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Critical Capabilities of Corporate Information Systems

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***Abstract*—this paper aims to identify the critical factors for evaluating the capabilities of corporate information system in Palembang from the perspective of the IT infrastructure and IT human resources competence. To fulfill these objectives of the study, this study adopts a conceptual framework that is developed by Antoni and Jie (2012). The framework consists of IT infrastructure quality and competence of IT human Resources, which are used as foundation of business operations in organizations. There is a need to develop their capabilities through the adoption of IT to enhance its performance and enhance their competitive position in the market place. IT capability is an organizational ability in effectively and efficiently using their IT resources, which can be determined by IT infrastructure, and IT human resource competencies. Findings indicate that there are many the critical capabilities of IT infrastructure and IT human Resource capabilities that can be utilized by organizations to develop their competencies in order to improve business performance. In Addition, the findings of the study would be of practical significance to the continuous improvement of organizational performance in Palembang and other cities in Indonesia.**

Keywords— IT capability, IT infrastructure, IT human resource competency, Organizational Performance

I. INTRODUCTION

The rapid advance in information technology (IT) has significantly facilitated the organizations to improve their business performance [1]. An effective improvement of business performance has significant impact on organizations in meeting the government environmental regulation and complaining the standard, improving organizational profitability, providing organizations with business opportunities and improving the competitive position of organization in the market place [2, 3]. As a result, organizations need to implement an approach in order to improve their organizational performance.

Adopting corporate information systems (CIS) is one of IT approach that can help organizations to improve their performance. It has a signification contribution in reducing the cost of business operations. Poelmans, et al. [4] for example, shows that organizations can use capability of IT infrastructure to significantly create effective and efficient business operations. Lee and Lee [5] argue that organizations can meet customer needs through providing information quality. Sembiring, et al. [6] state that organizations can employ their IT personnels to develop digitized information system including digitized documents and automating different business activities for reducing their energy consumption in business operations. Therefore, unsurprising that many organization have begun to develop business process strategies focusing on IT as a capability of organization to improve its performance [7]

CIS capability is defined as the ability of an organization in effectively and efficiently using their IT resources for developing its competencies in business operations [8]. It can be determined from different perspectives including IT infrastructure capability and IT human resource competencies [3, 9]. IT infrastructure capability is comprised of the network critical physical infrastructure, IT network and communication technologies, shared services (e.g. database management system and electronic data interchanges), business applications that can be shared infrastructure (.e.g. sales analysis, purchasing) [10]. IT human resources competencies consist of the technical capacities (e.g. computer network systems and programming), and managerial capacities (e.g. the ability to understand business environment)[1].

There is much research at investigating the role of IT capability for developing CIS capability of an organization [5, 8, 11, 12] . For example Jitpaiboon, et al. [8], identify factors of CIS in information system practices between business functions within an organization and between an organization and its business partners. Pessi, et al. [13] investigate the strategic role of IT and its significance throughout the organization increases complexity, variety, and the need of change. Serova [14] examine the role of CIS in an organization to enhance the business operation optimalization through the uniting people, information and business

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processes into an integrated information system as a single complex of technological solutions more effectively. Dečman and Klun [15] argue that utilizing IT infrastructure capability can be useful to users and impacted the speed of their work and the efficiency of the business processes. Tracy [16] states that there is a need of policies in CIS to ensure the business processes running well. Carton and Adam [17] argue that organizations require integrated Information systems including IT personnel, tools, and procedures in order to build flexibility of its business operations. Cooper and Molla [18] investigate the processes of, and the factors that influence, an IT organization' organizational IT capability. Dao, Langella & Carbo [19] investigate the capability of information system (IS), infrastructure IT human resources and supply chain management to help organizations delivering sustainable values to relevant stakeholders and gain sustained competitive advantage

Although there is much study at investigating the capabilities of CIS for developing competencies of organizations, there is limitation of studies that examine the critical capabilities of CIS focused on IT infrastructure and IT human resource competencies in developing the competencies of organizations. To address this gap, this paper draws from resources based view (RBV) theory and a related literature review to identify the critical capability of IT organizations used for developing its CIS capability in order to improve organizational performance. The research question is therefore: what are capabilities of CIS used for developing competencies of an organization? The outcome provides CIS competencies model.

This paper aims to identify the critical capabilities of CIS in Palembang from perspective of IT capability including IT infrastructure and IT human Resources competencies. A conceptual framework is developed based on previous research of Antoni and Jie [3]. The proposed framework is validated and tested with the survey data collected in Palembang using structural equation modeling (SEM). The study reveals that flexibilities (modularization of IS functions, standardization of information and reports, simple administrations, and business connectivity of stakeholders), Service abilities (multiplatform user interfaces, centralized database management systems, and online services), greenness abilities (efficiency of IT infrastructure, business operations, accessibility, reduction of environmental impact), technical skills (computer network system, operating system, data communication, database management systems, and emerging Technology), managerial skills (business environment, business needs, management systems standard, and government regulations) are the critical capabilities of corporate information systems in Palembang.

This paper is organized as follows. Firstly, a review of the related literature with respect to (a) IT capability, (b) IT Infrastructure, (c) IT Human Resources capability is presented. We then present the research methodology followed by comprehensive analysis of data collected, leading to the validation and testing of the proposed framework. Finally, the implication and conclusion will be discussed.

II. Evaluating Capabilities of Corporate Information Systems

There are many prior studies have recognized corporate information system (CIS) capability in different viewpoints and perspectives including organizational resources, business operations, and business management, organizational services and environmental performance.

In this study CIS capability is an organization's ability in using its IT infrastructure and IT human resources for improving performance effectively and efficient. IT infrastructure capability is a set of shared IT resources that provide a foundation to enable business applications [9]. It consists of service ability, flexibility, and greenness ability. Whereas, competence of IT human resources are the human resources associated with the use, exploitation, and leveraging of IT including managerial and technical skills [1, 20].

A. IT Infrastructure Capabilities

As discussed above, IT infrastructure is a set of shared IT resources that provide a foundation to enable business applications in an organization [10, 21]. This paper attempts to build a definition of IT infrastructure in different perspective. In this study, IT infrastructure quality refers to the capability of IT infrastructure consists of service, flexible and greenness capability.

The first capability of IT infrastructure is service ability, which can be defined as the abilities to provide kind of services to meet the business demand of organizations which focuses on the efficiency of business operations. These services consist of implementation of data privacy and security procedures to protect the security of information, adoption of the user interfaces that can be accessed by all platforms and applications, adoption of centralized database management systems in providing relevance and accurate information for whole stakeholders, and adoption of online electronic forms as entry points for internal and external users [22, 23]. For example, electronic commerce or e-commerce and e-procurement can be used as an additional marketing channel, allowing for global reach [24, 25]. As information is transacted electronically, ordering of good and service are made economically and easily. For demand side the potential capabilities from e-commerce include the information on the procurement process, where the process can be streamlined and trading procedures can be standardised through computerization. Therefore, the delays and errors in e-commerce and e-procurement can be reduced in order to develop eco-competencies of an organization [25].

Second, flexibility refers to the capability of the IT infrastructure to enable an organization to adapt to the changing environment. It is determined by modularity, connectivity, and compatibility [26]. The modularity can be defined as an approach for improving the services to stakeholders including customers and suppliers by modifying, removing and adding any software, hardware and data components of an infrastructure. It has capabilities to support the organizational competency for instance, repeated IS functions such as data or software module call routines, as well as data, can be converted into reusable objects. As data

and applications components become independent and reusable, they become part of infrastructure, and the processes of development, maintenance, or engineering of "direct-purpose" systems are simplified and the costs are reduced [26]. Furthermore, an adequate use of selected modules of publicly available software packages (e.g. ERP) can support the standardization of information in business operations. It means that the data and information provided by software packages are easily to share across organizations.

The connectivity can be defined as IT infrastructure' ability creating a link in whole business branches and units in an organization. It can be identified in two terms including 'reach and range'[27]. 'Reach' refers to locations that can be connected via infrastructure. For example, workstation network can be used for connecting business units and branches. For the external stakeholders, organizations can provide IS functions (e.g. web access and extranet) as interfaces accessed by stakeholder for business transactions [25]. 'Range' determines the level of functionality (e.g. information and/or transaction processing) that can be shared automatically and seamlessly across each level of 'reach' [28]. Therefore, the connectivity can assist organizations to share information to all business units, branches and stakeholders in order to develop competencies of business activities.

The compatibility refers to the extent to which an IT infrastructure either facilitates the sharing of any information internal and external an organization across any technology equipments. Duncan [26] argues that the compatibility is utilized to support the commonality between different applications and uses as well as to facilitate information sharing across and outside the organization, cross-functional integration infrastructure and reduce the business operation costs. Weil and Vitale [23] state that the organization requires the IT infrastructure that has ability to share services with different platform technologies including hardware platforms, base software platforms, communication technology and middleware. For example, any information including process, service, video, image, text, audio, or combination of these can be used by any system, regardless of manufacturer, hardware, make, or type. Using compatibility, organizations can respond the market quickly and develop new products and services rapidly. Therefore, IT infrastructure can transform organizational business operations efficiently and effectively to meet business demands [29, 30].

The last capability of IT infrastructure in this study is greenness capability. It refers to the ability of IT infrastructure used for developing envrionmental competencies of an organization [9, 31] . Then, IT infrastructure greenness or green IT is defined as the green computing that refers to the study and practice of design, manufacturing, and using computer hardware, software, and advanced communication system efficiently and effectively with minimal impact on the natural environment [32]. It can be interpreted as the utilization of green IT or infrastructure greenness to help organizations to develop its ecological competencies including emission management, resources stewardship and sustainability behaviour. For example, Molla et al (2008), McKendrick [33] and ChauDhuRi [34] state that virtualization of databases are able to help organizations to mitigate energy consumption in business activities. Mann, et al. [35] argue that thin client computing is one of the IT infrastructure greenness, which can assist organizations to develop their environmental capabilities. The thin client computing benefits for improving business performance including lowering administration costs, lowering energy consumption, lowering hardware cost, more efficient use of computing resources, using less network bandwidth, lowering up-gradation costs. Implementation Cloud Computing and Radio Frequency identification for improving business infrastructure efficiency [36, 37]. Therefore, based on this study, the adoption of IT infrastructure's capability is able to improve the ability of organizations to develop its business competencies.

B. Competence of IT Human Resources

Even though IT infrastructure's capabilities can aid organizations to develop their competencies in business operations, an organization requires IT human resources that have competencies to build and develop its information system in order to improve organizational performance. Competencies of IT human resources consist of technical skills and managerial skills available in an organization [7, 20]. First, the technical skill can be defined as the abilities of IT personnel in programming, system analysis and design, network system and communication, and competencies in emerging technologies [1]. The managerial skill is the ability to manage and arrage IT resources in organizations. Through these skills, IT human resources can contribute various IT related applications for effective and efficient implementation of organizational operations [20].

Based on the above discussion, IT personnel can facilitate organizations to develop their capabilities through skills including managerial and technical skills [7, 38, 39]. The managerial capabilities of IT human resources can be build a bridge between IT and business strategies through allocating appropriate IT resources for improving the organizational environmental performance [38, 40]. It can coordinate various activities with the successful implementation of specific IT applications [39]. The technical skill of IT human resources can assist the organization to integrate IT and business processes more effectively. It can also create communications among business units more efficiently by developing effective applications [1, 41].

There are many studies that have identified the role of managerial abilities of IT human resources in improving the organization performance. Colbert and Kurucz [42] state that IT human resources can support the business process of an organization by managing and redesigning environmentally sustainable business operations for reduce the consumption of material and energy in the organization. Furthermore, Molla, Cooper & Pittayachawan [31] argue that IT human resources can assist the organization to adopt and allocate the appropriate IT resources in its business operations through understanding business environment. Lapão [43] argues that IT human resources are able to interpret business problems and addressed by appropriate technical solutions. Having this

ability, the IT personnel can redesign effectively and efficiency business process; for instance, by developing IS functions for automating organizational business operations [28]. Furthermore, Yoon [44] and Cooper and Molla [45] argue that IT human resources which have knowledge regarding government environmental regulations can help an organization to develop IS used for meet government regulations. For example, SAP environmental compliance application is designed to help organization ensure compliance with environmental law and policies and reduce associated costs, efforts and risks on the plants and organization level [31, 46].

In the other side, many prior researches have argued that the technical capability of IT human resources can aid organizations to develop its competency. For example, Molla Molla, A., Cooper & Pittayachawan [31] argue that environmental performance of an organization can be improved through adopting virtualization of information technologies including database, server, and desktop virtualization. It means that the organization should have the IT human resources who have the ability to develop and build the business information system based on virtual technologies. Furthermore, Sayeed & Gill [47] argues that IT human resources can help an organization to reduce the operation costs and transportation cost through developing the computer network system and digitalized communication used for connecting all business units and branches. Adela, Marie-Claude & Richard [28] argues that an organization needs ISs to automate business operations to improve their environmental performance. Furthermore, organizations requires to develop IS functions providing information for meeting the external stakeholder compliances including governments policies.

In summary, numerous studies investigate the items of IT human resources competencies that might be used for developing the competencies of organizations.

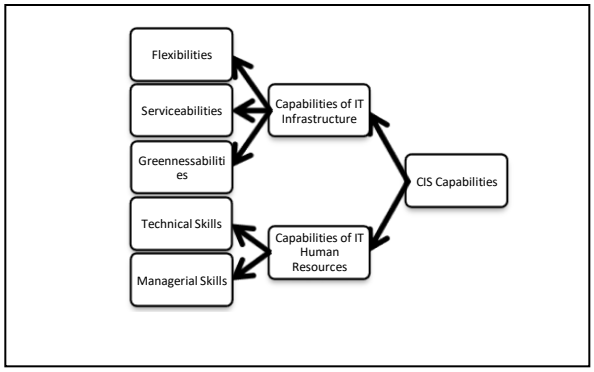

Fig 1. Conceptual framework

III. RESEARCH METHODOLOGY

This paper aims to identify the critical factors for evaluating the capabilities of corporate information system in Palembang from the perspective of the IT infrastructure's capability and IT human resources competency. To facilitate this, a conceptual framework is proposed as above by taking into account the nature of corporate information system development in Palembang as a small city. The proposed framework is tested and validated using SEM techniques. A research question is formulated as follows: what are IT capabilities used for developing CIS competencies of an organization?

To adequately answer the research question, the proposed framework has to be validated first. A survey is conducted for collecting the data. The questionnaire includes three types of questions for capturing (a) the demographic profile of the participants, (b) the IT Infrastructure's capabilities, and (c) the overall perceptions about the IT Human Resources Competencies. The questionnaire uses a five point Likert-type scale where the value "1" represents "not important at all" and the value "5" represents "highly important." Prior to the distribution of questionnaire, a pilot study was conducted to test the appropriateness of the questionnaire items.

The paper-based survey was conducted in Palembang between February 2016 and May 2016. The target population from manufacture, Plantation and Service industry have used IT in their daily business operations. Approximately 500 questionnaires were distributed. To enhance response rate, 500 questionnaires with a cover letter. 156 questionnaires do not reach the target respondents because of bad address. 82 questionnaires are undeliverable and 74 are identified as incorrect address from follow up mobile phone calls. Most of the undeliverable questionnaires are caused by organization out of business and organization move. A large number (88) of respondents refuse to participate in the survey. The reasons for non-response could be respondents' lack of interest in the research topic, their level of education (low education level), or some other social and economical factors. A total of 250 responses are received with a 50.1 % response rate. Six responses are unusable; therefore, they were removed from data analysis. The remaining 250 responses were retained. Table 1 shows the demographic profile of the respondents. Data were stored and screened using SPSS Statistics for addressing the missing values, outliers, normality.

TABLE I. DEMOGRAFIC CHARACTERISTICS OF THE RESPONDENTS

Division	Total	Percentage	Division	Total	Percentage
Industry			Degree		
Manufacturing	13	5	High School	0	0
Plantation	25	10	Diploma	12	4.8
Trading	100	40	Bachelor	28	11.2
Services	100	40	Master	172	68.8
Others	12	5	Doctoral	38	15.2
Total	250	100	Total	250	100
Business Position			Level of proficiency in the use of IT		
Executive	22	8.8	Low	17	6.8
Managers	104	41.6	Average	175	70
Supervisors	101	40.4	High	58	23.2
Others	23	9.2	Total	250	100
Total	250	100			

Statistical analysis as showed in Table 1 indicates that the demographic characteristics of questionnaire respondents. Our survey is targeted at several industries and managers above the middle management level. There are two main reasons for this. Firstly, the capability of IT infrastructure and IT human Resources contribute to greater effectiveness in a wide range of industries and organizations. Secondly, for

increasing the generalizability of these research findings, we utilize a diverse sample of person who generally understand their organizational capabilities and has the capability utilizing IT resources to perform business operations in their organization. Therefore the respondents could effectively provide correct response for our questionnaires survey.

The collected data are analyzed using SEM techniques for identifying the critical capabilities of corporate information systems. Such a technique is required in this research for testing the relationships between measured variables and unobserved constructs, and for estimating the relationships between unobserved constructs. SEM uses various types of models to depict the relationships among observed variables [48]. To assess the initial conceptual constructs, confirmatory factor analysis (CFA) and analysis of Moments structures (AMOS) version 21 are used. CFA tests a measurement theory by providing evidence on the validity of individual measures based on the model's overall fit and other evidence of the construct validity [49]. To assess the model's overall fit, various goodness of-fit (GOF) measures were used including chi-square (x2), the ratio of x2 to degree of freedom (x2/df), the GOF index (GFI), root mean square error of approximation (RMSEA), Tucker–Lewis index (TLI), and comparative fit index (CFI). The maximum likelihood estimation technique is used for estimating the parameters in the model.

IV. Data Analysis

Fig. 1 shows initial measurement model developed for the corporate information systems. The measurement model for IT infrastructure capabilities consists of flexibility, serviceability and greenness ability. Flexibility is determined by modularization of IS application system, standardization of information and reports, Implementation of simple rules and administrations and adoption of network systems for connecting business units and stakeholders together. Serviceability consists of availability of data security and privacy, adoption of user interfaces that can be accessed by all platforms and applications, adoption of centralized database management systems to respond new markets, development of new products and services rapidly, adoption of online or electronic form as entry points for internal and external users. Greenness ability consists of adoption of server virtualization for running multiple operating systems on one server to create efficiency and effectively business operations, adoption of storage virtualization for providing relevance of information presented to end users, accuracy and completeness of information, and timeless of information, adoption of desktop virtualization for access the data and information from any location, adoption of thin client computing used for accessing servers through a computer network, adoption of cloud computing for improving business infrastructure efficiency, use of radio frequency identification for managing and tracking organization assets.

Nine indicator variables IT human resources are postulated to load on computer network, specific programming language, operating systems, cloud computing, server consolidation and virtualization, desktop virtualization, data communication, data management, emerging technology skills, understanding organizational plans and strategies, business environments, interpret business problems, aligning the business strategies and IT strategies, learn business functions, anticipate business needs, knowledge in management system standard, government regulations, and standardization of IT equipments. None of the indicator variables in either model are cross-loaded on multiple constructs.

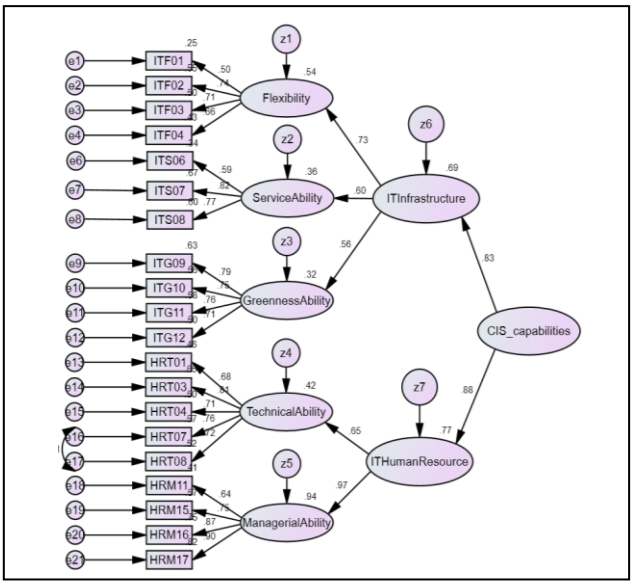

Fig 2. Final measurement model

V. Research Findings

This study investigates the capability of IT infrastructure in developing organizations' CIS competences. IT capability makes its mark through IT-related infrastructure and human resources competencies. The capability of IT infrastructure includes flexibilities, serviceability and greenness ability. Furthermore the IT human resource competencies consist of technical and managerial skills.

First, the final measurement model in Figure 2 shows that significant support is evident for the path of IT infrastructure that is determined by flexibility, serviceability and greenness with path coefficient values of 0.73, 0.60 and 0.56, respectively. Further analysis reveals that capabilities of IT human resources have path coefficient values of 0.66 and 0.97 for technical and managerial capability. The model accounts for 54% of variance in flexibility, 36% in serviceability, 32% in greenness ability, 44% in technical skills, and 94% in managerial skills. These findings show that the flexibility, serviceability, greenness ability, technical and managerial skill are important capabilities of CIS in organizations.

Modularized IS functions and standardized information and reports throughout the organizations, and implementation of simple administration procedures and rules, and connection with all business units and stakeholders are important attributes of flexibility factor. The serviceability is a significant capability for IT infrastructure. It is determined by

capability of multiplatform user interfaces, centralized database management systems, and online services. Efficiency of IT infrastructure and business operations, accessibility, and reduction of environmental impact are crucial capabilities of greenness ability for IT infrastructure. These research findings are consistent with Molla et al. (2012), who concluded that IT capability can serve to build environmental competence in organizations. It also supports Bose and Luo's (2011) research regarding the importance of IT capability for developing green IT competence. Technical skills is identified as capability of IT human resources such as capability of computer network system, operating system, data communication, database management systems, and emerging Technology. The managerial skills is identified as the most important capabilities for CIS of an organization. It explains the 94% variance of the model. A detailed analysis reveals that development capability of CIS in an organization can employ IT staff who has knowledge to understand the business environment that they support. The organizations also expect the IT staff to anticipate business needs through their technical skill; organizations expect IT staff can improve their competitive position in the market place through competence of management systems standard, and government regulations. These skills will allow organizations to understand the implementation of their business process in order to comply with government regulations and customers' needs. The finding above is consistent with that of Molla, et al. [50] about the importance of IT human resource competence in the standardization of IT equipment used in business process digitization to develop and improve environmental performance. Likewise, the above finding supports that of Cooper and Molla [18] regarding the importance of employee knowledge of environmental regulations to achieve effective re-engineering of business processes.

VI. CONCLUSION

This research investigates the critical capabilities CIS of an organization through IT infrastructure and IT human resource competencies. The conceptual framework is developed based on a review of the literature on RBV theory and IT capability. The framework is validated using SEM based on survey data collected in Palembang. It is evident that CIS capabilities are determined by the capability of IT infrastructure and IT human resources competencies.

The success of developing CIS capabilities will heavily depend on organizations' use of their IT infrastructure capabilities in conducting business operations. IT infrastructure capabilities provide organizations with the flexibility, serviceability and green abilities to perform business processes in order to accommodate stakeholder demands. For example, generating environmental competence in organizational business activities can be aided by adopting virtualization technologies in business processes that can delivery environmentally friendly services. Additionally, virtualization technologies will help organizations and their business partners to collaborate in business operations to decrease energy consumption and travel costs.

Furthermore, Managerial competence of IT human resources is needed to unite IT and business planning process more effectively, to communicate and work with business units more efficiently. It is also can be used for developing competencies of CIS in an organization through knowledge about the management system standard, government regulations, and knowledge about to identify the standardization of IT equipment. Therefore, to build CIS competence, organizations have to place their IT infrastructure capability and competence of IT human resources into their business processes.

TABLE 2. STATISTICS FOR MULTI-FACTOR MODEL ANALYSIS OF IT INFRASTRUCTURE CAPABILITIES AND IT HUMAN RESOURCES

Constructs	Items	Factor Loadings	CR	AVE	GOF indices		
					Absolute	Incremental	Parsimony
Flexibility	ITF01	0.502	0.737	0.500	X^2/df =2.220 P-value=0.000 RMSEA= 0.070 SRMR=0.075	CFI=0.944 IFI=0.945 TLI=0.928	PCFI=0.738 PNFI=0.707
	ITF02	0.742					
	ITF03	0.706					
	ITF04	0.657					
Serviceability	ITS06	0.586	0.776	0.544			
	ITS07	0.821					
	ITS08	0.772					
Greenness ability	ITG09	0.791	0.853	0.593			
	ITG10	0.750					
	ITG11	0.759					
	ITG12	0.706					
Technical ability	HRT01	0.652	0.85	0.54	CMIN/df =4.861 P-value=0.000 RMSEA= 0.069 SRMR=0.042	CFI=0.980 IFI=0.980 TLI=0.969	PCFI=0.640 PNFI=0.628
	HRT03	0.711					
	HRT04	0.690					
	HRT07	0.811					
	HRT08	0.783					

Managerial ability	HRM11	0.646	0.87	0.63
	HRM15	0.752		
	HRM16	0.865		
	HRM17	0.905		

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