

# Study on the influencing factors of the flexibility of university IT management in education 4.0

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**Abstract:** Education systems at all levels should embrace new technologies to comply with industry 4.0 developments. Universities need to adapt to these new changes. Flexibility is an essential factor, but studies that discuss the flexibility in service-based organizations are limited. The study of IT flexibility currently focuses on manufacturing organizations in aspects of IT infrastructure. IT infrastructure flexibility is not enough, because it is only one IT resource that is managed in IT management. The contribution of this study is to produce variables that significantly influence the flexibility of IT management in the university. T tests obtained that there are six variables that have a significant direct effect. The variables are data integration, modularity of an application, value drivers, human resource competence, human resource development and knowledge sharing. R square test shows that these variables also simultaneously influence the flexibility of IT management universities with a fairly high influence of 76%.

**Keywords:** IT management, IT flexibility, university changed, education 4.0.

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## 1 Introduction

Technological innovations in the industry 4.0 have changed the way humans work, do business, interact, learn, transact, and do many other activities (Gleason, 2018). The technology that emerges in Industry 4.0 also has a major influence on the education <sup>9</sup> system. Andrea states that industry 4.0 will encourage business to use new technology and smart media, which will affect the education system (Benešová and Tupa, 2017). Education system 4.0 is the response of the education world to the need for implementing the industrial revolution 4.0. The change to education 4.0 is expected to meet the increasing change in information technology, globalization, demands for market needs and competition. In education 4.0, learning is not limited to space and time as it can be done anywhere and anytime. Learning can be personalized so that students can independently determine their learning path. Results-based learning that is oriented to competence and skill has also been developed in the current learning system. Students are used as a center in the learning ecosystem. Another important thing in implementing education 4.0 is the use of dynamic technology to enable interaction between universities, industries, and the communities to meet competencies required in industry 4.0.

Changes <sup>8</sup> in university cannot be avoided. Therefore, the university must adapt to the changes in the academic and administrative processes. Changes in the way academic and administrative processes work cause some adjustments to be made, including those related to IT management at the university. IT management flexibility is needed to ensure IT management in higher education is aligned with the needs of the process

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of adaptation to change. Proper handling strategies are necessary in order to overcome the instability caused by changes. Improper management of changes can result in low productivity and efficiency. The appropriate strategy will have a positive impact on organizational performance (Han et al., 2017). The right strategy is very important because it can affect organizational performance.

Flexibility is an essential factor for universities to maintain sustainability (Esther Cameron and Mike Green, 2012). Several studies have further shown that rigidity and the inability to deal with new situations can lead to an information system failure. In addition, Dreyer and Gronhaug (2004) state that flexibility is a source of competitive advantage. However, studies that discuss the flexibility in service-based organizations such as universities are limited. The study of IT flexibility currently focuses on manufacturing organizations in aspects of IT infrastructure (Han et al., 2017).

IT infrastructure flexibility is not enough, because it is only one IT resource that is managed in IT management. The differences in input, process, and output between manufacturers and universities cause the flexibility in manufacturers cannot be directly applied in universities. Based on these problems, it is necessary to do a need analysis on the flexibility at the university. This study aimed to analyze the internal factors required to improve the flexibility of IT management in the university that is essential in education 4.0. Increased flexibility in IT management focusing on internal factors is expected to minimize the external factors causing resistance to change. External factors cannot be controlled by the university. One external factor that affects flexibility is government regulation. The existence of legal regulations from the government as an external party is one factor that causes resistance in adopting IT-based changes (Wasilah et al., 2018). The contribution of this research is to produce variables that affect the flexibility of IT management in the university. This study was conducted based on a comprehensive literature review and was empirically tested using a survey. The research phases were: identifying variables, designing the survey instrument, validating the instrument, collecting the data, and analyzing the data.

## **2. Literature Review**

### *2.1. IT management and IT management flexibility*

IT management has several functions, namely: planning, organizing, controlling, and integrating IT activities systematically (Wang et al., 2015). Implementing IT effectively and overseeing IT-related activities

are the IT management functions. IT management is considered to be successful if it is able to implement and control IT-related activities effectively (Zhang et al., 2008). In university, IT management is related to IT support for the sustainability of the academic and administrative processes. IT management support that is aligned with the development needs of the academic and administrative processes is very much needed in the current industrial 4.0 era. IT Management Support is needed in achieving business goals and responding to environments change (Delone, 1988).

Effective IT management can optimize the function of IT infrastructure in achieving business goals and adapting to changes. Adaptation to change requires the support of more responsive IT infrastructure. The availability of adequate access, a reliable platform will facilitate IT management in carrying out its functions. IT management must reconsider the IT assets needed to adapt (Feld and Stoddard, 2004). IT management is needed to reconsider existing IT assets effectively, generate new knowledge, provide new skills to users, and take advantage of opportunities (Bharadwaj and Grover, 2016). IT management needs to make adjustments to meet changing needs in the 4.0 revolution era. This cannot be avoided because the process will continuously change.

Flexibility is related to resource management (Dumas et al., 2012). Resource-based theory (Ali, et al., 2015; Duncan, 2016) state that resource consists of the organization, human, and infrastructure. This theory explains that infrastructure management, organizational management, and human resource management is elements that need to be considered in management flexibility. Referring to the resource-based theory (RBT), the management capability of information technology (IT) in universities in responding to changes is related to IT infrastructure management, organizational management, and human resource (HR) management.

In this research, IT management flexibility is defined as the ability of university IT management in managing resources so that they are able to adapt to the changes. Flexible IT management support is expected to facilitate IT managers and staffs in planning, controlling and aligning the IT implementation with strategic and operational needs. The discussion of IT management flexibility was focussed on IT management in universities, including IT infrastructure, organizational, and human resource support. Many factors influence the success of the improvement of the IT management flexibility in universities. The proper planning and management are expected to minimize the factors inhibiting the universities to adapt to IT changes.

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## *2.2. IT Infrastructure Management Factors*

IT infrastructure is part of the IT resource managed in IT management. A survey by the Information Week journal reported that creating a strong and flexible IT infrastructure is a top priority among the 150 IT managers surveyed (Lacerda and von Wangenheim, 2018). Meanwhile, in Delphi's study (Pokutta and Schmaltz, 2011), senior IT executives explain that the most important problem of IT Management is the development of a flexible and responsive IT infrastructure. Flexible IT infrastructure can increase the effectiveness of IT Management (Wang et al., 2015). Nevertheless the flexibility of IT infrastructure cannot have optimal impact if it is not supported by the flexibility of other resources.

Duncan (2016) offers an empirical investigation of the technical aspects of IT in building infrastructure flexibility. He explains that one way to describe the flexibility of a more appropriate technical IT infrastructure is through quality connectivity, compatibility, and modularity. Connectivity is the ability of technology to connect one component to another inside and outside the organization's environment. Meanwhile, compatibility of IT infrastructure is the ability to jointly utilize all forms of data and information between parts of the company, including compatibility in technical aspects of infrastructure. Duncan further explains that organizations with high connectivity, compatibility, and modularity are considered as organizations with high IT infrastructure flexibility.

### *2.2.1. Data Integration*

Data integration is the process of combining or uniting two or more data from various different database sources into a storage (Chitescu, 2012; Alonso et al., 2015; Daraio and Glänzel, 2016; Houari et al., 2016). Byrd and Turner (2000) state that integration is a combination of connectivity and compatibility. Data integration in this study is defined as university perceptions about the level of reliability of combining data to support ease of interaction in university. Data at the university consists of academic, financial, staffing and other supporting data. Interaction at university occurs in the internal and external environment. Interaction in the internal environment includes interaction between students, lecturers, academic administration, finance and all sections in university. Meanwhile, interactions in the external environment include interactions between universities, industry and the public. Gimun Kim (2011) states that interactions are important things that affect a company's ability to adapt to change. Interaction needs to be supported by the availability of complete and quality data. Data integration makes it possible to maintain data availability and avoid data duplication. Data integration systems are important in the development of real world applications, (Calvanese et al.,

2003; Goodhue et al., 2006) in an educational environment (Bakir, 2016). Integrated data management facilitates the process of change and ensures the quality of information produced (Houari et al., 2016). In connection with this, data integration in universities has the potential to influence the flexibility of IT management in universities.

### *2.2.2. Modularity of Application*

Modularity is a form of special design created to create a high level of independence (Sanchez, 2016). Organizations with IT modularity are organizations that can build or modify running applications quickly (Duncan, 2016). Modular system theory says that, the higher the modularity of the system, the flexibility will increase. (Sanchez, 1995). Modularity in software design is creating modules that are easily combined to produce customized application programs. (Hunter *et al.*, 1991).

Modularity of the application is managed by dividing the application into small parts called modules. Modularity in this study is defined as university perceptions about managing application modules for ease of change in university IS. Modularity management can facilitate the process of modification of the information system for adjusting the need for change. This is related to the management of application modules and the management of information system design documentation. Modular software will be effective if the modules are independent (Hunter et al., 1991). Independent modules are easier to build, test, and modify (Clements and Weiss, 1985). The ease of building, testing and modifying these applications causes modularity which can potentially affect the flexibility of IT management at the university. An Application with high modularity has the potential to influence the flexibility of IT management in universities.

### *2.3. Organization*

Effective organizations are organizations that make high-quality decisions (McDanie, 2011). Decision making is an important factor as it is one of the most difficult things for managers in times of uncertainty when a change occurs (Esther Cameron and Mike Green, 2012). Other factors are formalization and complexity. Formalization and complexity are elements of organizational structure that have a substantial impact on decision making. The formalization of procedures and complexity is crucial factors in decision making that will increase organizational flexibility.

The other organizational element that is no less important in influencing an IT management ability to adapt to change is the culture of the organization. Some studies report that the most frequently cited reason

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for failure is the neglect of the culture of the organization. Cultural factors affect the use and perception of IT, thus, it is also possible to influence the ability of the organization to adopt change (Grembergen and Haes, 2015). In IT-based changes, system and equipment changes are not enough to produce radical changes. Hence, cultural change is needed (Esther Cameron and Mike Green, 2012). Culture, in particular, is often considered important for the success of business processes and changes driven by IT (Schmiedel and Recker, 2014). Therefore, cultural factors need to be considered to improve the organizational flexibility, which includes IT leadership and value drivers (Cameron and Quinn, 2006).

### 2.3.1 Decision Support System (DSS)

The application of DSS is able to minimize the stages of operating the production system in the industrial revolution 4.0 (Doltsinis *et al.*, 2020). In addition to the production system, DSS is also applied to health services (Nova, Zarrin and Heckman, 2019), classification of employees at the company (Žunić, Djedović and Avdagić, 2016) and in the determination of scholarship recipients in schools (Situmorang, Pibriana and Tosida, 2018). The decision support system can help management in making decisions quickly and accurately.

DSS is related to IT support in providing information for quality decision making (Karagiannis, 2012). DSS in this study is defined as university perceptions about providing information to support the process decision making. The process are monitoring the performance of lecturers and employees in the HR department, procurement services in the logistics department, and student payment information. The existence of a monitoring system that produces quality information can be used as a support for decision making. Support in the form of the availability of relevant, accurate and fast information will help the management to produce the right and fast decisions. The ability to make decisions quickly and accurately has the potential to affect the flexibility of IT management at the university.

### 2.3.2 Formalization

Formalization describes the extent to which regulations, procedures, instructions are written and enforced. Structural formalization is characterized by the rules and procedures that influence the behavior of decision making (Chitescu, 2012; Bozkurt *et al.*, 2014). Formalization in this study is defined as university perceptions regarding the level of formal policies from management that are needed to support the implementation of IT changes in universities. Implementation of IT requires formal planning and rules. IT implementation planning is needed to define the



direction of IT implementation (Wang et al., 2015). IT implementation plans in university are prepared based on the priority level of need. The existence of IT implementation planning will have an impact on the implementation and development of more targeted IT. IT plans are needed in companies (Kearns and Lederer, 2003) and universities (Ajami and Al-Qirim, 2013). Procedures, formal rules and well-planned IT planning will make it easier for IT management universities to adapt to the changes. Therefore, the completeness and availability of procedures have the potential to influence the flexibility of IT management in universities.

### 2.3.3. Complexity

Complexity relates to the degree of difference. A high level of difference can cause difficulties in coordination. The complex operational environment requires great coordination, so that it is difficult to make changes (Chen et al., 2014). Complexity can be simplified through standardization (Farrell and Saloner, 1985). In this study standardization is defined as university perceptions of IT management standards that are needed to facilitate control, included: hardware, software and documentation. The application of standardization has an impact on managing IT easier and more efficient, and the documentation system has become simpler. Several studies have shown that the use of standardization can improve process control (Pick, 2015). Standardization in IT management at universities is implemented as an effort to improve process control effectively and efficiently. Therefore, the level of application of standardization has the potential to influence the flexibility of IT management within universities.

### 2.3.4. IT leadership

IT leadership is defined as the vision and level of commitment of management to adapt to change (Cameron and Quinn, 2006; Esther Cameron and Mike Green, 2012). In this study, IT leadership is defined as the vision and the level of commitment of management to adapt to change in universities. Commitment of management is important in order to adapt to change. Pang (2014) state that, IT managers who do not have an IT vision, will tend to reject change and survive the conditions of old resources for various reasons.

27 The availability of adequate resources is expected to be able to support the ability of IT management to adapt to changes (Wang *et al.*, 2015). In addition to the availability of resources, increased IT collaboration between universities and companies is also needed. Collaboration between universities and companies is expected to improve the alignment of the academic process with the output needed by companies as graduate users. This condition can only be realized with the support of university

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management who has an IT vision. Therefore, the types of leaders who have IT leadership can affect the flexibility of IT management.

### *2.3.5. Value drivers*

Value drivers related to the culture of values that trigger the adaptation of organizations (Cameron and Quinn, 2006; Esther Cameron and Mike Green, 2012; Albayrak and Albayrak, 2014). In this study value drivers are defined as the values that are the supporters of IT implementation in adapting to changes in universities. Universities need to have culture values that trigger the adaptation. In addition to cultural values, it also requires support for a conducive academic culture, as well as having cultural characteristics that are compatible with internal conditions (Albayrak and Albayrak, 2014).

42 The work culture of lecturers, staff and students at the university is needed to be able to adapt to changes (Mazali, 2017). The existence of a good work culture, the support of a conducive academic culture allows organizations to be able to switch quickly in the face of change. In response to the need of industry 4.0, university collaboration involving experts, government, and the industry is an essential value. The reach of IT collaboration in teaching, research, and community service was targeted in the Education 4.0 era to be able to adapt to change. Success in responding to needs can only be achieved if there is support for work culture from all elements of higher education (Widyasari et al, 2019). Thus, the value drivers have the potential to influence the flexibility of IT management in universities.

### *2.4. Human Resource (HR)*

Changes in work methods require conformity of HR competencies. This is related to the ability to use tools and other skills. Organizations need to make adjustments to their HR competencies to meet the changing needs. In addition to the need for allocation of human resources in accordance with their competence, in an effort to meet the growing need of competencies, training needs to be carried out periodically. Phillips said, that in addition to investment in technology, things that need to be prioritized are investments in human resources (Phillips and Wright, 2009). HR management is not only focused on selection, staffing and dismissal of employees but also to the development of human resources, namely education, learning and employee training (Esther Cameron and Mike Green, 2012).

#### 2.4.1 Human Resources Competence

Human Resources Competence related to managing HR competence adjustments to adopt changes in ways of working (López-Torres and Prior, 2016). In this study human resources competence is defined as managing HR competencies to adopt changes in universities, including: lecturers, IT staff and non-IT staff competencies. Human resources need to have supporting competencies that are appropriate to the need of the development of future IT changes. This is needed because IT management will be able to follow changes as expected if IT human resources have the knowledge and skills needed (Esther Cameron and Mike Green, 2012). HR who have the knowledge and skills as needed will be able to optimize the IT management functions to be able to adapt to changes. Based on the description HR competence has the potential to influence the ability of IT management to deal with change.

#### 2.4.2 Human Resource Development

Human resource development is related to the management of procurement of IT workshops to improve IT HR competencies (Benešová and Tupa, 2017). In this study, human resource development includes the management of IT training and workshops for all elements of the university to improve the IT competencies. University human resources need to be flexible to be able to carry out tasks with very different contexts (Hecklau et al., 2016). Training is important to be conducted periodically for HR to make adjustments and increase competencies according to changing needs (Silva et al., 2019). Human resources are equipped with several competencies that meet the need for change will have the ability to adapt quickly to the needs of change. In an effort to meet the evolving competency need, IT training needs to be conducted periodically (Hecklau et al., 2016). Planned HR development can prepare HR who have competencies that are in line with changing needs. This strongly supports the ability of IT management to adapt to change. Based on this description, the IT training facility for HR on a scheduled basis can affect the flexibility of IT management at the university.

#### 2.4.3 Knowledge sharing (KS)

Knowledge sharing is a mechanism to disseminate information and knowledge from one individual, group, or organisation to another (Pangil and Nasurdin, 2009; Gleason, 2018). In this study KS is defined as the ability of universities to manage information and knowledge in supporting business processes in university. Learning materials, results of research and community service are important sources of knowledge in universities. Fullwood (2017) state that KS is needed in academic institutions. Some universities have implemented KS (Mcmanus and

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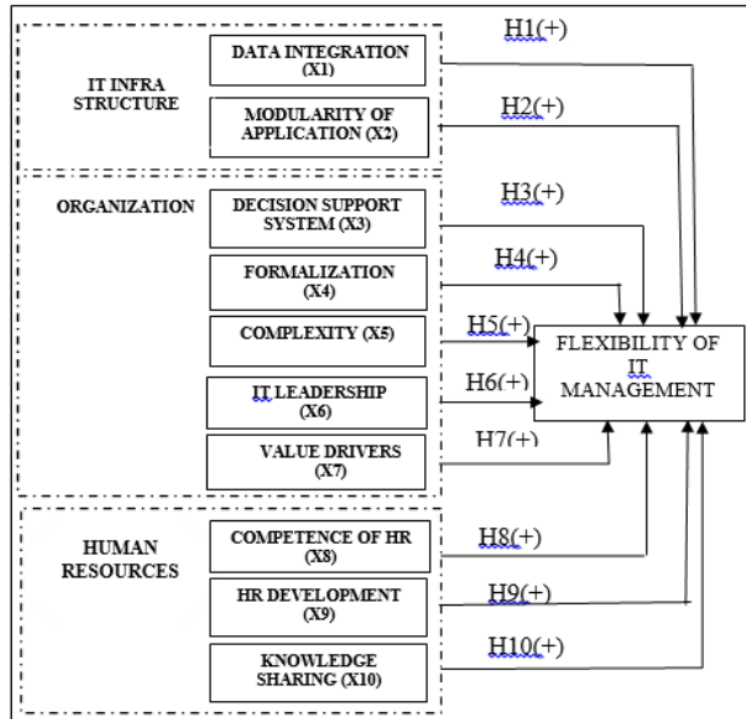
Loughridge, 2002; Joseph J. Branin, 2003; Al-Kurdi, El-Haddadeh and Eldabi, 2018). The knowledge can be a source of knowledge for internal users such as: students, lecturers, staff and university management. In addition to sharing knowledge with internal users, sharing knowledge and collaborating with external parties is an equally important requirement (Fullwood and Rowley, 2017). Knowledge sharing and collaboration can involve external parties, such as other universities, industry, and the government. Knowledge sharing behavior is very important in university (Al-Kurdi et al., 2020 ; Tan, 2016;). Well managed knowledge will facilitate IT management to carry out monitoring and evaluation functions. Based on the description, IT management flexibility has the potential to be affected by the successful management of knowledge sharing.

### **3. Research Method**

This research was conducted in four stages, namely: identifying variables, designing the survey instrument, collecting the data, and analysing the data. Activities at each stage are described as following.

#### *3.1. Identifying Variables/Constructs*

This stage was carried out by identifying supporting factors in increasing the flexibility of IT management in universities. This stage was done by literature studies and interview. The literature study involved reputable journals or Scopus indexed journals which are related to factors that have the potential to influence the ability of universities to adopt change. Journals and articles were related to IT flexibility, changes in universities, IT management, and IT-based change. Meanwhile, the interview was done by experts based on their experience. Experts are IT manager in a university at least three years experience (Moreira and Rocha, 2017; Ibnugraha et al., 2018). Based on the literature study, 10 factors were identifies as could potentially influence the flexibility. All of the hypotheses drawn in the research model in Figure 1.



**Figure 1.** Research Model.

The proposed hypothesis consists of ten hypotheses in the form of a direct influence on flexibility of IT management.

### 3.2. Designing the survey instrument

The indicators were derived from variables generated in the previous stage. Each variable has several indicators. Based on the generated constructs, the operationalization of all constructs and the indicator are presented in Table I.

**Table 1.** Constructs Operationalization and Indicator

Construct Name	Operational Definition	Indicator
Data integration (X1)	University perceptions about the level of reliability of combining data to support ease of interaction in university (Chitescu,	1. The range of data integration between sections (X1.1). 2. Integrated data scope (X1.2). 3. Access data in universities (X1.1).

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Construct Name	Operational Definition	Indicator
	2012; Alonso et al., 2015; Houari et al., 2016).	
Modularity of Application (X2)	University perceptions about managing application modules for ease of change in university IS (Duncan, 2016)	<ol style="list-style-type: none"> <li>1. Management of application modules on IS (X2.1).</li> <li>2. Managing the IS design documentation (X2.2).</li> <li>3. Management of software documentation (X2.3).</li> </ol>
Decision Support System (X3)	University perceptions about providing information to support the process decision making (Karagiannis, 2012)	<ol style="list-style-type: none"> <li>1. Availability of academic information (X3.1).</li> <li>2. Availability of financial information (X3.2).</li> <li>3. Availability of administrative and logistical information (X3.3).</li> </ol>
Formalization (X4)	University perceptions regarding the level of formal policies from management that are needed to support the implementation of IT changes in universities (Chitescu, 2012).	<ol style="list-style-type: none"> <li>1. The level of available formal policy from management to adopt the IT change (X4.1).</li> <li>2. The availability of the IT master plan (X4.2).</li> <li>3. The level of available procedures for implementing IT change (X4.3).</li> <li>4. The availability of IT implementation guidelines (X4.4).</li> </ol>
Complexity (X5)	University perceptions of the IT management standards that are needed in higher education to facilitate control (Pick, 2015)	<ol style="list-style-type: none"> <li>1. Standardized documents (X5.1)</li> <li>2. Standardized software (X5.2)</li> <li>3. Standardized hardware (X5.3)</li> </ol>
IT Leadership (X6)	University perceptions of the vision and the level of commitment of management to adapt to change in universities (Cameron and Quinn, 2006; Esther Cameron and Mike Green, 2012).	<ol style="list-style-type: none"> <li>1. Commitment of the management to provide IT facilities to support administration of academic (X6.1)</li> <li>2. Commitment of the management to support lectures activities (X6.2)</li> <li>3. Position of IT division on the universities structure (X6.3).</li> <li>4. Commitment of the management to provide IT facilities to support changes (X6.4).</li> </ol>
Value drivers (X7)	University perceptions regarding the values that are the supporters of IT implementation in adapting to changes in universities (Cameron and Quinn,	<ol style="list-style-type: none"> <li>1. IT collaboration with external (X7.1).</li> <li>2. The level of awareness of lecturers in using IT facilities (X7.2).</li> <li>3. The level of awareness of</li> </ol>

Construct Name	Operational Definition	Indicator
	2006; Esther Cameron and Mike Green, 2012; Albayrak and Albayrak, 2014).	employees in using IT facilities (X7.3). 4. Upgrading the vision and mission of the IT (X7.4).
Competencies of HR (X8)	University perceptions about managing HR competency adjustments to adopt changes in ways of work due to changes in IT support (López-Torres and Prior, 2016).	1. IT human resource on duty according to competence (X8.1) 2. Human resource IT certified (X8.2). 3. The percentage of lecturers who have IT competencies that are appropriate to their needs (X8.3). 4. Non-IT personnel who have IT competencies that are in line with needs (X8.4).
HR Development (X9)	University perceptions about the management of procurement of IT workshops to improve IT HR competencies (Benešová and Tupa, 2017).	1. Management of workshops by IT management for IT HR (X9.1). 2. Management of workshops by IT management for non IT HR (X9.2). 3. Management of workshops by IT management for lectures (X9.3).
Knowledge Sharing (X10)	University perceptions about the ability of universities to manage information and knowledge in supporting business processes in university (Gleason, 2018).	1. Management of knowledge sharing in supporting the learning process (X10.1). 2. Management of knowledge sharing in supporting the research process (X10.2). 3. Management of knowledge sharing in supporting community service (X10.3) 4. Management of knowledge sharing to support student activities (X10.4).

The indicator was derived as a basis for the design of the survey instrument in the form of questionnaire questions. The survey question type was closed-question using the five Linkert scale (Numprasertchai, et al.,2019). Furthermore, to find out the quality of the questionnaire, the confirmation of the survey instrument was conducted to validate the instrument. Instrument validation was measured based on the level of agreement for each item of the rater in assessing the questionnaire question items. The level of agreement was measured using the value of Cohen's Kappa. Cohen's Kappa value that can be accepted is a Kappa coefficient value above 0.6 (Cohen, 1960). Face validity tests were done to analyze items used as survey instruments. The face validity tests involved five raters as the experts. The level of the expert agreement showed a high similarity of perception in all pairs. The rater consists of university

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management staffs who have a formal educational background in IT. The value of Cohen's Kappa produced has met the criteria, which was greater than 0.6.

### 3.3. Data Collection

In this study, sampling was conducted through convenience sampling approach. In this study, sampling was carried out using online questionnaires that were sent to respondents using broadcasted email and WhatsApp. The target sample was 50 universities in which only 45 respond. Respondents who complied with the criteria were 40 respondents. Respondents at universities are the information technology manager. Respondent criteria are based on the appropriateness of respondent's knowledge and experience (Cooke and Hale, 2008).

The universities involved in the sample are public and private universities in Indonesia and have accreditation A or accreditation B. The demography of respondents are displayed in Table 2.

**Table 2.** Demography description table

Demography description		Frequency
Type of Univesity	Public	48%
	Private	52%
Acreditation	A	52%
	B	48%

## 4. Data Analysis

Data analysis involved measurement model assessment and structural model assessment. Measurement model involved the construct validity, reliability tests and discriminant validity. The resulting data were analyzed and tested to find out whether the study instrument that was designed produced construct that met the criteria of validity and reliability. Indicator validity test was seen based on factor loading values. Reliability testing was seen based on the value of Cronbach's alpha and composite reliability. Discriminant validity indicates the relationship among construct in the research model. Meanwhile, the structural model assessment shows the path coefficients and the strength of the determinate coefficients.

In this study, the analysis was carried out on 40 respondents. The number of samples can be considered to be a sufficient number of samples. Roscoe's rules (Hill, 1998), states that in experimental research, involving independent variables and measuring their effect on the dependent variable, the minimum recommended sample size is 30.





**Table 4.** Discriminant Validity

	X8	X5	X3	X4	X9	X1	Y	X6	X10	X2	X7
X8	0.882										
X5	0.222	0.897									
X3	0.411	0.474	0.829								
X4	0.096	0.692	0.694	0.800							
X9	0.492	0.167	0.366	0.140	0.878						
X1	0.100	0.520	0.293	0.636	0.100	0.763					
Y	0.236	0.236	0.460	0.181	0.335	0.383	0.806				
X6	0.367	0.283	0.512	0.419	0.349	0.359	0.206	0.757			
X10	0.635	0.563	0.434	0.390	0.349	0.312	0.369	0.354	0.877		
X2	0.301	0.132	0.730	0.150	0.281	0.148	0.433	0.167	0.277	0.883	
X7	0.590	0.377	0.429	0.441	0.362	0.445	0.399	0.569	0.498	0.250	0.856

Table 4 shows that the discriminant validity was appropriate. All variables have the highest attachment value to themselves. This shows that there was no autocorrelation between one variable with another variable.

#### 4.2. Structural Model Assessment

This test was carried out to prove the designed hypothesis and test the effect of the independent variables on the dependent variable. The path coefficient values for the 10 factors analyzed produced positive path coefficient values. This shows that the 10 factors have an influence on the IT management flexibility at the university. The path coefficient value, t-value, and p-value are the criteria for determining the significance of influencing a variable. The values test that are considered to have sufficient influence are the variables that produce p-values  $\leq 0.05$  and t-value  $\geq 1.96$  (Liu *et al.*, 2014). Table 5 shows the coefficient of influence of the variable which has a significant effect.

**Table 5.** Path Coefficients, t-value, p-value

Path	Path Coefficient	t-value	p-value	Decision
X1 → Y	0.35	2.08	0.04	Supported
X2 → Y	0.36	2.47	0.01	Supported
X3 → Y	0.15	0.88	0.38	Unsupported
X4 → Y	-0.19	0.99	0.32	Unsupported
X5 → Y	-0.19	1.13	0.26	Unsupported
X6 → Y	-0.15	0.96	0.34	Unsupported
X7 → Y	0.40	2.00	0.05	Supported
X8 → Y	0.39	2.07	0.04	Supported
X9 → Y	0.40	2.00	0.05	Supported
X10 → Y	0.50	2.49	0.01	Supported

R square test showed the predictive power of the model simultaneously, while the path coefficient shows how much influence each construct has. The results of the construct test simultaneously shows value of 0.76, showing that the value of influence simultaneously is quite high.

## **5. Discussion and implications**

### *5.1. Discussion*

Data integration (X1) produced t-value of 2.08 and p-value 0.04, showing that data integration significantly affects the increase in IT management flexibility. The range of data integration, integrated data scope, how to access data in universities help the university management in maintaining the reliability of the information produced. These conditions are needed to ensure that changes in the way work does not cause a decrease in the quality of information. Through the support of data integration, information quality is maintained despite many changes. The ability to maintain the quality of the information shows that integrated data management can support the flexibility of IT management. This means that integrated data management can facilitate the process of change and This is in line with point from (Houari et al., 2016) who state that integrated data management is useful to ensure that information quality is maintained. ensure the quality of information produced.

Modularity of application (X2) produced t-value of 2.47 and p-value 0.01. It shows that modularity significantly affects the increase in IT management flexibility. It shows that application management modules and management software documentation facilitate changes in information systems. In the university information system, modularity was done by dividing the system into simple modules. Each module has its function, which does not require high-level coordination when operated and can be reconsidered quickly and easily. This means that adding, modifying, and deleting one or more modules can be done easily without causing a significant impact on the whole system. That condition is in line with (Duncan, 2016) that state that IT modularity caused modify running applications quickly.

Value drivers (X7) produced t-value 2.00 and p-value 0.05. It shows that value drivers significantly affects the increase in IT management flexibility. The awareness of the importance of change will bring motivation. Motivation is needed in the face of discomfort due to changes. Awareness to turn into capital is important for success in change, because one of the causes of change failure is the lack of human motivation. That condition is in line with Calder, that state that one reason of rejecting the changes is the culture of surviving with the comfort of the work

*Title*

environment and old ways of working. The individual discomfort towards change causes less motivation in making changes (Calder, 2013).

Human resource competency (X8) produced t-value of 2.07 and p-value 0.04. Show that human resource competence significantly affects the increase in IT management flexibility. Human resource competence relates to changes in the way work occurs in the learning process, library management, and academic administration management in universities. This shows that to be able to succeed in adopting IT-based changes, universities need to ensure that lecturers, IT human resources, and non-IT human resources have appropriate competencies on duty. As stated by Cameron (2012), the ability to manage IT to adapt requires **human resources who have the knowledge and skills** that are appropriate of need.

Human resources development (X9) produced t-value of 2.00 and p-value 0.05. It shows that human resource development significantly affects the increase in IT management flexibility. It also shows that procurement of workshops for IT human resources, non-IT human resources and lecturers can improve the competence of IT human resources. Training becomes important to be carried out periodically for human resources to make adjustments and increase competencies according to the need of change. Human resources that are equipped with several competencies that meet the need for change will have the ability to adapt quickly to changing needs (Calder, 2013).

Knowledge sharing (X10) produced t-value of 2.49 and p-value 0.01. It shows that knowledge sharing significantly affects the increase in IT management flexibility. It shows that management of knowledge sharing in supporting the learning process, research process, community service, and management of publications on student activities can support the use of information and knowledge in universities. These conditions are needed to guarantee that if changes are made, information and knowledge have been managed properly. The ability to manage knowledge will help the level of IT management flexibility. This is related to the need for information available for all elements of higher education. The availability of information is very important for lecturers, students and all elements of university in supporting their tasks and increasing their competence.

Data integration, modularity of application, value drivers, human resource competence, human resource development and knowledge sharing shows **significant effects**. These factors are needed to support the success of the **learning process and academic services at the university**. This **is** related to the need of the ability of universities in providing services at this time, which requires universities to have IT management that is able to adapt to change. IT management in university includes the ability to manage IT to support the learning process and **academic services**. Integrated data strongly supports the success of the **learning**

process and academic services. Students, lecturers, and all related elements can access the required data without being limited by space and time. They can access accurate data easily and quickly. They can also make academic transactions and get results easily and quickly. Students can fill out study plans, and submit academic services easily. This is inseparable from the support of integrated academic, financial, staffing and other supporting data. Likewise, lecturers can input values, approve study plans and finalize the project guidance process easily.

Besides improving the quality of service, Universities need the support of information systems by information systems that can accommodate the development needs of users. The development of user needs can be in the form of changes in content, appearance, or features. The existence of modularity in the application of information systems at universities should in principle be able to adopt the changes needed without the compensation of time and high costs.

The success of learning and academic services can not be done without the support of quality human resources. In the current era of the industrial revolution HR at the university, which consists of: lecturers, staffs and management are required to have sufficient digital capabilities. Without sufficient digital capabilities, the HR will experience difficulties in exercising their functions. This requires cooperation from all elements in university. Some lecturers or officials who are reluctant to increase their competence, so they do not get the ability to adapt to new ways of working. Thus the need for separate handling from the management. This can be done, among others, by providing strict rules, or creating conditions that force each HR to meet the required qualifications. HR that does not increase competence will be left behind automatically. This forces HR to try to improve their competence. HR competencies in university must be improved according to need. Internally conducted training is one of the alternatives that can be done. This can be done independently by the university IT bureau or through training by external organizers. This requires support from university management both in terms of funding and setting rules. This is similar to Albayrak (Albayrak and Albayrak, 2014), that success in change requires the support of all elements involved in organization.

## 24 5.2. Implications

### 5.2.1. Implications for research

Previous studies focused mostly on IT infrastructure. The study reviewed IT infrastructure flexibility in manufacturing from various perspectives, namely: connectivity, compatibility and modularity (Alharbi, Heavin and Carton, 2015; Duncan, 2016). In addition, other studies are adding

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indicators of IT infrastructure flexibility with IT person (Nurshuhada and Hafez, 2011), and business knowledge (Byrd and Turner, 2000).

Facing IT-based changes, IT flexibility is not enough to focus solely on IT infrastructure flexibility. IT infrastructure is only one of the resources managed in IT management. In this study, there were 10 variables that are considered to influence the increase of IT management flexibility, namely: data integration, modularity of application, decision support systems, formalization, complexity, IT leadership, value drivers, human resource competencies, human resource development and knowledge sharing. Among the 10 proposed variables, there were 6 variables that significantly influence the IT management flexibility. The variables are: data integration, modularity of application, value drivers, human resource competencies, human resource development and knowledge sharing. Our research findings revealed a significant effect not only from the aspect of IT infrastructure, but also from organizational and human resource aspects.

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#### *5.2.2. Implications for practice*

This study has a number of implications for universities. The results of a study of factors that influence the IT Management flexibility can be used by IT managers and university management to pay more attention to aspects that can increase the flexibility of IT management. These factors are data integration, application modularity, value drivers, human resource competence, human resource development, and knowledge sharing. This can be used to prepare important strategies and factors needed so that IT management can adapt quickly. Managers must realize that IT infrastructure factors are not enough to improve the ability of universities to adapt to change. University must pay attention to other factors to be able to improve their adaptability. This is important for the university because if it does not adapt it will cause many negative impacts. It can threaten its existence.

The resulting variables and indicators can be used by university management to measure the ability of the university at this time, and the conditions targeted in the future related to the flexibility of IT management. The measurement results can then be used to make planning more structured by focusing on the preferred indicators. The plan can be used as a reference in allocating budgets in the IT field at the university.

### **6. Conclusion**

The study identified ten variables that have the potential to affect IT management flexibility. The variables consist of data integration, modularity of application, decision support systems, formalization,

complexity, IT leadership, value drivers, human resource competencies, human resource development and knowledge sharing. Variables and indicators for each variable were tested for validity and reliability. Indicator validity testing was carried out referring to the value of factor loading greater than 0.7 producing 29 indicators for independent variables. Furthermore, construct validity and reliability tests referred to the value of composite reliability and Cronbach alpha value. The test results for ten variables showed a value of more than 0.7. This condition indicates that these variables are variables that can be trusted to be used as a measure of IT flexibility.

The significant test showed that the variables that directly have a significant effect on IT flexibility at the university are data integration, modularity of application, value drivers, human resource competencies, human resource development and knowledge sharing. Meanwhile, the decision supports system variables, formalization, complexity and IT leadership have no significant effect. R-square test shows that these variables also simultaneously influence the flexibility of IT management in universities. Data integration, modularity of application, value drivers, human resource competence, human resource development and knowledge sharing simultaneously affects the flexibility of IT management. The simultaneous effect of these variables on IT management flexibility reached 76%. Meanwhile, 24% came from other factors outside the variables discussed in this study.

Further research can be done by influencing analysis involving types of universities. This is possible because the types of universities consisting of public and private universities have differences in several aspects, such as culture and funding sources. In addition, the indirect effect between independent variables has the opportunity to be further investigated.

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