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SYSTEMIC DESIGN & MASS CUSTOMISED SERVICE DELIVERY: ONE-STOP SERVICES FOR UNIVERSITY STUDENTS IN TAIWAN

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Abstract: The research examines the correlates of systemic design and mass customised service delivery through the "One-Stop Services" model, which has been applied at two of the most dynamic universities in Taiwan. A mixed research design using Structural Equation Modeling (SEM) analysis in combination with in-depth interviews after hypotheses testing results was employed for achieving the objective of the research. With the participation of 553 service staffs and operations managers from the two Taiwanese universities, the value of this research is to provide an empirical evidence of the impact of systems-thinking principles (Seddon, 2003) on the operationalisation of the mass customisation capability of student services in three different levels: micro, meso and macro systemic design. One of the significant contribution of this research was to create a measurement scale of the relationship between Systems-thinking design and mass – customised service capability of a higher education institution in student service operations, shortly termed as ST-MCS. As a result, universities which offered "One- Stop Services" could gain the service superiority over their rivals in terms of student experience and administrative efficiency in the context of globalisation.

Key words: Systems-thinking design, mass – customised service, One –Stop Services

INTRODUCTION

The World Declaration on Higher Education highlights the need to develop student services worldwide. It is imperative that higher education institutions (HEIs) provide services and programs that promote the quality of student life, to meet its needs and to improve learning and success achievements (Ludeman, 2002). The declaration is considered as the vision for student service operationalisation. The major functions of student services and administrations in any universities include admission, academic registry, fees and finance affairs, international affairs, central examinations, graduations, timetabling, customer services for students, and student information system, etc. Most of HEIs have identified the mission to provide the highest quality services to students due to student centricity approach. To implement this mission in reality, however, is a challenge for universities where there is an increasing heterogeneity in student demands while the paradox of efficiency and effectiveness of service delivery always exists. In addition, in the context of multicultural academic diversity stimulated by globalization, there is a continual growth and diversification (Audin et al., 2003) in students' demand especially in the situation of strong competitions among universities.

Focus Taiwan New Channel dated December 12, 2015 quoted Taiwan's Minister of Education that the number of universities in Taiwan must reduce to fewer than 100 by the year 2021 due to shrinking enrollment. This situation implies that currently there has been a strong competition among universities for survivals. Several universities are finding the niches to survive whereas many other ones are making attempt to look for an innovative way to gain competitive advantage over their rivals as well as to create value for students in terms of student experience and administrative efficiency (Dunnion and O'Donovan, 2014).

Derived from viewing students as individual customers in student service aspects at universities, there is a need for service staff to provide services to best meet individual student needs while at the same time delivering the services at near mass efficiency (Tseng et al., 1996) termed as mass customized services (MCS). In other words, MCS refer to as a means to achieve competitive edge for service organizations by improving their operational efficiency and effectiveness (De Koning et al., 2008) and this can only be achievable when it departs from a mass-production approach (Pine, 1993).

The design of efficient mass-production model is based on standardizing work procedures in which university staff members need to handle students' demands in a repetitive manner, with detailed descriptions of service procedures, dialogue scripts, and after-contact work standards (Jaaron and Backhouse, 2013). This standardization of procedures, however, is perceived to increase the mechanisation of the student-employee contact and as a result harming students' satisfaction (Dunnion and O'Donovan, 2014). Moreover, due to the increasing heterogeneity in students' service demands, it also urged attempts for HEIs to migrate from mass production models, which can get efficiency only, to mass customisation (MC) ones, which can obtain both efficiency and effectiveness (Tien, 2011).

When moving to an MC approach, one of the major challenges that any HEIs have to confront with is how to develop an MC service strategy, which is dependent on the choice of a proper service operations design (Da Silveira et al., 2001; Moon et al., 2011). In order to design the optimal service operations for customers to get what they want at reasonable price, Seddon (2008) believed that it is critical to shift from thinking of the system as one that pulls physical things together to thinking of the system as one that offers services together in response to the variety of customer demands, called 'systems-thinking'. Developed since 2003 by Seddon, the terminology of 'systems-thinking' used throughout this paper to describe the service delivery system has emerged from the translation to the service sector of lean manufacturing principles (Seddon and Brand, 2008), incorporating Deming's intervention theory (1982) together with Peter Checkland's Soft Systems Methodology (1981).

According to Jaaron and Backhouse (2013), the employment of the systems-thinking approach for service operations design has a significant impact on the service-offering organizations in terms of providing a real-time mass-customized service. Although MC of student services is essential and beneficial to universities as a sharp weapon in the competition, little attention has been paid to by previous empirical studies to models and tools that can operationalize MC in universities. Therefore, there is a need to conduct this research: "SYSTEMIC DESIGN & MASS CUSTOMIZED SERVICE DELIVERY: ONE-STOP SERVICES FOR UNIVERSITY STUDENTS IN TAIWAN" to investigate the correlates of the systems-thinking design and the universities' abilities to provide MCS for their students in reality via One - Stop Services at the most dynamic universities in Taiwan.

LITERATURE REVIEW

Systemic design

Systemic design is based on Systems-thinking principles, which can redesign service operations around customer demand versus functional hierarchies (Seddon, 2008). Systems-thinking is defined by opposition to 'command and control' traditional management (Seddon, 2003), as presented in **Table 1**, in terms of seven comparative dimensions including perspective, design of work, decision making, measurement, attitude to customers/ suppliers, role of management, ethos, change and motivation. This approach has been influential in the public sector, including HEIs, in terms of improving efficiency and effectiveness (Jackson et al. 2008). Therefore, the term 'systems-thinking' used in this paper follows Seddon's (2003) systems-thinking approach, which was successfully applied in the UK public and third sectors. These principles for MCS in Pham and Jaaron's previous research (2018) were trying to overcome the efficiency paradox of service delivery while still promoting the capacity of absorbing demand variety (Jackson et al., 2008).

Table 1. Principles of systems-thinking (Seddon & Brand, 2008)

Comparative dimension	Command and control thinking (mechanistic)	Systems-thinking (organic)
Perspective	Top-down, hierarchy	Outside-in, system
Design of work	Functional specialization	Demand, value and flow
Decision making	Separated from work	Integrated with work
Measurement	Output, targets, standards: related to budget	Capability, variation: related to purpose
Attitude to customers	Contractual	What matters?
Attitude to suppliers	Contractual	Co-operative
Role of management	Manage people and budgets	Act on the system
Ethos	Control	learning
Change	Reactive, projects	Adaptive, integral
Motivation	Extrinsic	Intrinsic

Mass Customized Service (MSC) in Higher Education Institutions (HEIs)

Mass customization (MC) originally came from manufacture area coined by Davis in 1987. Later on, Piller widened this concept for the first time into service area in 2004. MCS could now be defined as the capability of service organizations, administrative units at HEIs for example, to provide services which best meet individual student needs while at the same time deliver the services at near mass efficiency (Tseng et al., 1996). In a tertiary organization, service departments such as university admissions and academic registry are typically exposed to a greater demand variety from students (Seddon, 2003). Since student centrality in the higher education system nowadays plays a paramount role in driving up quality where the measure of quality is 'student satisfaction' (Browne, 2010), HEIs are thus attempting to find a way to significantly improve their services and truly differentiate themselves from their competitors (Dunnion and O'Donovan, 2014).

One-stop services delivery (OSS)

One – stop services delivery at universities in Taiwan has followed One-Stop-Shop public service delivery model, which initially developed in Australia as a public administration reform of the traditional hierarchical administrative culture since the mid-1980s (Wettenhall and Kimber, 1997). Today with a diversified structure and nature it can be found in the form of local government One-Stop-Shops in Australia, or Service Centers in New Zealand, or citizens' offices in Germany, or Maison Services Publique in France, or Integrated Service Points in the Slovak Republic, or in the form of Public Service Hall (PSH) in the US, etc. (Vashakidze, 2016).

The aim of OSS delivery model at universities in Taiwan is to change the nature and culture of communication between administration and students, or in another word, to give students exactly what services they want at the exact time they need in a possibly shortest duration, and eventually to obtain the highest level of students' satisfaction.

A distinctive feature of the OSS model at universities in Taiwan is their clear separation of Back-line and Front-line officers in the student service delivery chain. Front-line officers represent the university administration vis-à-vis students and continuously monitor students' expectations, i.e, they act as direct service delivers to students with effectiveness or customized services. Meanwhile, back-office staff is responsible for developing student services as well as advising on how to improve existing services and design new ones. In other words, back-officers work as efficient service providers who provide students with efficiency or mass services. Therefore, OSS model could enable universities to deliver MCS to students from the variety of students' service demand efficiently, thus, reducing cost and time for using services, accordingly improving the quality of student life as well as students' satisfaction levels.

Systems- thinking & MCS: Research Gap

Dunnion & O'Donovan (2014) argued that the prevailing 'command and control' (Seddon 2003) management logic, which can be found at work throughout both the public and private sectors, is the primary cause of inferior and expensive service. Based on their findings, they suggested an alternative way using Principles of Systems-thinking (Jackson et al. 2008), whilst comparing and contrasting this with the flawed thinking which currently prevails. In addition, Jaaron and Backhouse (2013) showed that the systems-thinking principles for service operations design have a great influence on the ability of service-offering organizations to deliver a real-time MCS. Although the importance of MCS is significant as analyzed above, few studies were previously conducted and there still need more empirical studies to prove the possibility of operationalizing MCS at HEIs.

Pham & Jaaron in their recent paper published in 2018 also developed a theoretical model in designing MC service-delivery for HEIs in the globalisation context. The empirical evidence at one of the famous British universities in their research indicated that the systems-thinking approach has significantly enhanced the universities' ability to design MCS, which are more able to absorb diversified student demand. However, this exposes a gap that we need to use different HEIs in different cultures and sittings to ensure that these constructs do not confound results. Hence, it is really meaningful if we could find a case from Asia to validate the previous findings of Pham & Jaaron's research.

Hypothesis Development

Based on the conceptual model shown in Figure 1, this research aimed to evaluate correlates of service delivery system design and MCS capability of the two most dynamic universities in Taiwan.

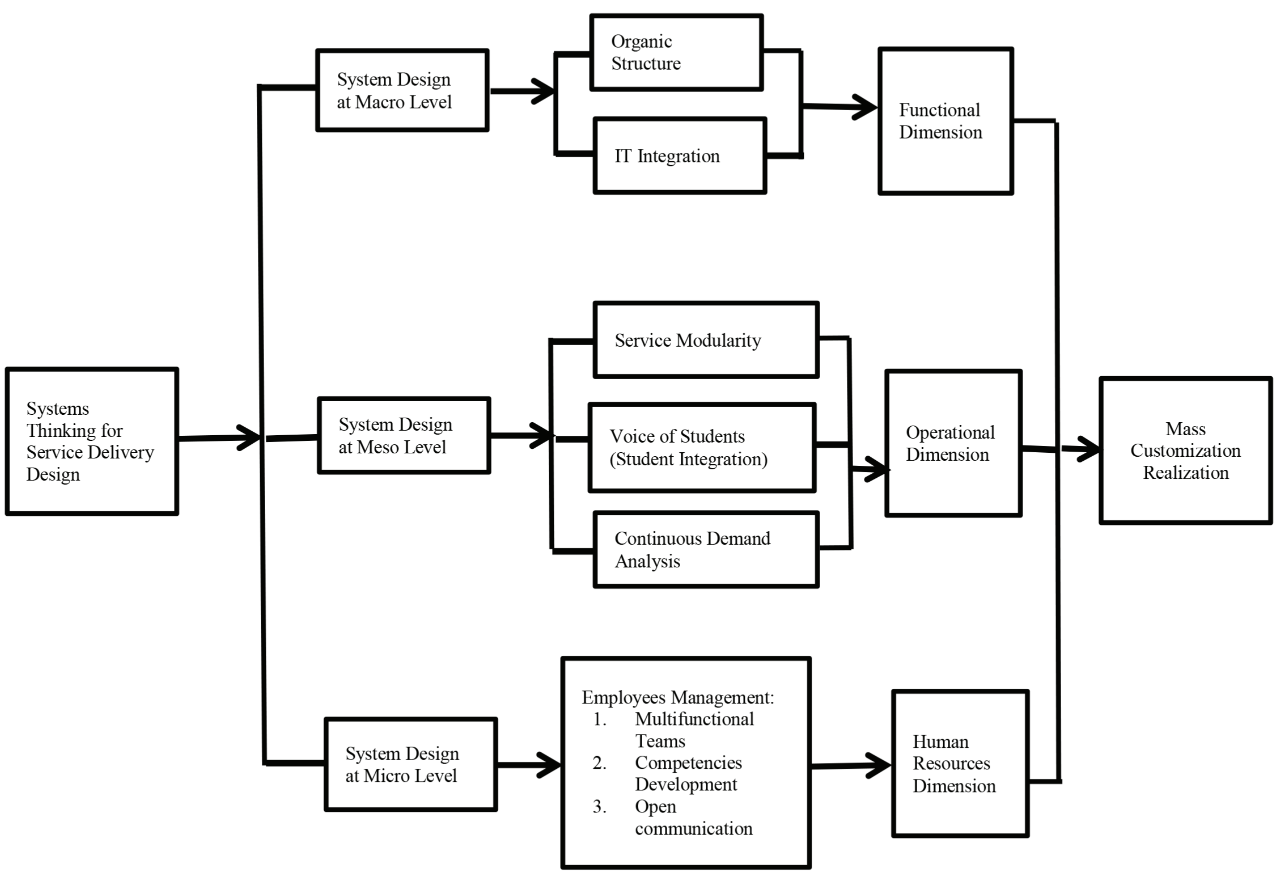

Figure 1. Conceptual model (Pham & Jaaron, 2018)

Development of Hypothesis #1 (H1): System design at micro level is positively associated with MCS capability

In the first level of MC realisation (micro level) the previous study results showed that achieving MC in the HEIs was dependent on the integration of three significant aspects: multifunctional team, staff competency and open communication (Pham & Jaaron, 2018).

The importance of multifunctional teams at the academic registry to enable mass-customised services (Parasuraman et al., 1985; Kennedy et al., 2002; Sony and Mekoth, 2012) where frontline employees play a significant role in customer satisfaction for service businesses. At university level, service staff and students' contacts form the basis of everyday operations and successes. By continuously studying students' demand, university staff members working in a multifunctional team, also known as an intervention team, were able to understand the type of demands and the root cause of failure demand as well as prevent similar errors in the future. This suggested that applying the principles of systems-thinking has the advantage of detecting failures and errors over traditional functional specialisation service operation design systems (Jaaron and Backhouse, 2016).

Once the multifunctional team at the academic registry was empowered to be involved in the process of decision-making the speed of service delivery would then improve, along with the effectiveness of the customised solution (Pham & Jaaron, 2018). This confirms the findings from several past studies in service customisation that indicated the involvement and participation of frontline employees as a key determinant in the successful implementation of MC service-delivery systems (Chen and Hao, 2010).

It is the continuously challenging task of university staff to address differing student demands every day, but this in turn helps the staff to develop new competencies (Sony and Mekoth, 2012). They are then able to provide better service quality thanks to their new experience accumulation from each interaction and transaction. Another opportunity for service staff at university to improve their knowledge and experience for mass-customised service supply was multiple forms of collaboration and sharing among staff members. For example, within team or inter-departmental oral communications, open discussions, informal/formal meetings, dialogues, and phone calls, etc. provided a creative way to enhance the quality of services and absorb the variety of student demands. This was especially useful when the needs were complicated or related to different departments (Pham & Jaaron, 2018).

Therefore, the following hypothesis was developed in relation to MCS capability in System design at micro level:

H1: System design at micro level, which includes three determinants: multifunctional team, staff competency and open communication, is positively associated with MCS capability

Development of Hypothesis #2 (H2): System design at meso level is positively associated with MCS capability

In the second level of MC realisation (meso level), some prior studies showed that achieving MC in the HEIs was dependent on the integration of three significant aspects: service modularity, voice of students, and continuous demand analysis (Pham & Jaaron, 2018)

In terms of process modularity in service-design, the form of a 'combinatorial' module had been applied to enable the academic registry to obtain the flexibility that effective MC requires (Feitzinger & Lee, 1997); however, the superiority of a systems-thinking application at operational level is that the 'innovative' form enables the service staff to offer completely new services in response to the students' demands. Duray et al. (2000) also realised that the systems-thinking approach for mass-customised delivery design at HEIs required modularity and customer integration; they are, in fact, inseparable for mass customisers.

If the voice of students has been listened to and integrated into new service-designs to leverage students' optimal marginal utility, then the consumer's early involvement has created the most value demand for all individuals. This confirms that the degree of customisation increases the earlier the student participation in the service-model occurs. This is the opposite of command and control thinking with a top-down perspective, where the voice of students seems never to be considered.

The aspect of systems-thinking that makes it optimal is the continuous demand analysis because the systems are designed specifically around it; therefore, the 'check – plan – do' process to redesign services is a never-ending cycle promoting further continuous improvement. This also helps to expose a drawback of conventional hierarchical thinking where customer demand is almost ignored, or the voice of customers was not taken into account enough.

Therefore, the following hypothesis was developed in relation to MCS capability in System design at meso level:

H2: System design at meso level, which includes three determinants: service modularity, voice of students, and continuous demand analysis, is positively associated with MCS capability.

Development of Hypothesis #3 (H3): System design at macro level is positively associated with MCS capability

In the third level of MC realisation (macro level), achieving MC in the HEIs was dependent on the integration of two significant aspects: organic structure and IT integration (Pham & Jaaron, 2018).

At the macro-level a systems-thinking approach builds an organic structure for academic registry, with advanced IT integration. This finding is consistent with Burns and Stalker's (1961) definition of 'organic structure', emphasising the flexibility both in processes and structures to absorb demand variation and uncertainty. This distinguishes the organic structure from mechanistic ones where standardisations of services are a yardstick and the number of service transactions is considered as a gauge of efficiency.

In addition, it is critical for the leader to experience the entire 'check – plan – do' process in order to understand his or her organisation as a system, yet at the same time make the service staff empowered enough to make decisions upon available data and quickly respond to the everchanging demands from students. In this scenario, the departmental leader is also viewed as part of the workforce, playing an active role in supporting the multifunctional team to solve new problems emerging from student demand. Such characteristics of an organic structure are shared by Robey and Sales (1994) and it is a clear illustration of the opposition of systemsthinking when contrasted with conventional thinking.

Moreover, advanced IT capabilities at the academic registry are considered as a prerequisite to implementation of MC. This is due to the huge amount of data to be transmitted, the complexity of processing, and the required cooperation of various different departments and functions of the whole university, all under a strict time limit (Pham & Jaaron, 2018). Advanced information technology and organic structure can deliver a better performance of new product/service development but will do so primarily through improving multifunctional team interactions (Chen, 2007).

Therefore, the following hypothesis was developed in relation to MCS capability in System design at macro level:

H3: System design at macro level, which includes two determinants: organic structure and IT integration, is positively associated with MCS capability

Development of hypotheses of H4, H5, H6a, H6b, H6c, H7a, H7b, H7c

Size of the service institution/ department hereby refers to the number of employees working at the service institution/ department.

Top Management Team (TMT) and Operations Manager: TMT refers to rector's board, deans of schools/ colleges/ faculty and President's Boards of a university while Operations Manager is a senior position in the service institution/ department to make sure to provide services that best meets the expectations and needs of students with a smooth efficiency. For example, head/ vice head of service departments, director/ vice director of a center, director of a program… In this research we included the two groups into TMT.

Size of the service institution/ department and TMT were included into the empirical model as controlling variables according to relevant literature and service industry operating characteristics (Verma et. al, 2012; Longoni & Cagliano, 2016).

Therefore, the hypotheses of H4, H5, H6a, H6b, H6c, H7a, H7b, H7c were developed in relation to MCS capability in all of the three above-mentioned levels, which was illustrated in details in **Table 2** in consonance with the objectives of the study.

Table 2. Hypotheses of the study

Hypothesis	Description
H1	System design following systems thinking principles at micro level is positively associated with MCS capability
H2	System design following systems thinking principles at meso level is positively associated with MCS capability
H3	Systems design following systems thinking principles at macro level is positively associated with MCS capability.
H4	Size of service institution in terms of the number of employees is positively associated with MCS capability
H5	Top Management Team is positively associated with MCS capability
H6a	Size of service institution is positively associated with systems design following systems thinking principles at macro level
H6b	Size of service institution is positively associated with systems design following systems thinking principles at meso level
H6c	Size of service institution is positively associated with systems design following systems thinking principles at micro level
H7a	Top Management Team is positively associated with systems design following systems thinking principles at macro level
H7b	Top Management Team is positively associated with systems design following systems thinking principles at meso level
H7c	Top Management Team is positively associated with systems design following systems thinking principles at micro level

OPERATIONAL DEFINITION OF VARIABLES AND OTHER TERMS

The operational definition of major variables as well as sub-variables of the study is present in **Table 3.**

Table 3. Operational definition of variables

Variable	Operational Definition	Citation
Systems design at Micro level (independent variable 1)	Human resources dimension	Pham & Jaaron (2018), Jaaron & Backhouse (2014a)
Systems design at Meso level (independent variable 2)	Operational Dimension	Pham & Jaaron (2018), Jaaron & Backhouse (2014a)
Systems design at Macro level (independent variable 3)	Functional dimension	Pham and Jaaron (2018), Jaaron & Backhouse (2014a)
Mass customization capability (dependent variable) OSS – One-Stop- Service	The capability of providing mass customized service delivery of a HEIs via "One Stop Service" offered by administrative units at universities in Taiwan	Pham and Jaaron (2018), Jaaron & Backhouse (2014b)
Top Management Team support (Controlling variable 1)	Support from Top Management Team in applying systems thinking principles for MCS in HEIs	Longoni, A., & Cagliano, R. (2016); Verma et. al. (2012)
Size of service institutions (Controlling variable 2)	The number of service staff in service department/ institution	Longoni, A., & Cagliano, R. (2016); Verma et. al. (2012)

Major variables	Sub variables	Operational definition	Citation
Systems design at Micro level (Independent variable 1)	Multifunctional teams	A group of employees from different functional departments collaborates together to enable MCS for students.	Pham & Jaaron (2018), Jaaron & Backhouse(2017), Parasuraman et al. (1985), Kennedy et al. (2002), Chen & Hao (2010)
	Competencies Development	Continuous improvement of staff members' internal competencies to handle various student demands in order to provide better MCS	Pham & Jaaron (2018), Sony and Mekoth (2012)
	Open communication	Multiple forms of collaboration and sharing among staff members within team or inter-department	Pham & Jaaron (2018)
Major variables	Sub variables	Operational definition	Citation
Systems design at Meso level (Independent variable 2)	Service modularity	Modularization of the service process which consists of two types: first, "combinatorial" is based on the combination or recombination of existing set of academic registry processes and knowledge networks to create a unique student service and second "innovative" the generation of totally new student service based on totally new student demand to satisfy that particular new demand	Pham & Jaaron (2018), Pekkarinen and Ulkuniemi (2008), Feitzinger and Lee (1997), Duray et al. (2000)
	Student Integration	Student voice is inherited in the new service operations design	Pham & Jaaron (2018)
	Continuous demand analysis	The received student demands are continuously analyzed to quickly provide new MCS for unexpected demands.	Pham & Jaaron (2018), Jaaron & Backhouse (2015)
Major variables	Sub variables	Operational definition	Citation
Systems design at Macro level (Independent variable 3)	Organic structure	the flexibility both in processes and structures to absorb demand variation and uncertainty which distinguishes the organic structure from mechanistic one where standardizations of services are a yardstick and the number of service transactions is considered as a gauge of efficiency	Pham & Jaaron (2018), Burns and Stalker(1961)
	IT Integration	IT systems that can access vital information from different functions and departments of the university to keep its operations effective and efficient	Pham & Jaaron (2018), Chen (2007)

METHODOLOGY

Sampling and Data Collection

In order to evaluate the correlates of systems-thinking principles (Seddon, 2003) and students' MCS operationalization in Taiwan, a survey questionnaire was conducted at the two most dynamic universities in Taiwan. The details of the two universities in Taiwan as well as those of the participants are kept anonymous throughout this paper. The universities has recently provided their students with "One –Stop Services" (OSS) for over two years, which is considered as a Systems-thinking application in student service delivery.

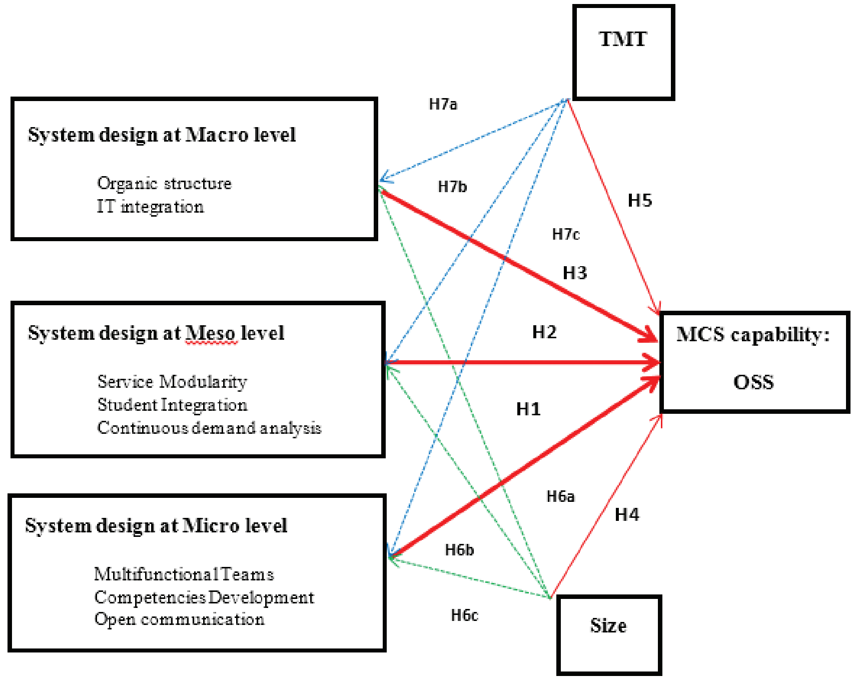

Figure 2. Research Framework

The survey questionnaire was created, designed and delivered by various types of both online (via GOOGLE DRIVE form) and face-to-face delivery at the two university sites. The questionnaire contained six sections: Demographic information, System design at Macro level, System design at Meso level, and System design at Micro level, Top Management Team, and Size of the service institutions/ departments. The questionnaire was developed based on a literature review in Systems-thinking principles & MCS research field and on the previous case study conducted by one of the authors of this paper. The questionnaire was checked by academics with background in systems-thinking principles, MCS, and operationalisation research. They assessed the reliability of the questionnaire and its consistency with the current literature, ultimately providing positive feedback. The questionnaire was then submitted to ten operations managers whose background corresponded with that of this survey's target respondent. These managers provided useful comment, for example, they highlighted the need to provide further explanations on a number of such concepts and terms as systems-thinking, MCS, TMT, System design at micro, meso, macro levels, etc. In these cases, we added some definition explanations, some details and examples to clarify the intended meaning.

Data collection was performed through various forms including face-to-face survey, e-mail survey, Line survey, and Messenger survey after the first contact by phone, emails, social network chats, small talks, or lunchtimes to introduce about the research topic. Data collection took place for nearly two years between December 2016 and November 2018. The targeted respondents were people in charge of service delivery and operations for students from human resources, operational and functional dimensions, hence, the questionnaire was completed by "front-line" service staff, "back-office" service staff, operations managers of service departments, and top management team (TMT) of the two universities.

The administrative staff populations of the two univerities were 473 and 274 respectively, making the total of 747. The sample of people participating in the survey was 597 service staffs and operations managers, which could represent for nearly 80 percent of the whole population. However, the sample was reduced to 553 since we used data only from respondents who firstly filled all the information needed for this research; secondly experienced in systems-thinking design for mass customized service (MSC) delivery at their departments/ institutions; and finally offered some kinds of "One - Stop Services" or "One-door Services" for students at at their departments/ institutions.

Among 159 males and 394 females chosen as the relevant respondents for the research, "back-office" service staff took the highest percentage of 45.4, followed by 36.9 % of "front-line" service staff and 17.7% of TMT/ operations managers. The total sample of 553 people came from five different sizes in terms of the number of employees in each department/ institution. **Table 4** illustrates the demographics of the sample in terms of service department size and respondents' job title at the department/ institution.

Table 4. Demographics of the sample

Characteristics	Sample %
Size (number of employees)	
Under 5	24.4
6-15	30.7
16-25	32.4
26-35	7.4
35+	5.1
Respondent's Job Title	
"Front-line" service staff	45.4
"Back-office" service staff	36.9
Operations Manager	17.7

Measures

In accordance with our research objectives, the main measured constructs concerned system design at three different levels following system thinking principles and MCS.

Independent variables: Systems-thinking principles. Systems-thinking principles are related to systems designs at three different levels of micro, meso and macro. System design at micro level refers to human resources dimension, which includes multifunctional teams, competencies development, and opens communication. System design at meso level refers to operational dimension, which includes service modularity, student integration and continuous student demand analysis. System design at macro level refers to functional dimension, which includes organic structure and information technology (IT). To access the adoption of systems thinking approach to provide MCS, respondents were asked to score on a Likert scale (from 1= very weak to 5= very strong) their level of agreement.

Dependent variable: MCS capability/ OSS. MCS capability refers to the capability of service institution/ department to provide and deliver a variety of student services that could best meet individual student needs at near mass efficiency via OSS at the two universities in Taiwan. MCS capability was evaluated on a Likert scale in terms of improvement in the last two years (from 1= far worse to 5= far better)

Controlling variables: Two controlling variables in the analysis included into the model were size of service institutions/ departments and TMT commitment to MCS using systems-thinking principles since the possible impacts of size and TMT on MCS capability should be controlled.

Reliability and validity

Firstly, Cronbach's alpha was used to test reliability of variables. If the group of factors that Cronbach alpha coefficient is greater than 0.5 then the sample would meet the requirements of scale (Hair et. al., 2006). However, if the Corrected Item-Total Correlation was smaller than 0.3 then the item should be removed. Also, if Item Deleted was larger than the Cronbach's alpha value of group then the item should be rejected (Cristobal et al., 2007). In this step, three items were removed including MICROMULTIB1**,** MICROOPENB10, and MESOSTUDEC7 due to failing the above-mentioned standards. **Table 5** shows the final value of Cronbach's Alpha of the ten groups of factors after deleting the unsatisfactory items, the number of items qualified for Cronbach's Alpha calculation for each group, and the number of removed items**.**

Table 5. Cronbach's Alpha

Variables	Cronbach's Alpha	Number of Items	Number of removed items
STMCS	.832	4	0
MICROMULTI	.922	3	1
MICROCOMPENTEN	.874	3	0
MICROOPEN	.844	3	1
MESOMODUL	.851	4	0
MESOSTUDE	.893	3	1
MESODEMAANA	.815	2	0
MACROOR	.879	4	0
MACROIT	.845	4	0
TMTE	.914	4	0

Secondly, an Exploratory Factor Analysis (EFA) was conducted to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors in a dataset. This type of analysis provides a factor structure, i.e. a grouping of variables based on strong correlations. In general, an EFA prepares the variables to be used for cleaner structural equation modeling (SEM). An EFA should always be conducted for new datasets (Norris & Lecavalier, 2010). Hence, EFA approach is suitable for this research where a completely new first-hand dataset of systems-thinking designs in relationship with MCS were collected and analysed.

In this research, the most common method of extracting Principal Axis Factoring along with Promax rotation was used in factor analysis. Factor analysis of the major components allows truncation of much less associated variables to these quantities which can be expressed as a linear correlation with the appropriate standards (Meyers et.al., 2016). In order to satisfy the conditions for EFA, the following requirements should be considered.

Firstly, Kaiser-Meyer-Olkin (KMO) Test , which is a measure of how suited the data is for factor analysis, was considered because the test measures sampling adequacy for each variable in the model and for the complete model. KMO returns values between 0 and 1. Compared to Kaiser (1974) criteria, with Kaiser-Meyer-Olkin Measure of Sampling Adequacy resulting in 0.856, the data collected was meritoriously suited for factor analysis.

Secondly, the Bartlett test was taken into consideration. If this test is statistically significant (i.e., Sig. <0.05), the observed variables are correlated with each other in the overall. The data collected in this research had the Sig. (Bartlett's Test) much smaller than 0.05 (.000), thus qualified enough for the factor analysis (Snedecor & Cochran, 1989) as shown in **Table 6.**

Table 6. KMO and Bartlett's Test & Pattern Matrix

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.856
Bartlett's Test of Sphericity	Approx. Chi-Square	11174.105
	df	561
	Sig.	.000

Factor structure refers to the intercorrelations among the variables being tested in the EFA. Looking at the Factor Matrix below, we can see that variables group into factors - more precisely, they "load" onto factors. **Table 7** illustrates a very clean factor structure in which convergent and discriminant validity are evident by the high loadings within factors, and no major cross-loadings between factors. The EFA results shows that 34 out of 37 items loading on 10 factors satisfied all the conditions for further analysis and all other items with factor loading value less than 0.5 had been removed from the model (Hairs et.al., 1998)

Table 7. Factor Matrix

Factor Matrix[a]										
	Factor									
	1	2	3	4	5	6	7	8	9	10
TMTE4	.919									
TMTE1	.887									
TMTE2	.806									
TMTE3	.801									
MACROORD4		.876								
MACROORD1		.793								
MACROORD3		.768								
MACROORD2		.767								

Contd...

MESOMODULC4			.821							
MESOMODULC3			.798							
MESOMODULC1			.732							
MESOMODULC2			.703							
MACROITD5				.907						
MACROITD8				.756						
MACROITD6				.691						
MACROITD7				.688						
MICROMULTIB2					.911					
MICROMULTIB4					.890					
MICROMULTIB3					.864					
MESOSTUDEC5						.887				
MESOSTUDEC6						.846				
MESOSTUDEC8						.839				
MICROCOMPE-TENB7							.885			
MICROCOMPE-TENB6							.816			
MICROCOMPE-TENB5							.810			
MICROOPENB11								.888		
MICROOPENB8								.753		
MICROOPENB9								.738		
STMCSA3									.875	
STMCSA4									.796	
STMCSA1									.631	
STMCSA2									.564	
MESODE-MAANAC9										.828
MESODE-MAANAC10										.812

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

'In order to identify whether MICROMULTI, MICROCOMPETEN, MICROOPEN belong to MICRO level, a reliability analysis using Cronbach's Alpha indicator was made. The results of Cronbach's Alpha in **Table 8** was 0.8 indicating that these nine items belongs to one group named MICRO level of systems-thinking design.

Table 8. Crobach's Alpha – MICRO level

Reliability Statistics	
Cronbach's Alpha	N of Items
.800	9

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MICROMULTIB2	25.08	27.226	.634	.759
MICROMULTIB3	25.16	27.496	.628	.760
MICROMULTIB4	25.06	26.078	.639	.757
MICROCOMPETENB5	25.52	29.565	.443	.787
MICROCOMPETENB6	25.45	31.005	.413	.789
MICROCOMPETENB7	25.49	29.638	.473	.782
MICROOPENB8	24.61	31.663	.368	.794
MICROOPENB9	24.55	32.060	.372	.794
MICROOPENB11	24.55	31.415	.419	.789

In order to identify whether MESOMODUL, MESOSTUDE, MESODEMAANA belong to MESO level, a reliability analysis using Cronbach's Alpha indicator was made. The results of Cronbach's Alpha in **Table 9** was 0.838 indicating that these nine items belongs to one group named MESO level of systems-thinking design.

Table 9. Crobach's Alpha – MESO level

Reliability Statistics	
Cronbach's Alpha	N of Items
.838	9

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MESOMODULC1	28.01	24.120	.565	.819
MESOMODULC2	27.84	24.110	.558	.820
MESOMODULC3	28.06	24.118	.570	.819
MESOMODULC4	27.99	24.197	.553	.821
MESOSTUDEC5	27.34	23.859	.570	.819
MESOSTUDEC6	27.23	23.326	.576	.818
MESOSTUDEC8	27.36	23.850	.616	.814
MESODEMAANAC9	27.47	25.369	.497	.827
MESODEMAANAC10	27.59	25.840	.421	.834

In order to identify whether MACROOR and MACROIT belong to MACRO level, a reliability analysis using Cronbach's Alpha indicator was made. The results of Cronbach's Alpha in **Table 10** was 0.8 indicating that these nine items belongs to one group named MACRO level of systems-thinking design.

Therefore, based on the results presented above, we could construct the three latent variables: MICRO, MESO, and MACRO for later SEM analysis.

Table 10. Crobach's Alpha – MACRO level

Reliability Statistics	
Cronbach's Alpha	N of Items
.800	8

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MACROORD1	26.18	17.030	.500	.780
MACROORD2	26.17	16.164	.599	.763
MACROORD3	26.09	16.275	.603	.762
MACROORD4	26.10	16.407	.626	.759
MACROITD5	26.30	18.650	.414	.791
MACROITD6	26.40	18.908	.418	.791
MACROITD7	26.15	18.235	.472	.783
MACROITD8	26.26	18.716	.443	.787

RESULTS

The results in **Figure 3** showed that RMSEA and CFI (confirmatory fit index) of the model is 0.052 and 0.926 respectively which brings the conclusion that the proposed model can be traditionally fitted the data since the reliability of the model meets almost the common standards (Hair et al., 2010)

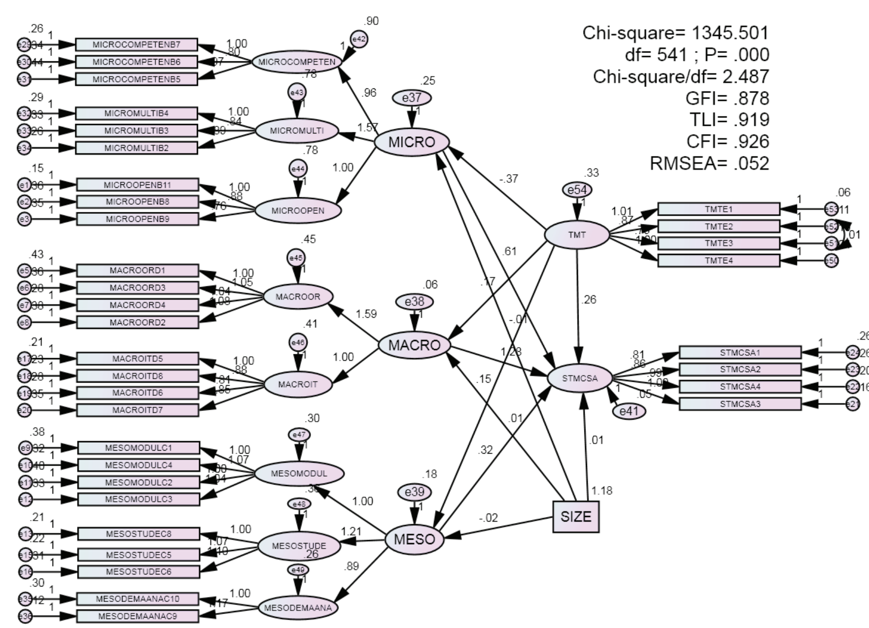

Figure. 3. SEM results

Hypotheses were tested using model in Figure 2. Size and TMT support were entered as controlling variables in the model. The model was tested using structural equation modeling (SEM) run with IBM AMOS 20. SEM is a methodology that enables a series of observable variables or items to be directly or indirectly related to latent variables or factors and allow for the simultaneous testing of multiple hypotheses using latent variables (Hays, 1994). The results of hypotheses testing were shown in **Table 12.** From the regression weight results shown in **Table 11**, we could have the following statements in response to each hypothesis.

Table 11. Regression Weights

			Estimate	S.E.	C.R.	P	Label
MACRO	<---	TMT	.170	.048	3.551	***	par_34
MICRO	<---	TMT	-.375	.141	-2.653	.008	par_36
MESO	<---	TMT	.152	.051	3.002	.003	par_37
MESO	<---	SIZE	-.022	.021	-1.017	.309	par_39
MACRO	<---	SIZE	.006	.018	.333	.739	par_40
MICRO	<---	SIZE	-.015	.024	-.610	.542	par_41
MICROCOMPETEN	<---	MICRO	.961	.141	6.797	***	par_22
MICROMULTI	<---	MICRO	1.573	.354	4.445	***	par_23
MICROOPEN	<---	MICRO	1.000				
MACROOR	<---	MACRO	1.592	.346	4.605	***	par_24
MACROIT	<---	MACRO	1.000				
MESOMODUL	<---	MESO	1.000				
MESOSTUDE	<---	MESO	1.206	.186	6.492	***	par_25
MESODEMAANA	<---	MESO	.891	.148	6.039	***	par_26
STMCSA	<---	MESO	.316	.077	4.095	***	par_27
STMCSA	<---	MACRO	1.283	.384	3.337	***	par_28
STMCSA	<---	TMT	.260	.097	2.671	.008	par_32
STMCSA	<---	MICRO	.614	.120	5.119	***	par_33
STMCSA	<---	SIZE	.010	.025	.398	.691	par_38
…							

The regression weight for System design at micro level (MICRO) in the prediction of MCS capability (STMCSA) is significantly different from zero at the ***, i.e. 0.001 level (two-tailed). When MICRO goes up by 1, STMCSA goes up by 0.614 in the condition of other constant factors.

The regression weight for System design at meso level (MESO) in the prediction of MCS capability (STMCSA) is significantly different from zero at the ***, i.e. 0.001 level (two-tailed). When MESO goes up by 1, STMCSA goes up by 0.316 in the condition of other constant factors.

The regression weight for System design at macro level (MACRO) in the prediction of MCS capability (STMCSA) is significantly different from zero at the ***, i.e. 0.001 level (two-tailed). When MACRO goes up by 1, STMCSA goes up by 1.283 in the condition of other constant factors..

The regression weight for Size of service institution in terms of the number of employees (SIZE) in the prediction of MCS capability (STMCSA) is **NOT** significantly different from zero at the 0.05 level (0.691) (two-tailed).

The regression weight for Top Management Team of Taiwanese universities (TMT) in the prediction of MCS capability (STMCSA) is significantly different from zero (0.008) at the 0.01 level (two-tailed). When TMT goes up by 1, STMCSA goes up by 0.26 in the condition of other constant factors.

The regression weight for Size of service institution in terms of the number of employees (SIZE) in the prediction of MICRO,MESO and MACRO is all **NOT** significantly different from zero at the 0.05 level (two-tailed).

The regression weight for Top Management Team of Taiwanese universities (TMT) in the prediction of MICRO, MESO and MACRO is **ALL** significantly different from zero at the 0.01 level (two-tailed). When TMT goes up by 1, MESO goes up by 0.152 and MACRO goes up by 0.170 in the condition of other constant factors. However, when TMT goes up by 1, MICRO goes down by 0.375 in the condition of other constant factors.

IN- DEPTH INTERVIEW AFTER HYPOTHESES TESTING RESULTS

Since the concern that "Omitted Variable Bias" (OVB) might occur when one or more unobserved variables were not included in the model, after getting the results of hypotheses testing, the authors conducted a number of interviews with five Heads of service departments/ institutions and dozens of interviews with front-line staff and back-office staff at the two universities in order to mitigate the impacts of OVB.

All the five service operations managers at the two universities were interested in how to increase student satisfaction in the context of strong competition between their center/ institution and other centers both inside and outside of their campuses. They all offered "One-Stop Services" for students at their offices, which can fulfill students' needs at the time they want. Two of them widely promoted One –Stop Services as an innovation of the department to deliver services to students on both websites and leaflets. Three of them popularized their "One-door Services" or "One–window Services" with organizational motto of EES (Effectiveness, Efficiency, and Satisfaction) on everywhere they could broadcast through various multi-media.

Also, the service staff provided the researchers a great deal of different documental sources in form of paper- based as well as electronic versions, which indicated that the redesign of service delivery system enabled the universities to have capacity to deliver MCS to students. Therefore, interviews after hypotheses testing results could confirm that Systems-thinking is indeed the reason behind this MCS capability and nothing else.

Table 12. The results of hypotheses testing

Hypothesis	Description	Results
H1	System design following systems thinking principles at micro level is positively associated with MCS capability	Support (.614)
H2	System design following systems thinking principles at meso level is positively associated with MCS capability	Support (.316)
H3	Systems design following systems thinking principles at macro level is positively associated with MCS capability.	Support (1.283)
H4	Size of service institution in terms of the number of employees is positively associated with MCS capability	No conclusion (p-value = .691)
H5	Top Management Team is positively associated with MCS capability	Support (.26)
H6a	Size of service institution is positively associated with systems design following systems thinking principles at macro level	No conclusion (p-value = .739)
H6b	Size of service institution is positively associated with systems design following systems thinking principles at meso level	No conclusion (p-value = .309)
H6c	Size of service institution is positively associated with systems design following systems thinking principles at micro level	No conclusion (p-value = .542)
H7a	Top Management Team is positively associated with systems design following systems thinking principles at macro level	Support (.17)
H7b	Top Management Team is positively associated with systems design following systems thinking principles at meso level	Support (.152)
H7c	Top Management Team is positively associated with systems design following systems thinking principles at micro level	Support(-.375)

DISCUSSIONS

The main objective of this paper was to test whether there was a significant impact of service delivery system design on MCS for students at the two most dynamic universities in Taiwan. Therefore, this study empirically contributes to the literature on exploration of correlates of systems-thinking design and MCS capability to deliver what students want in terms of service operations efficiently and effectively through the findings of the research. It was found that the system design following systems-thinking principles at all three levels: micro, meso and macro were positively associated with MCS capability at HEIs, which is congruent with the previous research findings (Pham & Jaaron, 2018; Jaaron & Backhouse, 2013).

Table 13, which showed the standardized regression weights, provided an evidence for discussing about the impact degree of micro, meso and macro levels on the capability of MCS offered by HEIs.

Table 13. Standardized Regression Weights

			Estimate
MACRO	<---	TMT	.381
MICRO	<---	TMT	-.400
MESO	<---	TMT	.205
MESO	<---	SIZE	-.055
MACRO	<---	SIZE	.025
MICRO	<---	SIZE	-.030
MICROCOMPETEN	<---	MICRO	.513
MICROMULTI	<---	MICRO	.722
MICROOPEN	<---	MICRO	.587
MACROOR	<---	MACRO	.524
MACROIT	<---	MACRO	.374
MESOMODUL	<---	MESO	.614
MESOSTUDE	<---	MESO	.654
MESODEMAANA	<---	MESO	.599
STMCSA	<---	MESO	.257
STMCSA	<---	MACRO	.627
STMCSA	<---	TMT	.284
STMCSA	<---	MICRO	.628
STMCSA	<---	SIZE	.021
…			

Among three levels of system design following systems-thinking principles, the findings showed that the system design at micro level has the strongest relationship with MCS capacity of both universities with coefficient estimate of 0.628. The system design following systems-thinking principles at micro level was explained by three employee elements of multifunctional team, staff competences development and open communications. The findings supported such prior researches as Pham & Jaaron (2018), Jaaron & Backhouse(2017), Parasuraman et al. (1985), Kennedy et al. (2002), Chen & Hao (2010), Sony and Mekoth (2012), where a group of employees from different functional departments collaborates together to enable MCS for students; continuous improvement of staff members' internal competencies could handle various student demands in order to provide better MCS; and multiple forms of collaboration and sharing among staff members within team or inter-department could deliver MCS in time.

The impact degree of system design at macro level on MCS delivery was in-between meso and micro levels, which resulted in coefficient of 0.627. This means that the organic structure of a service organization and IT integration in a system played the most important role to ensure MSC implementation. This finding is consistent with Burns and Stalker's (1961) definition of 'organic structure' defined by the flexibility both in processes and structures to absorb demand variation and uncertainty which distinguishes the organic structure from mechanistic one (Pham & Jaaron, 2018). Also, IT systems that can access vital information from different functions and departments of the university kept its operations effective and efficient. This result also supported several previous findings of the great role of advanced IT on service delivery in the digital era in particular and in any industries in general.

Although the impact of system design at meso level on the operations of MCS seemed to be smallest compared to the other two levels, the p-value at 0.000 confirmed that MCS depended on the integration of the three components: service modularity, voice of students, and continuous demand analysis, which shared with the findings of Feitzinger and Lee (1997) and Duray et al. (2000). At this level, students acted as customers raising their voice, which could be integrated in service modularity in a never-ending cycle of 'check – plan – do' process of Sysptems-thinking principles to redesign services, and as a result, promoting continuous innovation in MCS performance.

It is logical to get the results that TMT support is positively associated with MCS. In fact, there must be a concerted effort to migrate away from command and control thinking to systems-thinking because the service operations and delivery following systems-thinking principles requires a strong determination and leadership to succeed (Pham & Jaaron, 2018). Surprisingly, while TMT support helped to increase at meso and macro systemic design levels, it caused the decrease at micro level. It could be explained by an interview with a senior front-line office at one of the two universities that there was still a hierarchical management from Top Management to ordinary staff.

However, it is interesting to notice that, among control variables, size of service institution is not significant; thereby suggesting that any service departments or institutions could achieve MCS capability by applying systems-thinking principles regardless the number of service staff.

CONCLUSIONS

Theoretical implications

The research makes a big contribution to the fulfillment of the gap of mass customization as well as responds to the need of academic discussion of systems thinking approach in service operations. This research contributes to the theory by further developing previous research on the impact of system design following systems-thinking principles on MCS capability of HEIs for students as individual customer. The value of this research is to provide an empirical evidence of the impact of systems-thinking principles (Seddon, 2003) on the operationalization of the mass customisation capability of student service in three different levels: micro, meso and macro systemic design. Two major controlling variables including the top management support and the size of service department/ institution were added to the original model developed by one of the authors (2018) in order to clarify the causal relationship between service delivery system design and mass customized service capability. In particular, this research identifies System design at the three levels as relevant outcomes of TMT support in practice. Further, one of the most significant contribution of this research was to create a measurement scale of the relationship between Systems-thinking design and mass – customised service capabilty of a higher education institution for student service operations, shortly termed as ST-MCS.

Managerial implications

There are several managerial implications for universities adopting this model of systems thinking. As a result, universities which offer "One- Stop Services" could gain the service superiority over their rivals in terms of student experience and administrative efficiency in the context of globalization.

Since system design at micro level has the most significant impact on MCS capability of universities, therefore, in order to increase MSC capacity, the employee level needs to be paid more attention to, for example, creating working motivations and environment and facilitating open communications among service staff members across teams, as well as giving favorable conditions for staff to develop their competences

Since system design at macro level has a second significant impact on MCS capability of universities, therefore, in order to increase MSC capacity in the fastest and strongest way, university should invest in IT as well as change organizational structure towards organic and flat one.

Since system design at meso level has the third significant impact on MCS capability of universities, therefore, in order to improve the effectiveness of MCS, the demand of students should be listened to continuously and the involvement of students into service design should be earlier and the degree of student participation should be higher.

Since TMT has a significant influence on MCS performance of universities, thus, if leadership of a university is lack of a strong determination and practical policy, it is really difficult for the success of MCS delivery.

Since TMT has a significant influence on all three different levels of systemic design: Micro, Meso & Macro, and then further these three levels impact significantly on MCS operations, and TMT at the same time also makes great effect on MCS implementation, therefore, TMT plays the top of the top powerful role in the success or failure of MCS execution.

Since size of service institution is not significant to any levels of systemic design at all, it is implied that any service departments or institutions could achieve MCS capability by applying systems-thinking principles regardless the number of service staff.

LIMITATIONS & FUTURE RESEARCH WORK

Although the data collection from the most dynamic universities in Taiwan considered the most appropriate for meeting the research objective posed at the beginning of this paper, the researchers acknowledge the limitation of conducting two cases with regard to the element of generalizability. In fact, both universities are private ones, so this choice might limit the generalizability of our results to another context of public schools. This would call for future replication of the study in a state or public university group.

In addition, data from students in this study were not included. Therefore, it is expected that later research may look at the feedback of stakeholders, including students to the change of the before–and-after introduction of systemic design following systems-thinking to MCS.

Finally, only a few HEIs in developed economies such as the UK or Taiwan have applied systems-thinking principles for designing MCS for their students, therefore, it would be advisable that further studies would be conducted in different backgrounds, including developing countries where there is now a strong-ever competition among HEIs for edge and cost savings.

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