STI POLICY AND MANAGEMENT

The Relationship Between Competency Framework and Research Performance: An Empirical Study in the Public Research Institutes in Vietnam

Tran Quang Huy [a,*], Hoang Minh [a], Tu Thao Huong Giang [a]

[a] Vietnam Institute of Science, Technology and Innovation, Hanoi, Vietnam

ARTICLE INFO	ABSTRACT
	Competency framework has been studied widely for human resource development in organizations, but there are a few publications about researcher competency-based development in public research institutes. Therefore, this paper aims to investigate the relationship between competency framework and research performance in public research institutes to promote research career development in Vietnam. Data collected from 600 researchers in public research institutes was used for analyses. Confirmatory factor analysis technique (CFA) and hierarchical multiple regression were applied to test the relationship between competency framework and research performance. The results provide support for the view that competency framework positively affects research performance and task frequency positively moderates the relationship between competency framework and research performance in public research institutes. This paper explores the concept of competency framework for researchers in the public research institute context and clarifies its effect on the development of science, technology, and innovation in Vietnam.

I. INTRODUCTION

Science, Technology and Innovation (STI) plays an important role in national social-economic development worldwide and public research institutes (PRIs) are key factors in national innovation systems (NIS) to create and transfer knowledge to the society. There are several factors for PRIs to fulfill their assigned roles in the NIS, of which researchers are much related to funding structure and research agenda (Goto & Intarakumnerd, 2016). Researcher capability development through practical experiences of scientific research and technology development activities ensures their career development and sustains the research organization development.

Competency-based human resource development has been widely studied and applied in many fields with various advantages to enhance individual and organizational performance. Most of the industrial countries with good achievements in STI develop competency frameworks

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* Corresponding Author. Tran Quang Huy Tel: +84 904284680
E-mail: huytran@most.gov.vn

for researchers. The Research Development Framework (RDF) was designed and popularly used in research institutes and universities in the United Kingdom and other countries, which has been used for different activities for researcher career development such as training, career planning, competency profiling, and mentoring (Vitae, 2011).

Although the competency framework has been popularly applied in developed countries for both academia and industry; in Vietnam, it is used in enterprises for the long-term performance and others in the phrase of experiments (Le, 2016). From 2021 to 2030, the Vietnamese social-economics strategy emphasizes the key role of science, technology and innovation as well as digital transformation for fast and sustainable development through high productivity and national competitiveness. In such a context, PRIs' researcher competency development is required to align with regional and international standards with a suitable competency framework learned from other countries' experiences. Recently, the competency framework for Vietnamese researchers in the PRIs has been studied and a standard of 20 competencies divided into four domains of core competency, personal competency, research competency and management competency has been published and recommended for PRIs' training activities (Tran et al., 2021b). However, for the more effective uses of such competency framework in PRIs, the relationship between competency framework and research performance should be further studied in the specific context of Vietnam. Therefore, in this empirical research we explore the concept of researcher competency framework in the context of developing countries and clarify its direct and indirect effects on the research performance in the Vietnamese PRIs.

II. ANALYTICAL FRAMEWORK

A. Competency framework

The concept of competency was introduced in the research of C.McClelland (1973) of "Testing for competence rather than for intelligence" to emphasize the importance of individual competence for successful performance. Later on, various scholars have further studied the concept with different aspects and mostly reached a consensus on the behaviors of a specific job to complete its tasks to ensure individual performance (Tran et al., 2021a). The competency framework (CF) has been conceptualized as the combination of necessary competencies for an individual or organization to ensure the required performance with different structures (Dubois & Rothwell, 2004). Each competency of this CF was analyzed and described further in detail into different proficiency levels for evaluation to apply in various human resource management activities (Horton et al., 2002).

To take advantage of the competency-based human resource development approach, different organizations such as OECD, Vitae in the UK, CSIRO in Australia, and ITRI in Taiwan have developed and applied the competency framework for their employee development. OECD has developed the core and technical competency framework for managers in policy research and public administration (OECD, 2017). In 2010, Deloitte and APEC management career association had joined the research and proposed 20 essential competencies for the employees to ensure their successful tasks in 2020 with working skills in 3 domains including scientific research, research administration, and personnel administration (APEC & DELOITTE, 2010). In addition, the competency framework and research competency evaluation model in technical and engineering universities in Indonesia was introduced by Carolina et al. (2015) and the RDF introduced by Vitae (2011) with 4 domains of knowledge and intellectual abilities; personal effectiveness; research governance and organisation; engagement, influence and impact and widely used in the UK and other countries.

The competency framework for researchers in Vietnamese PRIs has been recently introduced and empirically studied by Tran et al. (2021b) with 20 competencies divided into 4 domains: core competency, personal competency, research competency and management competency. This competency framework was designed and developed based on the national job specification standards and practical knowledge and skills requirements to fulfill related tasks of public research institutes in Vietnam. The necessary

knowledge, skills, and attitudes for the successful performance of research tasks were collected through in-depth interviews, and group discussions and analyzed to establish each competency. Further competency framework validation was carried out by analyzing primary data to confirm that the suggested competencies are suitable for the practical tasks of researchers and that their correlations to research performance were statistically significant. That researcher competency framework was recommended to STI policymakers and PRIs managers for competency-based training to improve the researcher capabilities systematically and to conform with international research career standards. That may also be used as a competency-based compensation mechanism for researchers in the PRIs in Vietnam to attract more talents working in research and development activities.

1. Competency framework and research performance

Different factors influence individual and organizational performance in various types of organizations and contexts, of which employee competency is one of the key success factors. Some empirical studies confirmed the relationship between researcher competency and individual performance in research institutes (Prasad et al., 2016; Ajay et al., 2016; Guo et al., 2021; Natalia, 2016).

To improve the importance of Ph.D. holder researchers in Japan, Natalia (2016) analyzed the necessity and sufficiency of researchers' and engineers' competencies in the area of science and technology, given oncoming technological changes. The results from quantitative and qualitative analyses indicate those general competencies such as fundamental theoretical knowledge, ability to work on projects, teamwork and creativity will be in demand in 10-15 years, rather than highly specialized skills. Then, the research in Agriculture Research Institutes in Hyderabad Metro, India showed that employee core competency influenced the performance appraisal system using multiple regression analysis with a highly significant of 74% (Prasad et al., 2016). Another research in India PRIs by Ajay et

al. (2016) proved that the quality of researcher publication was highly affected by researcher competency and the research competencies mainly influenced academic research performance along with the mediating role of psychological capital in three top universities in China (Guo et al., 2021). Therefore, we propose the first two hypothesizes as below:

H1. The competency framework improves the performance of researchers in the PRIs in Vietnam.

Besides the above direct effect of competency on individual performance, various researches verified its indirect relationship by testing the mediating and moderating effects of other variables. To develop a suitable competency framework for performance improvement, the task analysis is important to check the frequency, requirements of knowledge, and skills to fulfill the task assignment (Janetta, 2002). Recent research has shown that task analysis has both direct and indirect effects on competency framework and performance (Augustine et al., 2021; Tabitha, 2017). Traditional job analysis also plays an important role in competency-based human resource development and clarifies different aspects of tasks including frequency, importance, and difficulty (Juan & Edward, 2009). In addition, Sarah et al. (2016) discovered the frequency of 11 tasks in records of managers' daily work, as well as the importance of each task, contribute to their job success. In the competency framework development for researchers in Vietnam, tasks based on the national standard job specification had been verified in the frequency and results (Tran et al., 2021b). From the conceptualization of task analysis, the competency framework should enhance the quality of research through working experiences, especially the more frequent tasks. Therefore, task frequency can strengthen the relationship between competency framework and research performance. Thus, we propose the next hypotheses as below:

H2: Task frequency moderates the relationship between competency framework and research performance, and the relationship will be stronger when the level of task frequency is high.

2. Research model

The research model, which is based on our hypotheses and the theoretical arguments afore-mentioned, is illustrated in Figure 1. We used confirmatory factor analysis and hierarchical multiple regression to evaluate and test this model.

Fig. (**1**) summarises the study's conceptual framework and the proposed hypotheses.
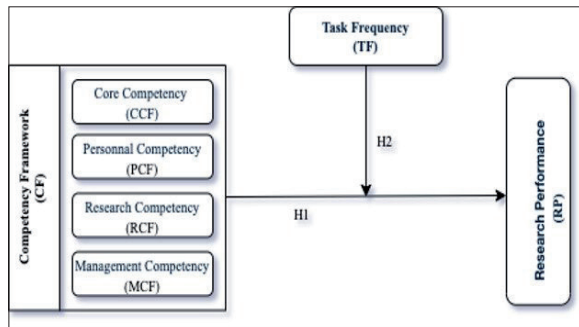
Source: The authors

Figure 1. The proposed conceptual model.

III. METHODOLOGY

A quantitative methodology was applied to empirically clarify the positive impact of a competency framework to research performance and the moderating role of task frequency on the relationship between competency framework and research performance in the PRIs. A series of discussions with human resource experts and managers of different research institutes was carried out to clarify the theoretical model and measurement instruments to ensure that the adapted measures are suitable for the PRIs context in Vietnam. Moreover, there were several in-depth interviews with research managers, and researchers to understand the current situation of a competency framework, task frequency, and research performance at their institutes.

A. Samples and questionnaire

According to the statistical data from National Agency for Science and Technology Information, by 2018 there were 687 research institutes with 26,681 researchers in Vietnam (NASTI, 2018). This total population was quite large and question-naires were sent to about 100 PRIs with different research fields (natural science, technology, and engineering, medical and pharmacy, agriculture and social science, and humanity) in Vietnam and there were 600 respondents, who were research-ers and research managers with different working experiences, research fields. This sample is suit-able according to the methodology used by Ajay et al. (2016), in which respondents were research-ers and managers in Indian research institutes. The questionnaire consists of 29 questions in Vietnamese related to a competency framework, task frequency, and research performance, that was delivered to researchers and managers via an online survey tool.

B. Measurement and scales

Competency framework: According to the qualitative research to analyze the competency requirements in the national job specification standards for Vietnamese researchers and in-depth interview results, Tran et al. (2021b) proposed a competency framework of 20 competencies divided into 4 domains as (i) Core competency *(analytical thinking, critical thinking, innovative thinking, and problem-solving skill)*, (ii) Personal competency *(research communication skill, digital skill, foreign language skill, teamwork skill, time management)*, (iii) Research competency *(research problem analysis, research proposal writing, data collection and processing, scientific research report writing, technology transfer, research publication, and intellectual property)*, and (iv) Management competency *(research planning, organizing research group, training, and research evaluation).* All scales were measured using a multiple, five-point Likert scale with response options ranging from 1 = "Poor performance" to 5 = "high proficiency"

Task frequency: As the national job specification standards, there are most common tasks required for researchers and could be classified into different task-related to *research projects, policy and planning, postgraduate teaching and supervision, conference organizing, main research activities, training and coaching, research report writing, data collecting, and processing.* These scales were measured using a multiple, five-point Likert scale with response options ranging from 1= "never" to 5 "always".

Research performance: as the Vietnamese researcher job specification standards and previous studies (Tran et al., 2021b), we proposed five indicators for research performance in PRIs such as *scientific research publication, research project, postgraduate teaching, and research application to practice, and research management*. These indicators also match with a study on factors influencing job performance in the National Agricultural Research Institutes in southeast Nigeria (Tokula et al., 2010). All scales were measured using a multiple, five-point Likert scale with response options ranging from 1 = "strongly disagreed" to 5 = "strongly agreed".

IV. RESULTS AND DISCUSSION

A. Results

Reliability and Validity

Demographic characteristics of the participants: to empirically test the hypotheses, 600 valid responses were analyzed. The responses were obtained from researchers and managers working at Vietnamese public research institutes. The respondents were directly or indirectly involved in the research activities in their organizations. Concerning job composition, there were 48 research assistants, 305 researchers, 194 principal researchers, and 53 senior researchers. Regarding the research field, there are 52 responses in natural science, 172 responses in technology and engineering, 67 responses in medical and pharmacy, 140 responses in agriculture, and 169 responses in social science and humanity.

Reliability and validity analysis: before hypotheses testing, we performed CFA to examine our hypothesized measurement model's construct reliability and validity. We used four indices to access the model fit, the ratio of chi-square goodness of fit to degrees of freedom ($X^2/df < 3.0$), root mean square error of approximation (RMSEA < 0.08), comparative fit index (CFI > 0.9) and goodness-of-fit index (GFI > 0.9) (Nguyen & Nguyen, 2008). After the model fit was confirmed, the composite reliability and validity of the constructs were tested to ensure
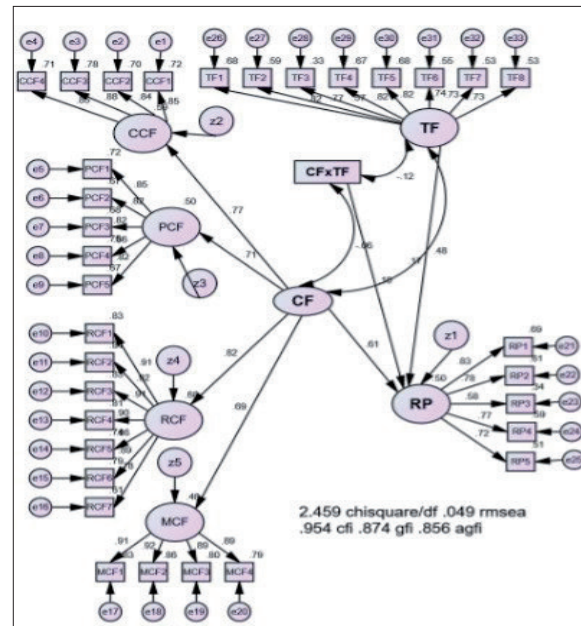
Source: The authors

Figure 2. Overall CFA model for measurement reliability and validity

the scale reliability (composite reliability > 0.7) and validity (Average Value Extracted > 0.5) (Stockburger, 1998) with statistical significance ($p < 0.05$). Through CFA, the measurement model demonstrated good fit to the data ($X^2 = 1273.570$, $df = 518$, $X^2/df = 2.459$, $p < 0.001$; RMSEA = 0.049, CFI = 0.954, GFI = 0.874 (Figure 2), and all the construct reliabilities and validities were tested. They are summarized in Table 1.

Hypothesis testing

We used a statistical package for social science (SPSS) to test the hypotheses. The hierarchical multiple regression analysis was adapted from Baron and Kenny (1986), and if the interaction was proven, we would then run a simple slope analysis following the procedure recommended by Preacher et al. (2006).

Regression analysis

The hypothesis testing included an examination of regression analyses in predicting research performance. For each of the independent variables in the regression models, the square root of the variable inflation factor was calculated (Fox, 1991). Variables in the analysis fell well within the

Table 1.
Construct reliability and validity test results

Factors	Observed variables or Constructs	Standard factor loading	Composite reliability	Average value extracted
Competency framework (CF)	Core competency	0.770	0.84	0.56
	Personal competency	0.710		
	Research competency	0.820		
	Management competency	0.690		
Task frequency (TF)	Research projects	0.822	0.91	0.57
	Policy and planning	0.769		
	Postgraduate teaching and supervision	0.575		
	Conference organizing	0.816		
	Main research activities	0.824		
	Training and coaching	0.740		
	Research report writing	0.731		
	Data collecting and processing	0.729		
Research performance (RP)	Publication	0.830	0,86	0,55
	Research project	0.780		
	Postgraduate teaching	0.580		
	Research application to practice	0.770		
	Research management	0.720		

accepted limits, indicating no problems with multicollinearity. To test the first hypothesis, a simple regression analysis was performed to establish the predictive power of the competency framework in the research performance. The resulting linear regression and its corresponding adjusted R^2 with standardization coefficients are presented in Table 2 (Model 1). This regression model is statistically significant with $p<0.01$, explaining 38 percent of the variation in research performance. The results show competency framework ($\beta= 0.516$, $p<0.01$) positively affects research performance. Therefore, H1 is supported.

Moderation analysis

The results from the hierarchical multiple regression analyzed by Stockburger (1998) are summarized in Table 2 (Model 2). To test the hypotheses, we first estimated null models in which we included only outcome variables, and random effects resulting from individuals. Thus, it was appropriate to investigate the effect of task frequency. The regression model was used to test our hypotheses that the relationship between competency framework and research performance would be positive (H1) and that this relationship would be stronger when the level of task frequency was high (H2).

The results for the model revealed that the competency framework was significantly related to research performance (t = 13.976, p< 0.001). The interaction of competency framework and task frequency was positive with statistical significance (t = 2.698, p<0.001). Then, we ran a simple slope analysis. As shown in Figure 3, when the level of task frequency was low, competency framework was positively associated with research performance; and when the level of task frequency was higher, competency framework was positively associated with research performance with a higher coefficient. This means that task frequency strengthens the positive relationship between competency framework and research performance. As shown in Table 2 (Models 1 and 2), the change of R^2 is from 0.380 to 0.397. Therefore, 1.7 percent of the overall variance was explained by the moderator and interaction after the effect of the control and

independent variables. Thus, H1 and H2 were supported.

Table 2.
Hierarchical Multiple Regression Analysis

Description	Research performance (Model 1)		Research performance (Model 2)	
	Coef-ficient	SE	Coef-ficient	SE
Independent variables				
Research fields	- 0,018	0.017	– 0.006	0.016
Job titles	- 0.193	0.032	– 0.093	0.042
Competency Framework	0.516***	0.035	0.493***	0.035
Task frequency			0.167***	0.039
Competency framework * Task frequency			0.087**	0.042
Adjusted R²	0.380		0.397	
F Statistic	123.381***		80.002***	

Note: * p < 0.05, **p < 0.01 and ***p < 0.001
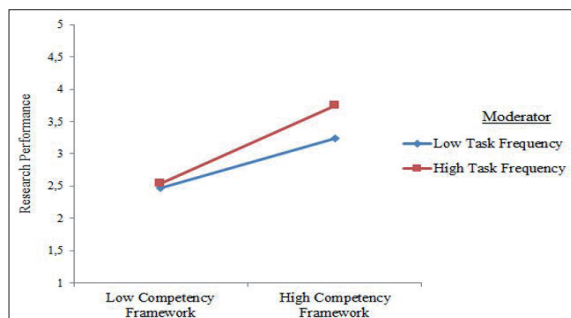
Source: The authors

Figure 3. Cross-level interaction plot

B. DISCUSSION

Relationship between competency framework and research performance

In the current research, we replicated previous studies (Ajay et al., 2016; Guo et al., 2021) and verified the relationship between competency framework and research performance measured by research project results, postgraduate teaching, publication, and practical application of research results. The findings provide initial empirical support for the impact of the competency framework on research performance through proficiency and work experience. In public research institutes,

one of the most important and valuable resources is researcher competence which ensures the fulfillment of the scientific and knowledgable tasks. With strong teams of researchers, PRIs would successfully deal with difficulties in funding issues and have a good balance of basic research and industry orientation (Goto & Inta-rakumnerd, 2016). The Vietnamese researcher's competency development should be aligned and conformed with international standards for the internationalization strategy in STI. Therefore, the competency framework which was learned from international experiences could be one of the important tools for researcher career development, and the research performance will also be oriented by international standards.

The moderating role of task frequency in the relationship between competency framework and research performance

The primary purpose of this study was to test the moderating role of task frequency on the relationship between competency framework and research performance in the research organization context. Figure 3 shows that when the level of task frequency was high, the positive effect on research performance was stronger. This implies that when PRIs leaders decide to promote the researcher competency to enhance the research results of their organizations, the introduction of task frequency in this relationship also enhances research results over and above the results achieved by adopting the competency framework alone. When researchers have more scientific research projects to do, they have more chances to practice and improve their knowledge and skills through work experiences. Based on the results, their competencies could be encouraged and applied to research activities leading to high performance based on their proficiency. The results emphasize that task frequency in the public research institutes context plays an important role in promoting research performance by its direct and indirect effect as a moderator. The scientific research and technology development activities are quite special to solve the new theoretical and practical problems which never been occurred before thus researcher competency and performance could be improved by practical

experiences. That indicates the importance of task frequency to enhance the researcher's capability and their performance accordingly.

V. CONCLUSION

Research and practical implications

The aforementioned results contribute to enriching the literature on competency frameworks and research institution practices. First, our findings provide a valuable additional contribution to the competency framework in the research institution context, thereby confirming that task frequency is the moderating effect between competency framework and research performance based on Vietnamese public research institutes' situation and empirical data. This clarifies the important role of the competency framework in a research institution in applying knowledge, and skills to enhance performance through practice. Moreover, we confirm a positive relationship between competency framework and research performance in PRIs. That indicates the influence of the competency framework to research performance directly and indirectly through task frequency by moderation effect.

Our research also provides valuable recommendations for PRIs leaders to change their management practices that could lead to better research performance. On the one hand, PRIs leaders support researcher competency development through training and coaching at the workplace or by encouraging a self-learning environment and a competency standard-based culture. On the other hand, leaders should assign research tasks according to researcher competence advantages so that they could have a chance to apply their knowledge and skills into practice, and job concentration mechanisms should also be considered for researchers' skill development. Through such mechanisms, researcher capability in terms of individual and organizational will be strengthened sustainably along with the institution's autonomy and research strategy supports from the government.

The social-economics development strategy for the period of 2020 to 2030 was approved last year emphasizing the key role of STI and digital transformation in enhancing the productivity for sustainable development. The national innovation system was introduced as the new approach for STI development driven by enterprises together with PRIs and Universities that could be the important pillars for knowledge creation and innovation promotion in the whole system. In such circumstances, researcher development (in terms of quantity, quality, and structure) could be one of the important solutions for STI development strategy in Vietnam through competency-based training, talent attraction, and recruitment with permanent and non-permanent working contracts as well as providing a conducive environment for researcher creativity. Therefore, the competency framework helps to improve researcher capability synchronously to meet the skill requirements of supporting and working with enterprises for knowledge transfer, research commercialization, and organizational and national innovations. In addition, the scientific research and technology development tasks suitable for STI development orientations and objectives would be highly encouraged with high frequency.

Limitations and future research

This research has some limitations. The first one is that the measurement of a competency framework, task frequency and research performance in this study is based mainly on the national job specification standards for Vietnamese researchers, and there should be further empirical studies in a research institution outside of Vietnam. The second one is moderating the role of task frequency on the relationship between competency framework and research performance conducted only for Vietnamese PRIs. Thus, more research needs to be carried out, particularly that addressing the mechanism underlying the moderator effect through case-based research

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