects with theories that highlight other business/management concerns to enrich our understanding in the topics.

References

Anderson, J. C., & Gerbing, D. W. (1991). Predicting the performance of measures in a confirmatory factor analysis with a pretest assessment of their substantive validities. *Journal of Applied Psychology*, 76(5), 732-741.

Ang, J., & Teo, T. (1997). CSFs and sources of assistance and expertise in strategic IS planning: a Singapore perspective. *European Journal of Information Systems*, 6(3), 164-171.

Bauer, L., Cranor, L. F., Reeder, R. W. et al. (2009). *Real Life Challenges in Access-control Management.* In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 899-908, ACM New York, NY, USA.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness-of-fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588-606.

Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.

Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, 16(3), 64-73.

Cole, G. A. 1993. *Management Theory and Practice*, 4th ed. DP Publications Ltd.

Cooper, R. B. & Zmud, R. W. (1990). Information technology implementation research: a technology diffusion approach. *Management Science*, 36(2), 123-139.

Gaming Sector Survey 2002-2012. *Direcção dos Serviços de Estatística e Censos, Macau.* Accessed June 2014. Available from http://www.dsec.gov.mo/default.aspx?noredirect=true

Guan, L., Hansen, D. R., & Mowen, M. M. (2008). *Cost management: accounting and control*, South-Western College Pub.

Hatcher, L. (1994). *A step-by-step approach to using the SAS system for factor analysis and structural equation modeling*. Cary, NC: SAS Institute.

Holland, C. P. & Light, B. (1999). *A critical success factors model for ERP implementation IEEE software*, May/June, 30-35.

Hotels and Similar Establishments Survey 2002-2012. *Direcção dos Serviços de Estatística e Censos, Macau.* Accessed June 2014. Available from http://www.dsec.gov.mo/default.aspx?noredirect=true

Kanter, R. M. (1983). *The change masters: innovation for productivity in the American corporation*. Simon & Shuster, New York.

Lam, W. (2005). Investigating success factors in enterprise application integration: a case-driven analysis. *European Journal of Information Systems* 14, pp.175-187.

Menor, L. J. (2000). *An empirical investigation of new service development competence and performance*. Unpublished doctoral dissertation, University of North Carolina, Chapel Hill.

Miles, R. H. (2010). Accelerating corporate transformations (Don't lose your nerve!). *Harvard Business Review*, January-February, 69-75.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(2), 192-222.

Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.

Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: an integrated approach*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Perreault, W. D. JR., & Leigh, L. E. (1989). Reliability of nominal data based on qualitative judgments. *Journal of Marketing Research*, 26(2), 135-148.

Post, R. S. & Kingsbury, A. A. (1991). *Security Administration*. London: Butterworth – Heinemann.

Ramsing, L. (2009). Project communication in a strategic internal perspective. *Corporate Communications: An International Journal*. Vol. 14 no. 3, 345-357.

Samarati, P. & Vimercati. S. C. (2001). *Access Control: Policies, Models, and Mechanisms.* In Foundations of Security Analysis and Design: Tutorial Lectures, Lecture Notes in Computer Science, vol. 2171, 137-193.

Schouten, J. & Beers, W. V. (2010). *Result-Oriented Management*. Uitgeverij Thema.

Segars, A. H., Grover, V., & Teng, J. T. C. (1998). Strategic information systems planning: planning system dimensions, internal coalignment, and implications for planning effectiveness. *Decision Science*, 29(2), 303-345.

Stratman, J. K., & Roth, A. V. (2002). Enterprise resource planning (ERP) competence constructs: two-stage multi-item scale development and validation. *Decision Science*, vol.33, No.4, 601-628.

York University (2006) *Access Control Program Framework: Policies, Procedures and Regulations*, Access_Control_Framework_BoardAudit.pdf, p2, York University.

Appendix

The following table shows the proposed and final SDACS project management constructs. The proposed constructs consist of 87 management items. After expert sorting, the total number of management items reduced to 82. Suggestions from expert judges are presented in the second column of the table.

	Suggestions from expert judges
1. Appropriate mechanisms and technology	
1.1 Workers clearly know what is expected from them	
1.1.1 Project teams understand the goals & objectives of the project	Relocated to 6.1
1.1.2 Project teams have the knowledge for the selection of mechanisms & technology	
1.1.3 Project teams have the knowledge & training to handle the selected technology & methodology.	Relocated to 2.1
1.1.4 Project teams understand the expectations from using the selected mechanisms & technology	
1.2 Workers are involved in establishing these expectations	
1.2.1 Benchmarking is used to identify appropriate mechanisms & technology	
1.2.2 Project teams are involved in defining & selecting mechanisms & technology for the project	
1.2.3 IT staff have the privilege to make decisions on technology matters	
1.3 Workers are allowed to determine themselves how they are going to meet these expectations	
1.3.1 Project team managers make the final decision for mechanisms & technology selection	
1.3.2 Project teams participate in determining the project processes	Relocated to 3.3 & retained
1.4 Workers obtain feedback about their performance	
1.4.1 Communications between project teams for knowledge & information sharing	
1.4.2 Periodic meetings with project teams aid fine-tuning performance & lessons sharing	Relocated to 3.4
1.4.3 Reports on mechanisms & technology adoption is submitted to top management	Dropped
1.4.4 Top management make the final approval for mechanisms & technology adoption	Dropped
2. Business standards	
2.1 Workers clearly know what is expected from them	
2.1.1 Adoption of business standards is based on the goals of SDACS project	
2.1.2 Project teams have knowledge of the relevant standards in the market	Dropped
2.1.3 Project teams understand the expectations of the standards	
2.2 Workers are involved in establishing these expectations	
2.2.1 Benchmarking is used to identify appropriate standards	Relocated to 6.2
2.2.2 Project teams are involved in the selection of standards for the project	Relocated to 3.2 & retained
2.2.3 User representatives are involved in the selection of standards for the project	Relocated to 1.2
2.2.4 Mission and visions of the client organization are considered for	Dropped

standards selection	
2.3 Workers are allowed to determine themselves how they are going to meet these expectations	
2.3.1 Project team managers make the final decision for standards selection	Relocated to 3.3 & 4.3
2.3.2 Project teams well-understood the adopted standards	
2.3.3 Project teams well-understand how the adopted standards are related to the goals of the SDACS project	Relocated to 1.3
2.3.4 Project teams understand how the adopted standards are related to their individual team objectives and responsibilities	Relocated to 1.3
2.4 Workers obtain feedback about their performance	
2.4.1 Continuous communication for timely feedback regarding how project teams meet the expected standards	Relocated to 6.4
2.4.2 Reports on business standards selection is submitted to top management	Dropped
2.4.3 Top management make the final approval on business standard adoption	
3.Access control installations and ongoing maintenance	
3.1 Workers clearly know what is expected from them	
3.1.1 Project teams well-understood the requirements and procedures of project installation & maintenance work	
3.1.2 Project teams well-understood their responsibilities in installation & maintenance processes	
3.2 Workers are involved in establishing these expectations	
3.2.1 Project teams are involved in the development of installation & maintenance processes	
3.2.2 User representatives are involved in establishing the expectation of access control installations & ongoing maintenance	
3.3 Workers are allowed to determine themselves how they are going to meet these expectations	
3.3.1 Work schedules are determined based on resources constraints and stakeholder expectations	Dropped
3.3.2 Installation & ongoing maintenance work is designed based on everyday business needs	Relocated to 6.3 & 2.3 & retained
3.3.3 Testing of installations are needed	Relocated to 6.3 and retained
3.3.4 Contingency plans must be prepared	Relocated to 6.3 & retained
3.3.5 Drills in contingency plans are essential	Relocated to 6.3 & retained
3.3.6 Project teams are trained to implement installations & ongoing maintenance	
3.4 Workers obtain feedback about their performance	
3.4.1 Cross-functional communications allow timely feedback for improvement	Relocated to 1.4
3.4.2 Periodic meetings among project teams for information sharing and feedback	Relocated to 6.4 & 1.4 and retained
3.4.3 Project team managers make the final decision on access control installation and ongoing maintenance	
3.4.4 Reports on installation and maintenance performance is submitted to top management on periodic basis	Relocated to 6.4 and retained
4. Costs allocation	

4.1 Workers clearly know what is expected from them	
4.1.1 Work breakdown structure for the project is identified	Dropped
4.1.2 Project team managers well-understood the various types of costs, the timing & accuracy of costs allocation, & the different methods that can be employed for costs allocation	
4.1.3 Project teams have the needed knowledge for costs allocation	
4.2 Workers are involved in establishing these expectations	
4.2.1 Costs allocation requires consideration of resource constraints	
4.2.2 User representatives are involved in costs allocation	
4.2.3 Project teams are involved in the costs allocation processes	
4.3 Workers are allowed to determine themselves how they are going to meet these expectations	
4.3.1 Project team managers make the final decision on cost allocation	
4.3.2 Producing departments (teams) have higher priority for costs allocation than supporting departments (teams)	
4.3.3 The factor of uncertainty is considered in costs allocation	
4.3.4 Time value of money is considered in costs allocation	
4.3.5 Cost control must be in place in case of changes to the project baseline	
4.3.6 Constant monitoring of project development helps to prevent cost overrun	
4.4 Workers obtain feedback about their performance	
4.4.1 Periodic meetings among project teams for information sharing & feedback	Dropped
4.4.2 Cost allocation requires final approval by top management	
5. Control of access cards	
5.1 Workers clearly know what is expected from them	
5.1.1 Multiple-level system of controlling is adopted for controlling the access cards	
5.1.2 Individuals who assign access rights are different from those who monitor the system	Dropped
5.1.3 Access rights are granted according to the actual business needs	Dropped
5.1.4 Workers have knowledge of users' access rights	
5.1.5 Workers have clearly conveyed the knowledge of access cards to users	
5.1.6 Access control workers have information of users' access right	
5.2 Workers are involved in establishing these expectations	
5.2.1 Organizational culture is considered when designing access control	Relocated to 2.2
5.2.2 Worker and end-user comments are considered when designing access control	Relocated to 1.2 & retained
5.2.3 Software and hardware workers play an active role in designing the processes & procedures for access control	Dropped
5.2.4 Project teams are involved in designing the processes & procedures for access control	Dropped
5.3 Workers are allowed to determine themselves how they are going to meet these expectations	
5.3.1 Project managers make the final decision on access control processes and procedures	Dropped
5.3.2 Access control workers receive training on access control processes and procedures	Relocated to 6.3
5.4 Workers obtain feedback about their performance	
5.4.1 Periodic meeting with project teams is needed for system enhancement	Relocated to 2.4
5.4.2 Reports on access control is submitted to top management on periodic basis	Relocated to 6.4

6. Institutional standards of ongoing management	
6.1 Workers clearly know what is expected from them	
6.1.1 Institutional standards of ongoing management for SDACS is align with organizational goals & objectives	
6.1.2 Project teams have knowledge of the relevant standards in the market	Dropped
6.1.3 Mission and visions of the client organization are considered for setting standards	Dropped
6.1.4 Organizational culture is considered in setting institutional standards	
6.1.5 Resources constraints are considered in setting standards of ongoing management	
6.1.6 Project teams well-understand the expectations of the standards of ongoing management	
6.1.7 Project teams have the needed knowledge for setting institutional standards of ongoing management	
6.1.8 Project teams well-understand how the adopted institutional standards are related to their individual team objectives & responsibilities	
6.1.9 Ongoing management staff have the knowledge and training to handle their work	Dropped
6.2 Workers are involved in establishing these expectations	
6.2.1 Project teams are involved in setting institutional standards of ongoing management	
6.2.2 User representatives are involved in the setting of institutional standards of ongoing management	
6.3 Workers are allowed to determine themselves how they are going to meet these expectations	
6.3.1 Project team managers make the final decision on institutional standards of ongoing management	Dropped
6.3.2 Institutional standards adopted are reasonably easy to apply to ongoing management work	
6.3.3 The adopted institutional standards do not conflict with user interests	
6.3.4 The adopted institutional standards do not conflict with actual business practice	
6.4 Workers obtain feedback about their performance	
6.4.1 Communicational channels are opened for feedbacks from users and workers	
6.4.2 Periodic reporting on the ongoing management work of SDACS to top management	Dropped
6.4.3 Top management make the final approval on institutional standards of ongoing management	