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Blended system thinking approach to strengthen the education and training in university-industry research collaboration

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ABSTRACT

University-industry research collaboration (UIRC) is a major source for research and innovations and economic growth. Despite the extensive evidence on the importance of such collaboration in developed and developing countries, the literature related to strengthen such collaboration along with its innovation performance is still scarce. Scholars believed that the impact of education and training on researchers haa a vigorous influence on research and innovations. Moreover, to enhance the competencies of education and training on researchers, it is mandatory to refurbish education and skills system in conjunction with technological infrastructure system along with their reinforcing factors i.e. knowledge sharing and research and development cooperation, respectively. In this paper, we evaluate the influence of education and skills and technological infrastructure system along with their corresponding reinforcing factors in the blended system thinking method to strengthen education and training. Evidence from UIRC in Malaysia provides empirical corroboration that the role of education and skills system and technological infrastructure system along with their reinforcing factors have a positive influence on education and training. Thus, the findings of this research suggest that intensifying the quality of education and skills system and technological infrastructure system with the reinforcing effect can enhance the effectiveness of education and training.

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KEYWORDS
University-industry research collaboration; education and skills system; system thinking; national innovation system

1. Introduction

University-industry research collaboration (UIRC) is one of the key components that deliver potential pathways to accelerate the economies of the nation (Iqbal 2018; Jones and Coates 2020; Lin and Yang 2020; Messeni Petruzzelli and Murgia 2020; Ting, Yahya, and Tan 2020). Regardless of extensive significance of UIRC, the existing literature suggested that the rate of technological innovation from UIRC is not satisfactory in several developing countries (Khayyat and Lee 2015; Bohin 2018; Parmentola, Ferretti, and Panetti 2020; Tseng, Huang, and Chen 2020). Several studies were conducted to explore the factors that can enhance such rate of technological innovation by minimalising the barriers of UIRC. Nevertheless, mostly focused on university-industry orientation-related factors, for instance, conducting workshops and seminars, hiring educated, trained and skilled personnel (Brazile et al. 2018; Dooley and Gubbins 2019; Chen, Lu, and Wang 2020) which usually act as a symptomatic way out of the problem (Iqbal 2018).

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Furthermore, universities and industries are the primary components of national innovation system (NIS) that directly performs technological innovation, while the factors of NIS are the secondary components that influence the interactions within the main component (UIRC) (Iqbal 2018; Chen et al. 2019). In this regard, Messeni Petruzzelli and Murgia (2020) emphasised that if the aim is to foster effective innovation, it is advisable to investigate the influence of the factors of NIS on the efficiency of UIRC. However, comprehensive literature about the factors related to the NIS and their influences on UIRC is still scarce.

Secondly, the main limitation of the current literature is the use of analytical thinking approach, which analyses the efficiency of specific parts or elements within the system from a linear perspective, thus has limited predictability of the outcomes (Fuentes and Dutrénit 2012; Freitas, Geuna, and Rossi 2013; Iqbal, Khan, and Senin 2015; Kafouros et al. 2015). Moreover, as universities and industries are the elements of the NIS, they maintain their existence through the mutual interaction of their secondary parts that lead to the construction of circular causality and demand a systemic approach for its evaluation (Melamed-Varela et al. 2019; Razorenov and Vodenko 2020; Wilson et al. 2020). Thus, only sequential consideration allows recognising fundamental weaknesses which consequently provide a sequential cause of the problem and the methods to cover it, which is impossible to achieve when using the analytical or linear model (Befus et al. 2018; Allender et al. 2019).

This study aims to investigate the influence of key factors of NIS on its secondary factor of URIC to strengthen the technological innovation in UIRC. In addition, this study proposes the use of system thinking approach instead of analytical thinking. System thinking approach not only focuses on the linear parts of the system but also focuses on their patterns and events and describes how they work together (circular causality). Furthermore, system thinking not only provides the sequential solution of the problem but also comes up with the reinforcing factors that can reinforce the system (Sarriot et al. 2015). Thus, by utilising the system thinking approach, education and training (ET) is identified as the main constraint between UIRC. It consequently provides the solution to diminish the constraints by indicating the factors, education and skills system (ESS) and technological infrastructure system (TIS) as the critical factors of NIS. Furthermore, knowledge sharing (KS) and R&D cooperation (RDC) are identified as the reinforcing factors to maximise the technological innovation of UIRC. Extensive and exhaustive discussion is elaborated in Section 2.2.

This research includes five main contributions. First, it contributes to the growing debate on UIRC and presents a theory of system thinking as a practical solution to enhance their rate of technological innovation capabilities. Second, the theory of system thinking previously has not been used in the studies of UIRC. This research proves the efficacy of the theory of system thinking in the same context. Thirdly, this research extends the literature of UIRC with the influence of the critical factors of NIS by illustrating the applicability of the theory of system thinking. Fourth, this research provides the reinforcing factors that can reinforce the innovative capability of UIRC. Finally, this research has practical implications for policymakers who can consider the theory of system thinking and the ESS and TIS as the significant factors to receive the valuable outcomes from the country's universities and industries in the shape of the new research and innovations.

The paper is structured as follows: Section 2 briefly discusses literature review and hypothesis development, detailed methodology is illustrated in Section 3. Section 4 provides results and analysis of the study followed by conclusion and recommendations in Section 5.

2. Literature review and hypothesis development

2.1. System thinking approach in UIRC

The theory of system thinking originally is used in the biological sciences; basically, this theory was developed in the Second World War to analyse and to deal with the complex problems for policy making or military planning. System thinking seeks to answer the question of how parts are interconnected with each other. This theory critically encourages a consideration of interrelationships

(Senge 2006; Wilson et al. 2020). White (1995) compared system thinking with analytical thinking and explained that analytical thinking is the concept in which analysis of the system is shown with the help of the individual part. Whereas, system thinking is a tool that makes sense how parts work together (Sedlacko, Martinuzzi, and Dobernig 2014; Iqbal, Khan, and Senin 2015).

System thinking has a major focus of examining the effect of one factor on another, and it can be considered as a modelling tool to identify factors that need to be improved in order that optimum results are achieved in a specific subject with the minimisation or elimination of possible barriers (Agyepong et al. 2014; Befus et al. 2018). An important feature of the system thinking is the demonstration of circular causality. Therefore, causal relations are developed as a series of cause and effect. The essential idea behind the cause and effect is an information–action–consequences paradigm (Kunc 2008). The action that is based upon the information is attempted creates consequences. These consequences generate further information and actions, which may, in turn, continue the process. System thinking viewed problem situations in terms of the relationships of each part of the system (Wilson et al. 2020).

Additionally, system thinking has two fundamental loops that show the flows in the system (Alzraiee, Moselhi, and Zayed 2012; Sedlacko, Martinuzzi, and Dobernig 2014). These fundamental loops are (a) balancing feedback loop and (b) reinforcing loop. A balancing feedback loop brings corrective action on the system. In other words, balancing loop covers the situation with the problem, if the current level of the situation is down; the balancing loop pushes its up. The key benefit of the balancing loop is its ability to bring the solution to the problem systematically (Sarriot et al. 2015). Arnold and Wade (2015) mentioned that significant effects on the balancing loop can be denoted by the strong (→) or weak (---→) causal loops. A strong loop shows that a variable has a significant effect on the other, whereas a weak loop demonstrates that a variable does not have a significant effect. While a reinforcing feedback loop reinforces change with even more change. This can lead to rapid growth at an ever-increasing rate. This type of growth pattern is often referred to as exponential growth (Agyepong et al. 2014). In the system thinking model, capital R is used to denote the reinforcing causal loop.

Abundant characteristics system thinking was utilised in several different discipline, such as team building (Behl and Ferreira 2014), quality management (Conti 2006), project management (Fusso, Ducker, and Ito 2013), risk management (Kadarova, Kalafusova, and Darkacova 2014) and for the health organisation analysis (Lane, Munro, and Husemann 2016), but the utilisation of system thinking in the consideration of policy making for research and innovative organisations is still scarce. Subramanian and Wang (2019) indicated that the theory of system thinking is appropriate to study national systems of innovation that shows feedback mechanisms. Similarly, Emery and Trist (1965) used the system-thinking approach to create a framework for evaluating organisational performance. Furthermore, Allender et al. (2019) mentioned that it allows policy makers to better comprehend structural weaknesses and provide the opportunity for developing a framework to make the system successful, which is impossible to achieve when using a linear model. Thus, this research suggests that system thinking is the remarkable theory to enhance the efficiencies of UIRC by investigating the influence of NIS.

2.2. Hypothesis development

It is generally accepted that education and training (ET) are the mantras for the continuous development of research and innovations and the economic competitiveness (Lai and Lu 2016; Firsova, Lukashenko, and Azarova 2021). Researchers found that highly educated and trained personnel highly contribute to the development of research and innovations (Higueras-Rodríguez, Medina-García, and Molina-Ruiz 2020; Veis et al. 2021). However, it is observed that when UIRC is formed, ET is one of the major constraints between them (Brimble and Doner 2007; Davenport, Crick, and Hourizi 2020). Specifically, in lower-income countries primitive methods of teaching and training are still followed in universities to educate and train the personnel: following the old syllabus for teaching, mindset curriculum, theory-based curriculum, and the behaviour of stickiness on their developed curriculum and the like. In addition, industries do collaborate with universities to recruit fresh graduates. If the curriculum does not fulfil industrial requirement, it consequently leads both parties incapable of collaborating or producing innovative outcome (Gámez-Pérez et al. 2020).

In this regard, education and skill system (ESS) in NIS is the factor that triggers the education and training between university-industry personnel (Hooshyar et al. 2020). Perfect ESS always consists of quality of scientific knowledge-producing organisations, quality of teaching and training organisations and quality of internship organisations that are valuable to enhance the output of R&D activities of UIRC (Bamfield 2013). Pontarollo, Orellana, and Segovia (2020) and Meek, Teichler, and Kearny (2009) elaborated that the standard of ESS in developing countries remains bleak, they require rapid changing where the research-based teaching and training practices can be developed. Similarly, Healey, Jenkins, and Lea (2014) and Bunatovich, Khidayevich, and Abdurakhmonovich (2020) delineated that ESS must have a research-based curriculum rather than a theory-based one; a theory-based curriculum only produced the graduates with theoretical knowledge, which is insufficient for the development of research and innovations. Furthermore, according to Guimón (2013) and Firsova, Lukashenko, and Azarova (2021) advance methods of teaching, learning, and training in ESS can boost up the research and innovation capabilities between universities and industries. In this regard, this research hypothesised that:

H1a: Education and skill system in NIS has a positive influence on education and training between UIRC.

Similarly, Eid (2012) examines the impact of technological infrastructure system (TIS) on productivity growth in 17 high-income organisations for economic co-operation and development (OECD) countries using country-level data over the period 1981–2006. The results concluded that R&D performed by highly educated and trained personnel is positively affecting productivity growth in all specifications. Similarly, productivity growth that is crucial to sustain the economies is only possible with the well-developed research and innovative organisations (Iqbal et al. 2011, 2013). New or changing practices, programmes, policies, and agendas are transforming TIS worldwide. From the notions and perceptions of 'global competency' a strong TIS is a desirable objective in a changing global scale and context (Lee and Lee 2020). A national TIS encompasses the quality of research institutions, quality of industries, and training management institutions that provide facilities to UIRC to create research and innovations. In this regard, a well-structured TIS in a country is also one of the main instruments to enhance learning capabilities, absorptive capacities, and technological competencies of UIRC (Hamidi et al. 2020). Thus, this research hypothesised that:

H2a: Technological infrastructure system in NIS has a positive influence on education and training between UIRC.

Furthermore, according to the theory of system thinking, the system can generate its desired condition. Considering actual condition and after corrective actions, by taking some reinforcing action, the desired condition can be achieved in a system. Thus, this research proposes some reinforcing factors to reinforce the ET of UIRC, such as knowledge sharing (KS) between ESS enables the research organisation to capitalise on its facilities and resources (Dehghani 2020). Contributors to the literature share the presumption that different sectors of NIS, specifically, ESS in NIS enable that the organisations must be competent enough to provide specific knowledge and resources that are relevant to the enhancement of research and innovations (Wang and Noe 2010; Iqbal, Khan, and Senin 2012). Thus, to reach the performance goals, it is important for the organisations to exploit the knowledge resources that already exist in the ESS (Wang and Noe 2010; Messeni Petruzzelli and Murgia 2020). Thus, to maximise the innovative performance of UIRC, KS as a reinforcing factor is induced at the ESS. This reinforcing factor boosts the capabilities of ESS, which consequently positively influences the ET of university-industry personnel. Thus, the research hypothesises that:

H1b: Knowledge sharing as a reinforcing factor of education and skill system has a positive influence on education and training between UIRC.

Similarly, to maximise the innovative performance of UIRC, this research proposes research and development cooperation (RDC) as a reinforcing factor. RDC boosts the overall capabilities of TIS in NIS, which consequently enhances the ET of UIRC (Cantabene and Grassi 2020). RDC is the cooperative behaviour where different sectors engage in various decision makings and by spreading their knowledge, skills and resources enhance the capabilities and performances of organisations (Wu et al. 2020).

H2b: Research and development cooperation as a reinforcing factor of technological infrastructure system has a positive influence on education and training of UIRC.

The in-depth system thinking-based influence of ESS on E&T, TIS on E&T with their balancing and reinforcing factors and complete theoretical framework can be visualised in Figures 1–3, respectively.

3. Methodology

In this study, a survey approach based on the positivism paradigm was utilised, where an open-ended questionnaire is used for data collection. In this paradigm, data, evidence and rational consideration first shape the knowledge and later hypothesis is tested with the help of statistical method and make claims (Phillips and Burbules 2000; Park, Konge, and Artino 2020). Furthermore, the theory of system thinking and the verified statistical software smart PLS and SPSS were utilised for the elaboration and proof of our hypothesis. As the study contained technological innovations, the data for this study were obtained from all research universities (RU) in Malaysia which are known to be excellent in research and innovation. From RUs, two departments were chosen: departments of electrical and chemical engineering. From the webometric search, it has been analysed that both departments have more research groups and industrial collaboration than other departments. Thus, the two departments and their collaborated industries were selected as respondents. In this study, top-tier academic professors (universities) and top management from collaborated industries were identified as an individual unit analysis to meet the requirements for answering the research questions. The total population of both departments is 500 approximately. Thus, according to the table of Krejcie and Morgan (1970) in 500 populations with 95% confidence level, the required

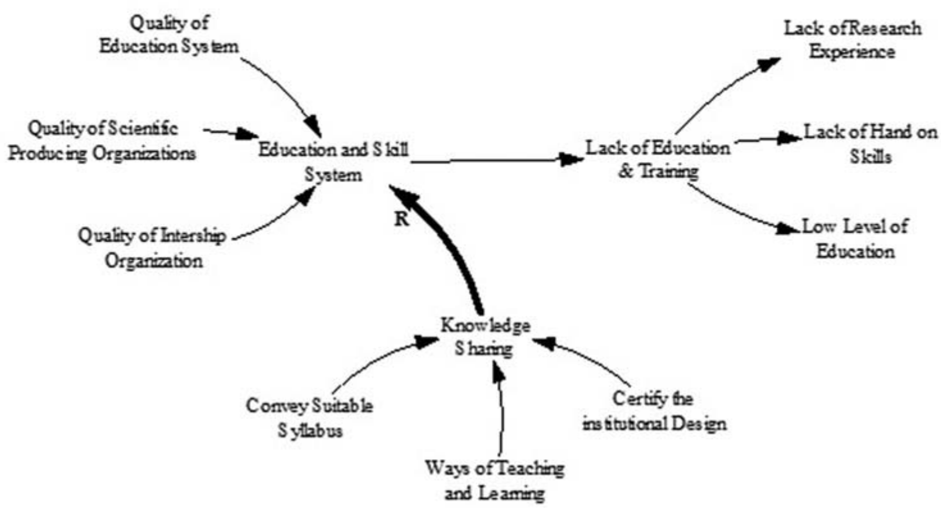

Figure 1. Influence of ESS on E&T.

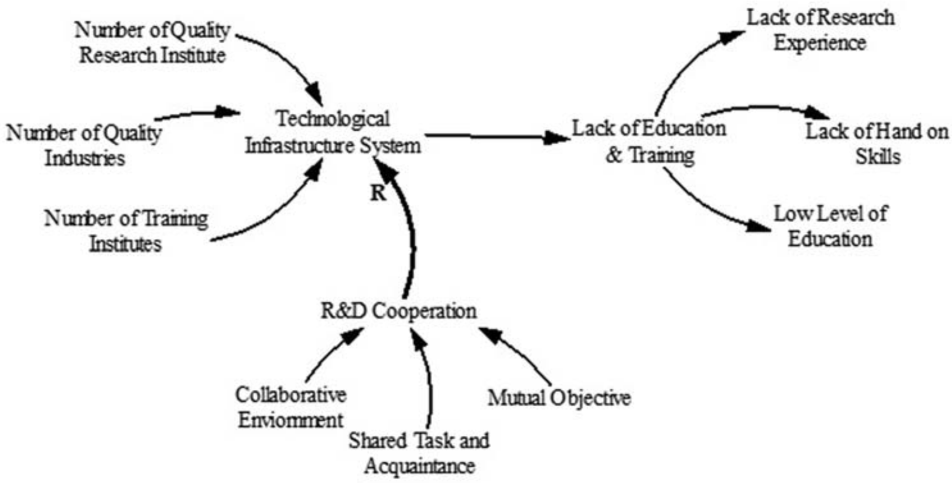

Figure 2. Influence of TIS on E&T.

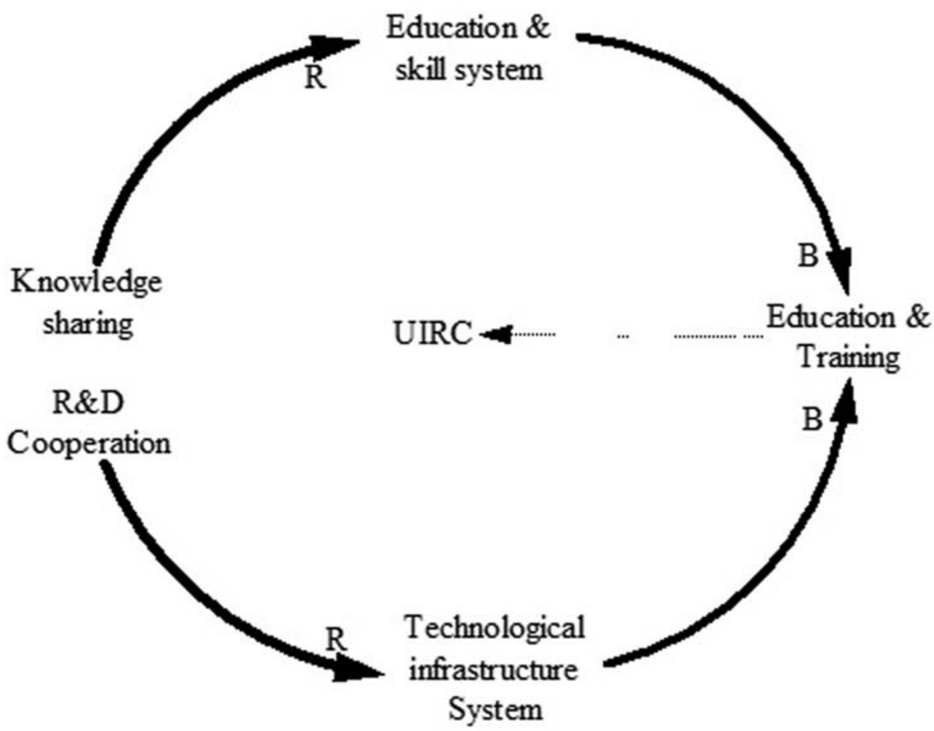

Figure 3. Theoretical framework using system thinking.

respondents are 210. However, in this research, evidence has been collected from 214 respondents to obtain more accurate results. Our research instrument includes ET as a dependent variable, ESS & TIS, as independant variable while KS & RDC as reinforcing variables. Valid variables were selected from the previous studies and measured based upon the scope of the current study. Table 1

Table 1. Variables, constructs and items of research instruments.

Variables	Constructs	*N*	Items
DV	ET	1	Methods of teaching and training
		2	Curriculum of teaching and training
		3	Theory-based teaching perceptions
IDV	ESS	1	Quality of knowledge-producing organisations
		2	Research-based curriculum for teaching and training
		3	Research-based methodologies for teaching and training
	TIS	1	Quality of research centres
		2	Research-based industries
		3	Quality of training institutes
		4	Quality of knowledge access to providing institutions
RF	RDC	1	Collaborative capabilities to contribute to innovation
		2	Collaborative provision of knowledge, skills, and resources
	KS	1	Relevant sharing of knowledge and resources among research groups
		2	Transfer and implement new ideas and experiences among research groups

shows dependent variable (DV), independent variable (IDV) and the reinforcing factors (RF), with their corresponding constructs and items.

4. Results, analysis and discussion

For the data analysis, SPSS and Partial least square analysis (PLS) were utilised. Here is to mention that Section 2 clearly shows all variables of this study are formative. In this regard, for the evaluation of the formative path model, assessment of the measurement and structure model must be carried out sequentially (Liu 2017).

4.1. Assessment of the measurement model

This model describes how the latent constructs are measured in terms of their measurement properties. In this regard, the measurement model is assessed by measuring the validity of the constructs and their indicators.

4.1.1. Assessment of construct validity

At the construct level, it is suggested that there should not be redundancy between the constructs. For this purpose, multicollinearity is deduced for each of the constructs. Multicollinearity occurs when there is a high correlation between two or more variables in the model. Estimates of a regression coefficient become unreliable if there is multicollinearity between the variables. The present study has five variables; thus, sufficient efforts were made to operationalise those variables properly.

For construct validity, the variance of inflation factors (VIF) was tested to evaluate the possibility of multicollinearity issues. Based on Hair et al. (2014) for formative construct VIF must not be greater than 5 and tolerance should be higher than 0.20. Table 2 shows the VIF test by running the stepwise regression analysis for each construct. The result indicated that all the VIFs are less than 5 and all the tolerance values are above 0.20; consequently, no sign of multicollinearity was found.

4.1.2. Assessment of indicator validity

At the indicator level, the question arises as to whether each indicator delivers a contribution to the construct by carrying the intended meaning. It is suggested that there should be strong relevancy between the indicator and the construct. To check the relevancy of the indicators with their construct, the weight of each indicator is assessed (Henseler and Chin 2009; Tenenhaus and Esposito Vinzi 2005). Furthermore, PLS estimates the indicator weights ($p < 1/\sqrt{n}$) that measure the contribution of each indicator to the constructs. Here it is mentioned that in this research minimum 2

Table 2. Assessment of constructs validity.

Constructs	Indicators	Collinearity statistics	
		Tolerance	VIF
ET	ET_1	0.999	1.001
	ET_2	0.886	1.128
	ET_3	0.886	1.129
TIS	TI_1	0.912	1.097
	TI_2	0.896	1.116
	TI_3	0.856	1.168
	TI_4	0.910	1.099
ESS	ES_1	0.766	1.306
	ES_2	0.838	1.193
	ES_3	0.727	1.375
RDC	RC_1	0.715	1.399
	RC_2	0.715	1.399
KS	KS_1	0.700	1.429
	KS_2	0.700	1.429

and maximum 4 indicators have been used for each of the constructs, so *p*-values of 2, 3, and 4 indicators are 0.709, 0.578, and 0.5, respectively, as shown in Table 3.

Table 3 shows the indicators weight of all the related constructs. The significant item weight indicates that all the indicators explain a significant portion of the variance to their constructs. Two indicators, 'ESS (ES_2)' and 'KS (KS_2)', based on their formulaic value have somehow fluctuated frequency. In this regard, according to Hair et al. (2014), item loadings are also countable when indicators weights are not significant at ($p < 1/\sqrt{n}$). Thus, the item loadings of all the constructs are significant ($p > 0.50$) and show the absolute importance and relevancy with their respective constructs. After having a valid measurement model for this study, the PLS analysis was conducted to assess structural model in the next step phase.

4.2. Assessment of structural model

The hypothesised relationships in the structural model, including two main relationships (H1a, H2a) and two reinforcing effects (H1b, H2b), were examined. The structural model was tested in terms of path coefficients and R^2 values.

4.2.1. Results of hypothesis

The results of the hypothesis have been illustrated with the help of the research model. In this study, the research model has been illustrated in two phases: an initial structural model and the final

Table 3. Assessment of indicators validity.

Constructs	Indicators	Indicators weight ($t - V$)	Indicators loading ($t - V$)
ET	ET_1	0.5272	0.5399
	ET_2	0.5225	0.7622
	ET_3	0.4997	0.7236
TIS	TI_1	0.4867	0.7598
	TI_2	0.2535	0.5913
	TI_3	0.3261	0.6767
	TI_4	0.4876	0.7424
ESS	ES_1	0.0506	0.5909
	ES_2	0.9275	0.9901
	ES_3	0.1255	0.6933
RDC	RC_1	0.4503	0.8148
	RC_2	0.6842	0.9253
KS	KS_1	0.0412	0.5740
	KS_2	0.9768	0.9995

structural model. In more detail, Figure 4 shows the effect of the factors of NIS (ESS) and (TIS) on the constraint (ET) of UIRC. In this regard, path coefficient (β) values, indicating the effect of ESS and TIS and the R^2 values, explain the variances on the ET of UIRC. For instance, β values of ESS (0.575) and TIS (0.221) shows significant effects on ET of UIRC. Similarly, R^2 values of ET 48.5% show significant variance. Hence Figure 4 proves that ESS and TIS are the critical factors of NIS that can enhance the ET between UIRC.

Furthermore, Figure 5 shows support for the reinforcing role on the factors of NIS and on the constraints of UIRC. By inducing reinforcing factor KS and RDC increased the path coefficients of ESS (0.575–0.975) and TIS (0.221–0.223) to ET. Simultaneously increased the variances (R^2) of ET 0.485 (48.5%) to 0.498 (49.8%). Figure 5 shows that KS and RDC are the considerable reinforcing factors in enriching the efficiencies of ESS and TIS and consequently enhancing the ET of UIRC. Additionally, *t*-statistics was also examined to investigate the accuracy of each path.

Table 4 shows the results of *t*-statistics values of {H1(a and b) and H2(a and b)} that are significant at ($p > 1.96$) from their path estimates. Thus, the *t*-statistics of the ESS ($t = 15.88$) and reinforcing factor illustrates that the KS ($t = 22.45$) has a significant effect on the ET. Similarly, the *t*-statistics of the TIS ($t = 11.57$) and reinforcing factor RDC ($t = 6.00$) have a significant effect on ET.

4.3. Discussion

Based on the analysis, this research proves that factors of NIS are the critical successful factors to enhance the innovative capabilities of UIRC. It is generally accepted that the existence of appropriate and strong ESS at national level favours the innovative capacity in a country (Maggioni 2002). Perfect ESS not only enhances the individuals' level of education but also supports the output of R&D activities of UIRC (Hanushek and Ludger 2007). Similarly, TIS of a country works as an institutional focusing device that helps in the development of research and innovations via organising and guiding the collective search for knowledge, learning and transformation of the technologies and provide specific innovation-relevant capabilities to research and development organisations (Justman and Teubal 1995).

Furthermore, this research contributes to the literature by proposing KS and RDC as the reinforcing factors. Although from the analysis of the research, it is coherent that the strong ESS at national level can reduce the constraints of ET, but KS as a reinforcing factor enhances the efficiencies of the national ESS. Similarly, it is quite clear that the strong TIS of NIS always can enhance the ET, but RDC

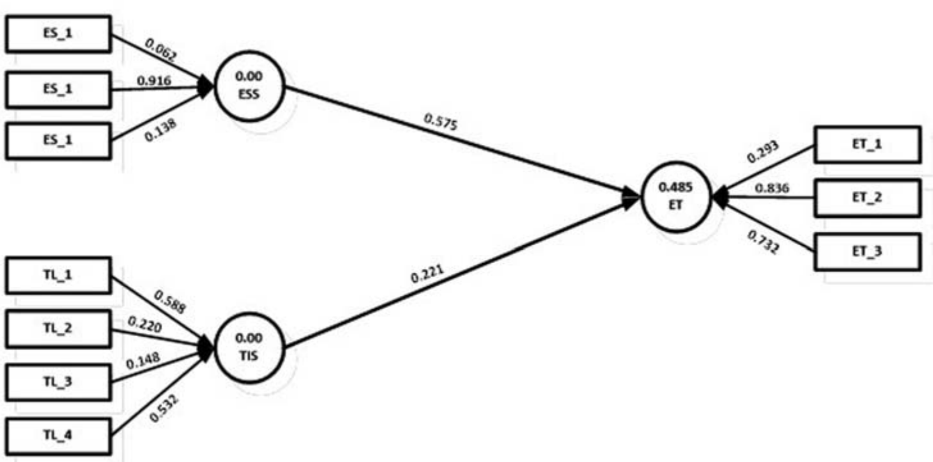

Figure 4. Effect of ESS and TIS on ET.

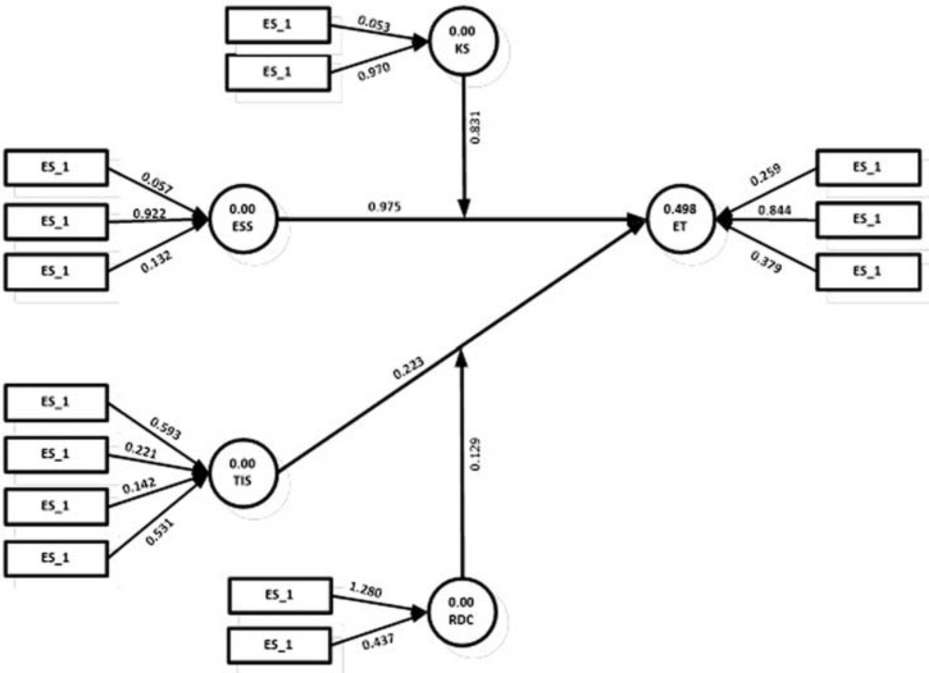

Figure 5. Effect of ESS and TIS on ET.

Table 4. Path coefficient and *t*-statistics.

N	Hypothesis	Path coefficient	Standard error	*t*-Statistics
H1a	ESS → ET	0.575	0.042	15.88
H1b	KS → ET	0.831	0.037	22.45
H2a	TIS → ET	0.221	0.042	11.57
H2b	RDC → ET	0.129	0.028	6.00

provides a leading assistance to the TIS to be more efficient for the provision of knowledge and skills to the research organisations.

In addition, this research contributes to the literature by proposing KS and RDC as the reinforcing factors. Although from the analysis of the research, it is coherent that the strong ESS at national level can reduce the constraints of ET, but KS as a reinforcing factor enhances the efficiencies of the national ESS. Similarly, it is quite clear that the strong TIS of NIS always can enhance the ET, but RDC provides a leading assistance to the TIS to be more efficient for the provision of knowledge and skills to the research organisations.

5. Conclusion and recommendations

The present study presented a fragmented and long-lasting way of enhancing the innovative capabilities of UIRC. Several studies contribute to the evaluation of UIRC; however, theory-based studies are still scarce. Thus, having a theoretical foundation is the significance of the present study. Our paper attempts to bridge the gap between research and innovation organisations and the policy makers by illustrating the influence of NIS on UIRC. The core competency of the system thinking is that it can be applied in any on-going situation. This research makes a number of contributions. First, it contributes to the growing debate on the constraints and enhancing the research and innovative activities in the context of universities and industries (Brimble and Doner 2007; Xu 2013; Li 2011; Azizan 2013; Alexander and Yuriy 2015) and offers a practical solution through system thinking. Theory of system thinking provides a new perspective by considering the factors of NIS as the key success factor to enhance the innovative performance of UIRC.

Second, this research investigated the education and training as the critical constraints of UIRC. An important feature of the system thinking is prompting us to see the cause of the problem. In the macroeconomic environment, a system thinker must observe unseen forces. Thus, system thinking is the theory that helps policy makers to see the patterns of events and to cover it (Richmond 1994; Wilson et al. 2020). Thirdly, this research proves the efficacy of the system thinking by suggesting the factors of NIS; ESS and TIS as the perfect systemic solutions to diminish the constraints of ET. Fourth, this research contributes to the literature by proposing KS and RDC as the reinforcing factors. Lastly from the practical perspective, system thinking can help policy makers by having an extensive and comprehensive knowledge about the influence of (NIS) on (UIRC). In terms of practical implications, this study tried to develop a framework to strengthen the innovative capability of UIRC. In other words, the findings of the current study provide intuition to the policy makers to understand the relationship between the strong system of innovation and the innovative capabilities of UIRC.

This research identifies future research directions that will help in overcoming the limitations of this research. Using Malaysia as a scope of the study, this research proposes comparative works conducted across different other developed and developing countries. Furthermore, replicating the study by comparing other countries could be valuable to identify the major differences in terms of enhancing the innovative capability of UIRC.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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