

MANAGEMENT INNOVATION IN BALANCING TECHNOLOGY INNOVATION TO HARNESS UNIVERSITIES PERFORMANCE IN THE ERA OF COMMUNITY 4.0

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Abstract: The Internet of things (IoT) has changed the way universities managing the people and the way of transferring knowledge. To go with the current trend, universities invest a considerable amount in technology to be acknowledged as an innovative university. However, lower productivity of lecturers, the complaint on the quality of outputs as well as the decreased enrolment requires universities to explore another arena to innovate. Academia has started accentuating that to capture the comprehensive benefits of innovation, technological innovation must be mixed with management innovation that is altering the practice of management within organizations by adopting new organizational structures, processes, and practices to generate a valuable source of competitive advantage. As most innovations are associated with product development, this study highlights management practices as a process innovation in responding to the trend. While there is a growing body of in-depth qualitative research that provides insight into the sequence of events that occurs during process innovation, these studies have not systematically analyzed the organizational capabilities that fuel management innovation mainly in an educational organization. Therefore, Structural Equation Modelling (SEM) is employed to spot the arena for further study. Finally, the model is expected to provide the model for universities wishing to promote innovation within the organization in supporting the Indonesian government' aspire to achieve the economic growth above 7% in the years to come.

Key words: management, technology, innovation, complementary, university

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Introduction

The new reality in the modern economy is the concept of Industry 4.0 as innovation and technological advancement become a crucial role in all organization (Ślusarczyk, 2018). Despite the undeniable importance of technological innovation, another type of innovation has successfully been immersed outside the domain of technology. This non-technological innovation which is more complicated to replicate and may support to a long-lasting competitive advantage has been denoted as management innovation (Mol and Birkinshaw, 2012) and public sector has started to implement management innovation (Ab Rahman et al., 2018; Závadský et al., 2016). The success story of top Indonesian universities like the

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University of Indonesia, Bandung Institute of Technology is excellent examples that owe their success to management innovation, not technology innovation. However, as management innovation is still relatively under-researched (Nieves and Ciprés, 2015) a better understanding of management innovation, especially within the educational organization should be a priority on the research agenda (Voigt et al., 2018). Mol (2018) defines management innovation as the generation and implementation of new management practice, process, structure, or technique that is new to state of the art and is intended to further organizational goals. New management practices, processes, structures, and techniques imply changes in respectively the day-to-day activities of managers as part of their job in the organization (what managers do), the routines governing their work (how they do it), the organizational context in which their work is performed, and the associated techniques (Vaccaro et al., 2012).

Since the ministry of research and higher education of Indonesia has started to include innovation as one of evaluated elements in determining the rank of the university besides human resources, management, research, and students' achievement (Abbas et al., 2018), current university systems need leaders who is highly competent and shows robust leadership practices that universities are effectively managed (McCaffery, 2018; Aleksejeva, 2016). This phenomenon brings remarkable modifications in educational management under which the direction of academies, costing, human resources and general administration were conferred on the university. Consequently, university leaders need to be deeply thoughtful to changes and innovation in the field of education as the conventional university system is no longer able to anticipate the society's growing demand (Scott, 2018).

Even though the hot flow in academic concern, management innovation stays as an under-researched focus as the most substantial part of studies has been dedicated to analyzing how the business may encourage technological innovation (Damanpour et al., 2018). Further, innovation management in a school setting is commonly associated with a perceived incapacity to innovate meritoriously (Voigt et al., 2018). In other word, schools do not display the business-like attitude to innovation where cost-effective innovations are maintained, and less successful practices are abandoned. Management innovation usually has the objective of elevating the effectiveness and efficiency of inside organization operation (Birkinshaw, 2010; Walker et al., 2015). This way, management innovation raises the productivity and competitiveness of companies (Clauss, 2017) and facilitates economic progression (Trutneva and Kruglov, 2015). However, raising a management innovation is a complicated process (Benner and Tushman, 2015; Rajiani et al., 2016) and comprises internal and external change negotiators (Birkinshaw, 2008). Internal negotiators agents could be a firm's managers and employees who are taking part in the management innovation. External change agents include outside experts, scholars or other external people who guide the adoption of a management innovation (Birkinshaw et al., 2008; Vaccaro et al., 2012).

As innovation is considered to be the main driving force of advancements and prosperity (Keklik, 2018), as well as the recent condition where every country is struggling to identify educational innovations compatible to the necessity of the nation (Rasiah, 2017), the purpose of this study is to advance our understanding on the dimensions of management innovation and, its impact on university's performance.

Literature Review

Though management innovation is a somewhat new terminology in the management texts, the notion has been deliberated for years through somewhat substitutable words like 'organizational,' 'managerial' or 'administrative' innovation (Khanagha et al., 2013). However, despite their interchangeability, administrative innovation, organizational innovation, and management innovation are different (Azar and Ciabuschi, 2017). Administrative innovation has a narrower scope than organizational innovation. In contrast with management innovation, organizational innovation is naturally related with a narrower array of innovations around source allocation, organizational structure and human resource policies (Vaccaro et al. 2012), and eliminates operations and marketing management (Birkinshaw, 2010). The concept of management innovation is more incorporating as it denotes to changes in the way the work of management is conducted (Amarakoon et al., 2018).

The literature reviewed above indicates there are relatively few references or models to help the university to innovate in management to improve universities performance. Therefore, it is crucial to provide a model to guide how universities leaders may base their innovation management factors. This way, we provide an integrated framework of management innovation that highlights the primary constructs and outcomes adopted by Volberda et al. (2013). The framework identifies the antecedents of management innovation (managerial, intra-organizational, and inter-organizational); dimensions of management innovation (new practices, processes, structures and techniques); outcomes of management innovation in terms of various dimensions of performance (e. firm performance, productivity growth, quality of work, group satisfaction); and contextual factors that affect management innovation (such as organizational size and competitiveness of the industry). In light of the research gap, this project draws on the dynamic capabilities approach to provide new insights into firms' management innovation activities and the mechanisms through which they complement technology innovation in shaping firm performance. Dynamic capabilities are defined as a firm's "ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Piening and Salge, 2015). To sum up, management innovation includes modifications in how and what managers do in determining directions, making decisions, harmonizing activities and encouraging people. These changes are shown in new managerial practices,

structures, or processes which are context-specific, vague and ambiguous to duplicate, making them a vital source of competitive advantage. Although a company may shape the management innovations of others, its successfulness is likely determined by how those management innovations are reformed to the distinctive features of the organization.

Table 1. The framework of management innovation

Constructs	Dimensions	Sources
Management innovation	<ul style="list-style-type: none"> – new managerial practices – new managerial process – new organizational structures – new managerial techniques 	Birkinshaw (2010) and Vaccaro et al. (2012)
Technology innovation	<ul style="list-style-type: none"> – breadth of knowledge – depth of knowledge – process innovation 	Mol and Birkinshaw (2012)
Dynamic capability	<ul style="list-style-type: none"> – ability to integrate internal competencies – ability to reconfigure external competences – ability to address rapidly changing the environment 	Piening and Salge (2015)
Managerial antecedents	<ul style="list-style-type: none"> – transformational leadership – transactional leadership – top management reflexivity – managerial tenure – CEO novelty 	Mihalache (2012)
Intra-organizational	<ul style="list-style-type: none"> – diagnostic and implementation capability – educated workforce – internal change agents 	Mol and Birkinshaw (2012)
Extra-organizational	<ul style="list-style-type: none"> – external change agents – involvement in external networks – interaction with earlier adopters 	Damanpour and Aravind (2011)
Contextual factors	<ul style="list-style-type: none"> – organizational size – environmental circumstances – performance decline 	Vaccaro et al. (2012)

Methodology

This research uses quantitative methods of data intending to analyze the specific company's management innovation practices in the domains of managerial activities, intra-organizational process, extra-organizational process, contextual factors as well as dynamic capabilities in Indonesian higher education sectors. The

target population of this study is 150 department heads from various faculties in several big cities of Indonesia including Jakarta, Surabaya, and Banjarmasin. By using the Structural Equation Model (SEM), the standard rule is that the minimum number of observation is at least five times as many observations (Hair et al., 2006). As there were 24 indicators to be tested, a sample of 150 falls within an acceptable sample range. Although SEM is an extension of multiple regressions, it relies very heavily on pictures called path diagrams to visualize what is going on. Also, in SEM, we do not talk about “independent” and “dependent” variables. Instead, we talk about exogenous variables and endogenous variables. To avoid confusion, we say that an exogenous variable has paths coming from it and none leading to it. All instruments integrated into the questionnaire were derived from the previous literature exploration. Also, all questions were consulted with a panel of a scholar and industrial experts to assess the validity of items in the questionnaires. The seven-point Likert-type scales (1 – strongly disagree; 7 - strongly agree) were applied throughout the questionnaire.

The relationship among constructs is depicted in a theoretical framework. The management innovation as an endogenous construct is measured with four dimensions: new managerial practices (MI1), new managerial process (MI2), new organizational structures (MI3) and new managerial techniques (MI4) adapted from the work of Birkinshaw (2010) and Vaccaro et al., (2012). Technology innovation as an endogenous construct is measured with three dimensions: breadth of knowledge (TI1), depth of knowledge (TI2) and process innovation (TI3) adapted from Mol and Birkinshaw (2012). Another endogenous construct: dynamic capability is measured with three dimensions: the ability to integrate internal competencies (DC1), ability to reconfigure external competences (DC2) and ability to address rapidly changing the environment (DC3) developed by Piening and Salge (2015). In the other hand, the exogenous variable of managerial antecedents are measured with transformational leadership (MA1), transactional leadership (MA2), top management reflexivity (MA3), managerial tenure (MA4) and CEO novelty (MA5) adapted from Mihalache (2012). Intra-organizational antecedents are measured with diagnostic and implementation capability (IO1), educated workforce (IO2), and internal change agents (IO3) adapted from Mol and Birkinshaw (2012). Extra-organizational antecedents are measured with external change agents (EO1), involvement in external networks (EO2) and interaction with earlier adopters (EO3) adapted from Damanpour and Aravind (2011). Contextual factors are measured with organizational size (CF1), environmental circumstances (CF2) and performance decline (CF3) developed from the work of Vaccaro et al. (2012). Six hypotheses will be tested.

1. *Technology innovation is positively related to management innovation.*
2. *Contextual factor is positively related to management innovation.*
3. *Managerial antecedent is positively related to management innovation.*
4. *Intra-organizational factor is positively related to management innovation.*
5. *Extra-organizational factor is positively related to management innovation.*

6. *Management innovation is positively related to dynamic capability.*

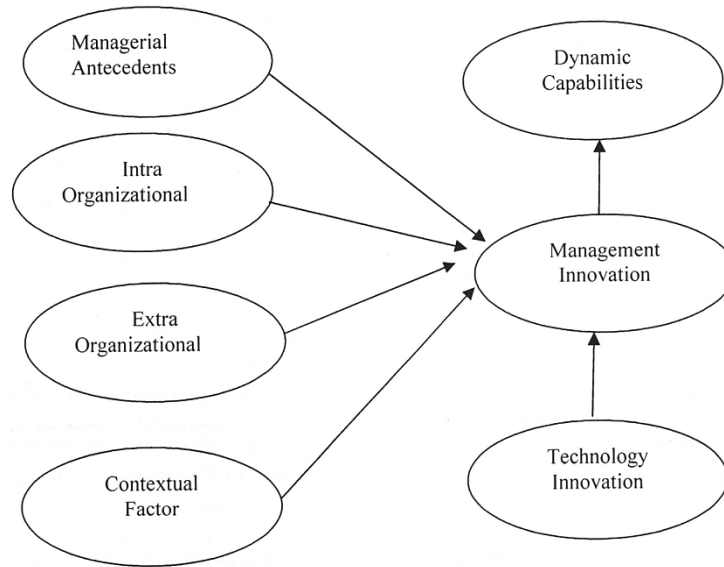


Figure 1. Theoretical framework

Factors loading are employed to evaluate discriminant validity where only items with factors loading surpass 0.50 will stay in the model (Hair et al., 2006). When all in SEM requirement are fulfilled, theory trimming (Crockett, 2012) is performed by eliminating path with insignificant coefficients, and this becomes the model for management innovation in Indonesian universities setting.

Results and Discussion

Measurement model in Table 2 displays that the factors loading generated all exceeded 0.50 denoting that the instrument had satisfactory convergent validity. Structural equation modeling commonly invites arguments on model assessment as no model can indeed meet all the demanded measures (Schumacker and Lomax, 2004). For example, SEM needs small value for Chi-square statistic (χ^2) and probability (P) smaller than 0.05. Though these statistics are usually conveyed in structural equation modeling results, they are rarely considered and generally unnoticed as researchers prefer to other alternative measurements to evaluate the model fit (Robins et al., 2007). The argument is that Chi-square statistic (χ^2) and probability (P) are closely related to sample size that the bigger the sample then, the smaller the Chi-square statistic and the higher the probability. Hu and Bentler (1999) contend that threshold values approaching to 0.95 for Tucker-Lewis Index (TLI), 0.90 for Norm Fit Index (NFI), 0.90 for Incremental Fit Index (IFI), 0.06 for Root Mean Square Error of Approximation (RMSEA) may adequately support the assumption of a perfect fit between the suggested model and the data. Other

researchers suggested other goodness-of-fit statistics containing CMIN/DF (The Minimum Sample Discrepancy Function) expected ≤ 2.0 ; GFI (Goodness-of-Fit Index) approaching 0.90 and AGFI (Adjusted Goodness-of-Fit Index) close to 0.90 or greater (Hair et al., 2006).

Table 2. Loading factors for convergent validity

Construct	Loading Factors	Construct	Loading Factors
MI1<---Management Innovation	0.831	TI1 <---Technology Innovation	0.771
MI2<---Management Innovation	0.820	TI2 <---Technology Innovation	0.853
MI3<---Management Innovation	0.836	TI3 <---Technology Innovation	0.872
MI4<---Management Innovation	0.819		
DC1<---Dynamic Capability	0.863	MA1 <---Managerial	0.826
DC2<---Dynamic Capability	0.895	MA2 <---Managerial	0.786
DC3<---Dynamic Capability	0.835	MA3 <---Managerial	0.775
		MA4 <---Managerial	0.803
IO1 <---Intra Organizational	0.810	EO1 <---Extra Organizational	0.779
IO2 <---Intra Organizational	0.732	EO2 <---Extra Organizational	0.777
IO3 <---Intra Organizational	0.790	EO3 <---Extra Organizational	0.826
CF1 <---Contextual Factor	0.787		
CF2 <---Contextual Factor	0.781		
CF3 <---Contextual Factor	0.811		

The full model of the research after the specification is observable in Figure 2. By referring to the χ^2 test ($\chi^2 = 10.932$) and probability ($P = 0.10$), this model capture goodness-of-fit of the model. Also when observed from other measurement, the model indicates an acceptable fitness: CMIN/DF = 1.235 (expected smaller than 2), GFI = 0.953 (higher than 0.90), AGFI = 0.912 (higher than 0.90), CFI = 0.987 (higher than 0.95), TLI = 0.961 (higher than 0.95), RMSEA = 0.06 (in the borderline).

The summary result of structural equation modeling is presented in Table 3. The table indicated that all paths are significant denoting that all six hypotheses are accepted. These paths are then for the prediction of the management innovation model for dynamic capabilities in Indonesian universities.

Table 3. Summary of results

Constructs	Estimate	S.E.	C.R.	P	Conclusion
MI < -- TI	0.263	0.070	2.710	***	Significant
MI < -- CF	0.369	0.100	3.845	***	Significant
MI < -- MA	0.301	0.104	2.894	0.004	Significant
MI < -- IO	0.550	0.142	4.704	***	Significant
MI < -- EO	0.284	0.084	2.347	***	Significant
DC < -- MI	0.320	0.072	3.683	***	Significant

Notes: *** = $p < 0.00$

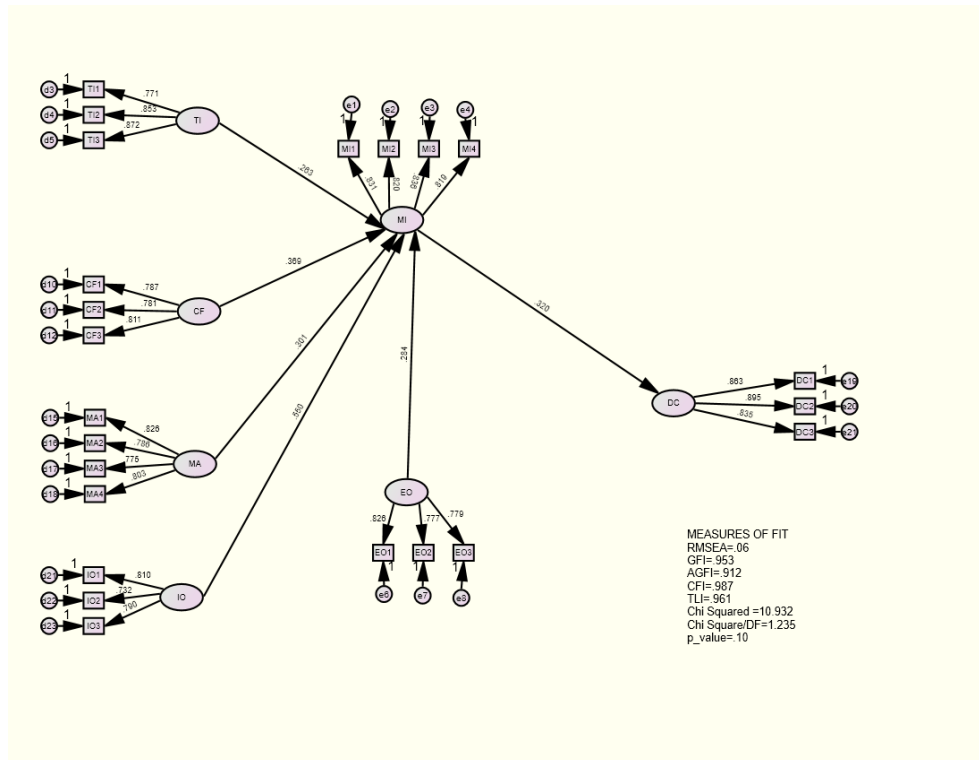


Figure 2. Full model

This research was concentrated on the elaboration of the model of innovation in Indonesian universities by observing the significant path then calculating the amount of the total effect (Awang, 2015). The model: *Technology Innovation* ----> *Management Innovation*----> *Dynamic Capabilities* generates the direct effect of *Technology Innovation* ----> *Management Innovation* = 0.263, and the direct effect of *Management Innovation* to *Dynamic Capabilities* is 0.285. This figure brings the total effect of $0.263 \times 0.320 = 0.084$ indicating that 8.4% ability to integrate internal competencies, ability to reconfigure external competences and ability to address rapidly changing environment is determined by breadth of knowledge in technology, depth of knowledge in technology and process innovation with the condition that the management will implement new managerial practices, new managerial process, new organizational structures, and new managerial techniques. Similarly, the model: *Contextual Factor* ----> *Management Innovation*----> *Dynamic Capabilities* produces the direct effect of *Contextual Factor* ----> *Management Innovation* = 0.369 and the direct effect of *Management Innovation* to *Dynamic Capabilities* are 0.320. This amount produces the total effect of $0.369 \times 0.320 = 0.1180$ specifying that 11.8% ability to integrate internal competencies, ability to reconfigure external competences and ability to

address rapidly changing environment is determined by organizational size, environmental circumstances and awareness of performance decline provided that the management will implement new managerial practices, new managerial process, new organizational structures, and new managerial techniques. By the same calculation, 9.6% ability to integrate internal competencies, ability to reconfigure external competences and ability to address rapidly changing environment is influenced by transformational leadership, transactional leadership, top management reflexivity, managerial tenure, and CEO novelty if the management will employ new managerial practices, new managerial process, new organizational structures, and new managerial techniques. Furthermore, 17.6% capability to integrate internal competencies, ability to reconfigure external competences and ability to address rapidly changing environment is affected by diagnostic and implementation capability, educated workforce, and internal change agents with the prerequisite that the management will adopt new managerial practices, new managerial process, new organizational structures, and new managerial techniques. Finally, 9% capability to integrate internal competencies, ability to reconfigure external competences and ability to address rapidly changing environment is caused by external change agents, involvement in external networks, and interaction with earlier adopters with the condition that the management will embrace new managerial practices, new managerial process, new organizational structures, and new managerial techniques.

Since this study is to provide the model for universities desiring to promote innovation within the organization in assisting the government's hope to realize the economic growth by optimizing the role of people as well as encouraging innovation as demanded by the ministry of higher education, the paths recommended are *Intra-organizational Factor* -----> *Management Innovation*----> *Dynamic Capabilities* and *Contextual Factor* -----> *Management Innovation*----> *Dynamic Capabilities* as each path generates the highest total effect of 17.6 % and 11.8% respectively. This class of capabilities determines organizational and managerial competencies to scan the environment and design the business models that overview new threats and opportunities. As such to innovate, the university must reconfigure diagnostic and implementation capability, educated workforce, and internal change agents' in the first place then organizational size, environmental circumstances and awareness of performance decline. The finding indicates that at certain critical stages, the ability of a CEO and the top management of the university to identify the main trend and then define a response to guide the university forward is critical to the firm's dynamic capabilities. However, the organization's values, culture, and collective ability to promptly deploy a new business model are also essential to the strength or weakness of the school's dynamic capabilities. The new managerial practices, process, organizational and managerial techniques determine how the university creates, shapes, and deploys capabilities. When this is done well, the effort results in innovative combinations of resources supported by effective value-capture

mechanisms. In the era of 4.0 communities, besides the development and utilizing of pedagogical innovations have become the main tools of reforming the educational systems' policies (Radin and Riashchenko, 2017), the future of a university is also shaped by the ability to mix science, technology, and business creatively.

Conclusion

As universities in Indonesia are facing increased competition and a rushing leap of technological change adopted by the minister of research, technology, and higher education to monitor the performance, they need to think through non-technological innovation that is harder to duplicate. These non-technological forms of innovations are referred to as management innovation covering modification in the how and what department head and higher rank officers in universities do in setting directions, making decisions, coordinating activities and leading people. The changes are shown in the forms of new managerial practices, structures, or processes which are context-specific, unclear and hard to imitate making them a vital source of dynamic capabilities of universities. As both technological and management innovation occur in trajectory path (Purchase et al. 2017; Santos et al., 2018) while management innovation research in a university setting is rare, the proposed paths *Intra organizational Factor* -----> *Management Innovation*----> *Dynamic Capabilities* and *Contextual Factor* -----> *Management Innovation*----> *Dynamic Capabilities* can be used as a point of departure for universities to start with. Though this research in line with Walker et al. (2015) convincing that management innovation does not differ from technological innovation as both affect performance significantly, it is against Coccia (2016) arguing that technological innovation mainly precedes the achievement of management innovation. This notion implies the complicatedness of innovation processes that future research is compulsory to reveal the relationship between management and technological innovation further. The authors are fully conscious of boundaries of the research model for this paper but are at the same time aware of the necessity to elaborate the discussion in this area, both among theoreticians and practitioners. Future studies should be expanded to larger Southeast Asia territories to ensure the generalizability of the findings.

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RÓWNOWAŻENIA INNOWACJI TECHNOLOGICZNYCH
WYKORZYSTUJĄCA MOŻLIWOŚCI UNIWERSYTETÓW W DOBIE
SPOŁECZNOŚCI 4.0**

Streszczenie: Internet rzeczy (IoT) zmienił sposób, w jaki uniwersytety zarządzają ludźmi i sposobem przekazywania wiedzy. Zgodnie z obecnym trendem uniwersytety inwestują znaczne środki w technologię, aby zostać uznanym za innowacyjny uniwersytet. Jednak niższa produktywność wykładowców, skargi na jakość usług oraz zmniejszenie liczby rekrutujących wymagają od uniwersytetów odkrywania innej dziedziny innowacji.

Szkolnictwo wyższe zaczęło podkreślać, że aby uchwycić wszechstronne korzyści innowacji, innowacje technologiczne muszą być mieszane z innowacjami w zarządzaniu, które zmieniają praktykę zarządzania w organizacjach, przyjmując nowe struktury organizacyjne, procesy i praktyki, aby wygenerować cenne źródło przewagi konkurencyjnej. Ponieważ większość innowacji wiąże się z rozwojem produktu, niniejsze studium podkreśla praktyki zarządzania jako innowację w procesie reagowania na trend. Chociaż istnieje coraz więcej szczegółowych badań jakościowych, które zapewniają wgląd w sekwencję zdarzeń zachodzących podczas innowacji procesowych, badania te nie analizowały systematycznie zdolności organizacyjnych, które napędzają innowacje w zarządzaniu, głównie w organizacji edukacyjnej. Dlatego do modelowania areny do dalszych badań stosuje się modelowanie równań strukturalnych (SEM). Wreszcie oczekuje się, że model zapewni procedurę uniwersytetom, które chcą promować innowacje w organizacji, wspierając rząd indonezyjski, dążąc do osiągnięcia wzrostu gospodarczego powyżej 7% w nadchodzących latach.

Słowa kluczowe: zarządzanie, technologia, innowacja, uniwersytet

利用社区大学4.0高效率实现技术创新平衡管理创新

简介：物联网（IoT）改变了大学管理人员的方式和知识传播方式。根据目前的趋势，大学正在大力投资技术，以被认为是一所创新型大学。然而，讲师的生产力较低，对产品质量的抱怨以及参赛人数的减少要求大学发现不同的创新领域。学术界开始强调，为了获得创新的综合效益，技术创新必须与改变组织管理实践的管理创新相结合，采用新的组织结构，流程和实践来产生有价值的竞争优势来源。由于大多数创新都与产品开发相关，因此本研究强调管理实践是应对趋势过程中的创新。虽然有越来越详细的定性研究可以深入了解过程创新过程中发生的事件顺序，但这些研究并没有系统地分析推动管理创新的组织能力，主要是在教育组织中。因此，结构方程（SEM）的建模被用于模拟竞技场以供进一步研究。最后，该模型有望为希望促进组织创新的大学提供一个模型，支持印尼政府，寻求在未来几年实现7%以上的增长。

关键词：管理，技术，创新，大学。