A study on the development of the "Taiwan project management competence scale"

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Abstract. On the basis of the 46 competence elements in the International Project Management Association (IPMA) ICB Version 3.0 and the PMP competence guidelines in PMBOK® Guide -- Fifth Edition by the Project Management Institute, this study formulates a "Preliminary Draft of the Taiwan Project Management Competence Scale". After expert review, a pretest was developed for the Taiwan Project Management Competence Scale. With adult students in adult education institutions as the respondents, a pretest was conducted in order to collect data. Confirmatory factor analysis, and reliability analysis were then conducted to construct the "Taiwan Project Management Competence Scale", which covers the four dimensions of project management of cognitive and conceptual competences, behavioral and technical competences, contextual competences, and moral and ethical competences. It is intended that this scale could be used as reference in future investigations into and measurement of project management competence in Taiwan, thus, facilitating the diagnosis, improvement, and refinement of performance in terms of project management competence.

1 Introduction

1.1 Study motives

According to the IPMA competence Baseline (ICB 3.0), as formulated by the International Project Management Association (IPMA), "Project" refers to temporary investment and efforts of an organization within a certain period of time in order to achieve special targets [31]; in addition, the American Project Management Institute (PMI) suggests that "Project" refers to temporary efforts to create a unique product, service, or result [29]. Based on all the definitions of project management, as made by international professional organizations (IPMA & PMI) and project management scholars [5, 12, 15], [18-26], [34,37], this research concludes that project management refers to a kind of managerial art created by the application of effective management methods and systematic management processes to integrate humans and resources in order to achieve tasks under the drive of limited resource conditions, and reach the established and unique goal visions.

According to the IPMA competence Baseline, as formulated by IPMA, Kao (2013a) established the contents of the Taiwan National Competence Baseline (TNCB) as the main body structure, and

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then, integrated the knowledge system and management processes of ISO, PMI, and PRINCE2 of England in order to put forward the organizational roles, tasks, management structure, and management processes of project management; the establishment of "Project Management Indicators" includes project initiation, integration, planning, and management; project scope planning and management; project schedule planning and management; project cost planning and management; project quality planning and management; project human resources planning and management; project communication planning and management; project risk planning and management; and project procurement planning and management, for a total of 9 levels of project management with 66 indicators. Kao(2011a) established 82 school project management indicators regarding the ten dimensions of the integration management of school projects, scope management, schedule management, cost management, quality management, human resources management, communication management, risk management, procurement management, and organization maturity degree. Kao (2014) established initiation and integration management, scope management, schedule management, cost management, quality management, human resources management, communication management, risk management, procurement management of community construction and execution, maturity degree of project management, and other methods and strategies, with community construction project management as the title, and a total of 82 indicators of are established. However, even with the norms and reference standards of project management indicators, do the managers of the execution of a project have the project management competence to effectively perform the work and tasks of the project?

As an old saying goes "Human efforts is the decisive factor", meaning even if the connotation and standard of the indicators of project management are understood, if the competence of the execution of project management is not owned, the tasks of the project may not be performed properly. Therefore, this study intends to explore the connotation and projects of Taiwanese project management competence, develop a Taiwanese project management competence performance scale through empirical investigation of the current project management situations, and examine cultural characteristics through ICB 3.0 of IPMA and by referencing PMI competence specifications, which will measure managers' degrees of management competence in project execution, measure the training courses for strengthening project management competence and planning project management professional development, as well as the basis for the formulation of a development strategy for project management personnel in order to cultivate talents with project management competence and give play to the functions of human resources management of proper talents, proper arrangements, and proper use to promote the realization of project management goals, and this is the motivation of this study.

1.2 Study purposes

Based on the foregoing statement of study motivations and study background, the purposes of this study are, as follows:

1.2.1 To understand the connotation of project management competence.

1.2.2 To establish a questionnaire scale for project management competence.

1.2.3 To propose a Taiwanese project management competence performance scale according to the results of this study, which shall act as reference for future investigations into and measurements of project management competence in Taiwan, thus, facilitating the diagnosis, counseling, improvement, and refinement of performance in terms of project management competence.

1.3 Study method and process

First, through literature review and analysis, this study integrates the connotation of project management competence and constructs the "Preliminary Draft of a Questionnaire on Taiwan's Project Management Competence Performance", where experts from industry, government, and

academia are invited to construct expert validity, and then, a total of 328 persons from industry, government, and academia are extracted as the study samples in order to implement a questionnaire survey of Taiwan's project management competence performance; the validity of the recovered questionnaire data is analyzed with Structural Equation Modeling (SEM), and Cronbach's α reliability analysis and other statistical methods are adopted to establish Taiwan's project management competence performance scale.

2 Exploration of project management competence

2.1 Operation process of project management

The operation system of project management includes: setting project management goals, planning operational process, operation of methods, construction of team, allocation and use of resources, a platform base of information and knowledge management, establishment of the system, etc., which are all required to integrate project business resources and labor, and complete set tasks, in order to achieve the project goals. In terms of the connotation of project management processes, many scholars and professional groups in the field of project management[2],[3], [6-8], [10], [11, 13, 16],[17], [19], [21-23], [25], [26, 29, 32], [33] have their own unique theoretical and practical understanding, thus, this research integrates the various statements to put forward the operation connotation of project management processes, including setting project goals, initiating, planning, executing, controlling, and closing.

2.1.1 Setting of project goals

Project goals shall be determined by the project initiator, and must be combined with the operational strategy goals of the organization. "Achieve Project Goals", refers to the final deliverables of the project, which are accepted by the customer and all project parties are satisfied with the performance of the project team. The setting of project goals must meet the following five principles: Specific, Measurable, Achievable, Realistic, and Time - the first letters of the five words above are connected to form SMART, that is to say, the setting of project management goals shall conform to SMART principles [9, 19, 34].

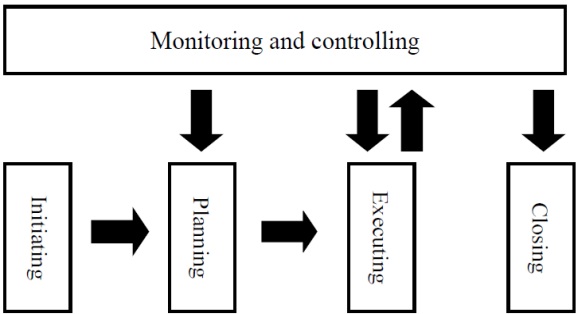### 2.1.2 Project management process

Figure 1. Project management process diagram, Source, Editorial Committee of Taiwan Project Management Association, , 21(2014).

The sequence of project management work at each stage is also called the Project Management Process, which includes the five processes of Initiating, Planning, Executing, Controlling, and Closing on the basis of the *International Project Management Knowledge System* (detailed in Figure 1), as

compiled by the Editorial Committee of Taiwan Project Management Association, and *A Guide to Project Management Body of Knowledge Fourth Edition* (detailed in Figure 2), as compiled by the American Project Management Institute (PMI) [9, 28].
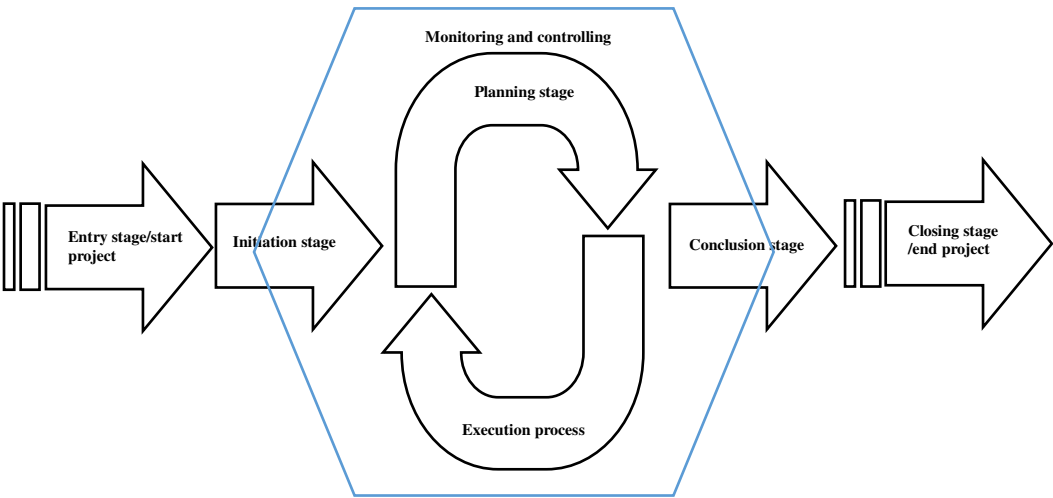

Figure 2. Project management process diagram, Source, PMI, 40(2008).
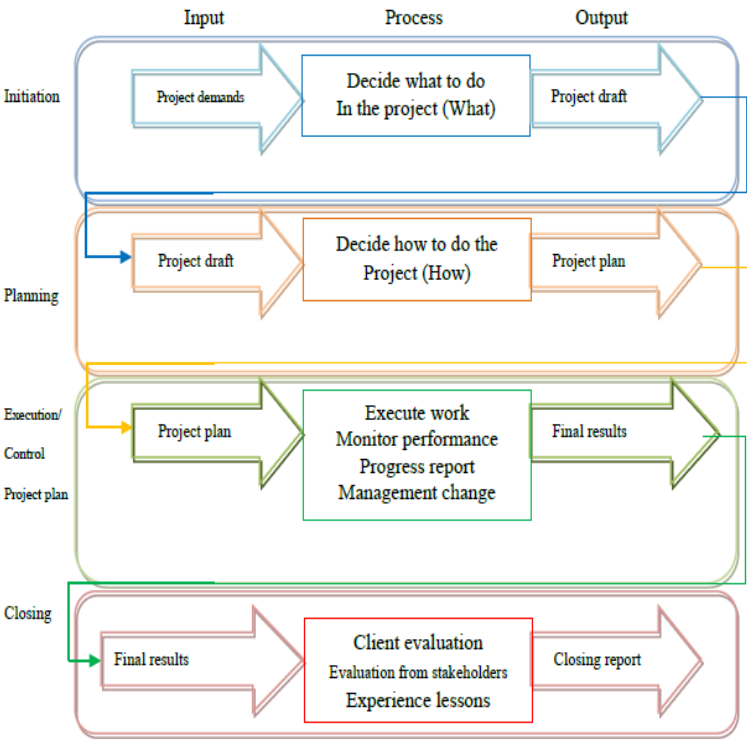

Figure 3. Project management process, Source: Kao, 207(2013b).

The connotation of the project management process, as shown in Figure 3, can be preliminarily summed up by project management activities that follow the Process of Input→Process→Output

(IPO), in combination with the five stage activities of initiating, planning, executing, controlling, and closing. In the initiating stage, the main operational task is to determine the steps of the project: project requirements are the input source basis of project initiation, while the project draft is the output of documents in the initiation stage; in the planning stage, project draft- output in the initiating stage becomes the input source basis for the planning and operation of the project, and the project plans are the output documents of planning and operation; in the executing/controlling stage, project plan-the output of the planning stage becomes the input source basis for executing project works, monitoring performance, progress reports, and change of management projects, and the final deliverables are the output documents, products, or services of executing and controlling a project; in the closing stage, final deliverables-the output of executing/controlling stage becomes the input source basis for the project closing operation, including customer's evaluation, evaluations of related personnel, experience, and lessons, and the close-out report is the output document of project closing. It can be known from the above IPO operational processes that, the operational mode of the project management process is to closely connect previous operations with the latter stages of project management, in other words, project management has obvious stage connections and operational systems [19].

2.2 Connotation of project management competence

McClelland (1973) suggested the measurement of competency to replace intelligence, which acts as the prediction basis for personal success. The connotation of competence includes knowledge, skills, and emotions, with outside behaviors as the measurement basis; in addition, it can be divided into individual's "possession" of ability, referring to possessed knowledge, emotions, skills, or "presented" ability, meaning actual performance of behaviors and successful performance of certain tasks [14]. As defined by Cheng, Lin, and Cheng (2009), competence refers to "the ability to use knowledge and the attitude and skills to perform tasks, meaning every behavior, motivation, and knowledge in relation to the success of works" quoted from, [36]. Spencer and Spencer (1993) put forward the Iceberg Model, (like an iceberg floating on the surface of the ocean), where the proposed competence includes 5 elements in terms of skills, knowledge, self-concept, traits, and motives; where skills and knowledge are more explicit, are easily trained, developed, and changed, which belong to superficial competence; and self-concept, traits, and motives, which are relatively implicit and not easily changed, and they belong to implicit competence (just like an iceberg hidden under the water). Project management competence, as explored in this study, refers to the explicit competence of knowledge and skills possessed by project management personnel.

In accordance with the ICB 3.0 competence baseline, as issued by IPMA (2009), a total of 46 project management competence elements, including 20 technical competence elements, 15 behavior competence elements, and 11 situation competence elements, shall act as the reference standard for the world to join IPMA member organizations, as well as the promotion of project management education training and project management competence certification. The connotation of ICB 3.0 competence baseline is, as follows.

2.2.1 20 technical competence elements for project management

1.01 Project management success: refers to the identification of interested parties towards project management results.
1.02 Interested parties: defined as direct or indirect personnel related to the project, as well as the priority of their interest in the project, and their opinions on the significance of the project are clarified.
1.03 Project requirements and objectives: refers to meeting the requirements and objectives of interested parties and customers.
1.04 Risk and opportunity: they refer to qualitative/quantitative risk management and opportunity evaluations in the process of planning and executing a project.

1.05 Quality: it refers to quality policy, objectives, and responsibilities determining what level the project should achieve in order to satisfy customers.

1.06 Project organization is a group of people: the arrangements of authority, relationships, and responsibilities conforming to enterprises, as well as the functional processes and related infrastructure.

1.07 Teamwork: it refers to the promotion of the project team to work harmoniously together in order to reach a common project objective.

1.08 Problem resolution: it refers to the use of many different methods to solve problems related to the project.

1.09 Project structures: it refers to the decomposition of project works into tasks, work packages, and activities in order to ensure no activity is leaked during the execution of a project.

1.10 Scope and deliverables: they refer to clarifying project scope and deliverables.

1.11 Time and project phases: they refer to the sequence of the project work package/activity, project period estimation, process arrangements, establishing a project deadline, and monitoring its implementation in a timely manner.

1.12 Resources: they refer to ensuring personnel have the necessary techniques, behaviors, and situational competence, and providing sufficient information, tools, and training in order to perform a task successfully.

1.13 Cost and finance: they refer to the assessment of the sum of all the activity costs since project initiation.

1.14 Procurement and contract: they refer to identifying potential suppliers and price inquiries for bidding and tendering to select suppliers, determining the best suppliers, and signing and managing contracts.

1.15 Changes: it refers to the changes of project plans or contract clauses after the occurrence of unpredicted incidents.

1.16 Control and reports: they refer to the evaluation of actual project progress and performance, and providing reports after comparing project baselines.

1.17 Information and documentation: they refer to the data and information conforming to organization policies and project management.

1.18 Communication: it refers to accurately conveying the correct information to all parties in order that they can understand and meet expectations.

1.19 Start-up: it refers to analyzing project feasibility, clarifying concepts, and signing letters of authorization for the project.

1.20 Close-out: it refers to the evaluation of project results and gained experience after the project is completed, and documenting the experience for future project reference.

2.2.2 15 behavior competence elements of project management

2.01 Leadership: it refers to exerting effective guidance in order that a team can understand and accept the guidance trend; it also refers to providing guidance and motivating others to achieve project goals.

2.02 Engagement and motivation: the project manager must understand the skills, experience, personal attitude, environment, and intrinsic motives of each member in order to encourage each member, and make project members be devoted to the project work; obtain the project and identification of internal staff and relevant persons regarding the project.

2.03 Self-control: it refers to handling daily work, changing requests and responding to pressure situation with a systematic and trained method.

2.04 Assertiveness: it refers to reaching a consensus through debate and argument in the common goals, and stating own views with authority.

2.05 Relaxation: it refers to the ability to relieve tension in tough times so as to restore the spirit of team.

2.06 Openness: it refers to allowing people to express their opinions and suggestions freely, accepting knowledge and experience of others and avoiding discrimination in discussing issues.

2.07 Creativity: it refers to the ability to blend all kinds of knowledge and promote team members to think and handle matters with original and imaginative methods.

2.08 Results orientation: it refers to making team focused on key objectives so as to make the interested parties of the project get the best results.

2.09 Efficiency: it refers to the ability to effectively use time cost and resources cost so as to produce agreed deliverables and realize the expectations of interested parties.

2.10 Consultation: it refers to the exchange of disagreed opinions on project topic, and the openness of disagreed opinions so as to lead the resolution agreed mutually.

2.11 Negotiation: it refers to the resolution of different opinions of each party of a project or program in a public manner in order to achieve a mutually satisfactory solution program.

2.12 Conflict and crisis: refers to collecting information, weighing and selecting programs, working towards positive and synergetic solutions in the shortest possible time in face of conflict and crisis, and solving project and contract negotiations with calmness, self-control, and friendliness.

2.13 Reliability: it refers to making others trust you, and the realization of the quality delivery of results within the planned time.

2.14 Values appreciation: it refers to knowing about the inherent essence of others, understanding the different values among project members, and communicating and accepting other views.

2.15 Ethics: it refers to the acceptance of behaviors of team members through ethics communication of legal basis.

2.2.3 11 situation competence elements of project management

3.01 Project orientation: it refers to managing a project management job to make the operations become more efficient, and be beneficial to market competition.

3.02 Program orientation: it refers to integrating specific and related projects, with the application of policy to program management and the development of program management abilities, in order to achieve strategy goals.

3.03 Portfolio orientation: it refers to the knowledge/experience of integrating projects not necessarily associated in order to control program coordination and optimize budget and resources.

3.04 Project, program, and portfolio implementation: they refer the ability of the organization to continuously improve projects, enlarge projects, combine projects, and be engaged in change management, in order to determine best practices in line with the baseline.

3.05 Permanent organization: it refers to continuously providing resources/facilities/products to a permanent organization (such as, accounting and personnel departments), and establishing friendly relations.

3.06 Business: it refers to project management through industry, business, or profession to provide products or services in order to ensure project execution results conform to the requirements of the operation (such as law, finance, economy, human resources, sales and marketing, information technology).

3.07 Systems, products, and technology: they insure that the systems, products, and technologies used inside and outside the organization are all managed as projects, from the development of conception to production to distribution.

3.08 Personnel management: it refers to the planning, recruitment, selection, training, retention, performance evaluations, and motives and abilities of a project team to meet the human resource management needs of the project.

3.09 Health, security, safety, and environment: they refer to ensuring all activities in the project are planned and implemented under the conditions of health, security, safety, and environmental protection.

3.10 Finance: it refers to providing the information required by the project's financial management department, and managing and controlling all finances.

3.11 Legal: it refers to the planning and execution of a project in accordance with laws (such as, no claims caused by infringement, breach of contract, or legal review before signing the contract).

PMI (2012) points out that, effective project management requires a project manager to have the following competences, in addition to specific domains skills and general management expertise: (1) Knowledge: it refers to the project manager's knowledge of the processes and operations of project management; (2)Performance: it refers to the project manager's ability to execute and complete all project matters through management knowledge; (3)Personal ability: it refers to the behavior performance of a project manager in the execution of related projects or activities. Personal effectiveness traits involved in project management include attitude, core personality, and the ability to lead and guide teams to achieve goals and balance project limits. In addition, the project manager has the responsibility to meet the following requirements, including meeting the requirements of tasks, teams, and individuals, organizing and developing strategies and links within the project team, and understanding and applying best practice knowledge, tools, and techniques, thus, strengthening their knowledge management, performance management, goal leadership, and project management. PMI (2012) also points out that a project manager completes tasks through the project team and other interested parties, thus, an effective project manager must balance moral, interpersonal interactions, and conceptual skills to assist in the analysis of situations, and conduct appropriate interactions with other interested parties, including: Leadership, Team building, Motivation, Communication, Influencing, Decision making, Political and cultural awareness, Negotiation, Trust building, Conflict management, and Coaching.

2.3 Connotation of project management competence performance scale

A summarization of the above mentioned contents is, as follows: there are five processes for project management competence: initiating, planning, executing, controlling, and closing, which provide the structure for competence in project management, including cognitive and skill performances, in combination with attitude, moral ethics, and project management standards. This study has a total of 30 cognitive competence project management performances, 30 technical competence performances, 10 attitude competence performances, and 10 moral ethics competence performances, for a total of 80 items in the performance scale. The items of the project management competence performance scale are, as follows:

2.3.1 Cognitive competence performance of project management

2.3.1.1 Cognitive competence performance of initiating a project

01. I know the processes and implementation methods for initiating a project.
02. I know the principles and implementation methods for setting project goals.
03. I know the items and methods for the proposal of a project concept book (draft).
04. I know the process and implementation methods for project feasibility analysis.
05. I know the items and methods for the proposal of a project authorization letter.

2.3.1.2 Cognitive competence performance of project planning

01. I know the processes and methods for the proposal of a project plan.
02. I know the planning processes and methods for a project schedule.
03. I know the planning processes and methods for a project budget.
04. I know the planning processes and methods for project quality.
05. I know the planning processes and methods for project scope.
06. I know the planning processes and methods for project risk.
07. I know the planning processes and methods for a project's human resources.

08. I know the planning processes and methods for equipment, tools, and materials of a project.
09. I know the planning processes and methods for project procurement and bidding.
10. I know the planning processes and methods for communication with a project's interested parties.

2.3.1.3 Cognitive competence performance of project controlling

01. I know the processes and methods for the control and management of a project schedule.
02. I know the processes and methods for the control and management of a project budget.
03. I know the processes and methods for the control and management of project quality.
04. I know the processes and methods for the control and management of project scope.
05. I know the processes and methods for the control and management of project risk.
06. I know the processes and methods for the control and management of a project's human resources.
07. I know the processes and methods for the control and management of project equipment and materials.
08. I know the processes and methods for the control and management of project procurement and bidding.
09. I know the processes and methods for effective control and management of a project's interested parties.
10. I know the processes and methods for controlling and managing the related laws and contracts of a project.

2.3.1.4 Cognitive Competence Performance of Project Closing

01. I know the processes and methods of closing a project.
02. I know the processes and methods for closing a project's contract.
03. I know the processes and methods for closing the administrative affairs of a project.
04. I know the processes and methods for holding a project review meeting.
05. I know the processes and methods for managing the knowledge and experience contained in project documents.

2.3.2 Technical competence performance of project management

2.3.2.1 Technical competence performance of project initiation

01. I will initiate projects with benefits.
02. I will set project goals.
03. I will propose a project concept book (draft).
04. I will operate the tools and techniques used for project feasibility analysis.
05. I will propose a project authorization letter.

2.3.2.2 Technical competence performance of project planning

01. I will propose a project plan.
02. I will operate the tools and techniques used for project schedule planning.
03. I will operate the tools and techniques used for project budget planning.
04. I will operate the tools and techniques used for project quality planning.
05. I will operate the tools and techniques used for project scope planning.
06. I will operate the tools and techniques used for project risk planning.
07. I will operate the tools and techniques used for project human resource planning.
08. I will operate the tools and techniques used for project equipment and materials planning.

09. I will operate the tools and techniques used for project procurement and bid planning.
10. I will operate the tools and techniques used for communication planning with a project's interested parties.

2.3.2.3 Technical competence performance of project controlling and management

01. I will control and manage the project schedule.
02. I will control and manage the project budget.
03. I will control and manage project quality.
04. I will control and manage project scope.
05. I will control and manage project risk.
06. I will control and manage the project's human resources.
07. I will control and manage the project's equipment and materials.
08. I will control and manage the procurement bidding of a program.
09. I will effectively control and manage the interested parties of the project.
10. I will control and manage the related laws and contracts of the project.

2.3.2.4 Technical competence performance of project closing

01. I will operate the tools and techniques of project closing.
02. I will operate the tools and techniques of closing the project's contracts.
03. I will operate the tools and techniques of closing the project's administrative affairs.
04. I will hold project review meetings.
05. I will manage the knowledge and experience documents of the project.

2.3.3 Attitude competence performance of project

01. I will actively study and solve the problems of the project.
02. I will actively apply innovative methods to improve project performance.
03. I will have great confidence in the executed project.
04. I will learn and grow continuously.
05. I can effectively control and manage my emotions and pressure.
06. I am willing to cooperate with team members.
07. I am willing to share my creations and opinions with team members.
08. I agree with the objectives and aspirations of the project.
09. I will try to promote the success of the project.
10. I will actively engage in the development of a project management career.

2.3.4 Moral ethnics competence performance of project

01. I will observe laws and ethical norms.
02. I will fulfill my responsibilities and obligations.
03. I will observe promises and agreements.
04. I will respect the cultural differences between team members.
05. I will keep program secrets confidential.
06. I will cooperate with project limits and hypothesis state.
07. I will treat my colleagues with equality and mutual benefit.
08. I will promote team harmony.
09. I will actively maintain the security of the project's environment.
10. I will actively promote the welfare and benefit of the project team.

3 Establishment of project management competence performance scale

Taking Taiwan's government, industry, and academic fields as the study subjects, this study establishes a project management competence performance scale, conducts comprehensive analysis and sorting of related literatures, and compiles the items for a project management competence performance scale questionnaire, and then, expert validity, construct validity, reliability, and other statistical analysis methods are adopted in order to establish the project management competence performance scale of this study.

3.1 Methods for the establishment of project management performance and the organization of performance questionnaire

Through the foregoing literature reviews and analysis, this study summarizes and edits the preliminary draft of a project management competence performance questionnaire scale, and then, invites project management practitioners, university (college) professors, and study scholars and experts in the field of project management as the auditing experts of the preliminary draft of the study questionnaire. In terms of project management practitioners, 2 high-level senior project supervisors from public sector institutions, and 3 high-level senior project supervisors from industry are invited as the auditing experts for the preliminary draft of the questionnaire scale in this study; secondly, in terms of university (college) professors or scholars in the field of project management, with the assistance of Taiwan's project management institutes and organizations, for a total of 10 scholars and experts from Taiwan's National Pingtung University, National Kaohsiung First University of Science and Technology, Republic of China Military Academy, Chang Jung Christian University, Aletheia University, Cheng Shiu University, Tajen University, and the Open University of Kaohsiung are invited as experts to audit the preliminary draft of questionnaire in this study.

After the preliminary draft questionnaire is approved by the experts, pretesting is conducted, with 350 pretested questionnaires sent out, 328 valid questionnaires are recovered, and validity and reliability are established based on the data of the recovered questionnaires. The validity of this study shall be analyzed by the Structural Equation Modeling (SEM) of the LISREL software application. One of the most important characteristics of SEM Analysis is that it must be based on certain theoretical basis, meaning that SEM is a kind of statistical technique used to test the applicableness of priori theoretical model [4]. The researchers must have very clear instructions or specific theoretical basis for the contents and natures of the potential variables before measurement, and have an established early decision composition mode for each corresponding observation variable. The implementation of analysis is to test the applicableness of the proposed factor structure; this procedure can be used to test structure effectiveness during the development of measurement tools, and can also be used to test the theoretical framework, thus, it is also known as confirmatory factor analysis (cfa) [3, 35].

The four dimensions of cognitive competence, technical competence, attitude competence, and moral ethics competence for project management are compiled in the questionnaire "Taiwan Project Management Competence Performance Scale", as developed in this study, by referring to ISO, IPMA, PMI, British PRINCE2, and other project competence baseline and knowledge systems, and a total of 80 project management competence performance items are listed. As the scale of this study has a definite theoretical basis and model, confirmatory factor analysis of Structural Equation Modeling is carried out by LISREL software regarding the validity analysis of the questionnaire in this study, in order to understand the factor model of its internal structure; Cronbach's α is carried out by SPSS software for reliability analysis of this study, in order to understand the internal consistency of the items at each level.

3.2 Results of the establishment of Taiwan management project competence performance

Through the results of expert validity analysis in this study, four dimensions and 80 items in the preliminary draft of the questionnaire are retained, among them, some words in the items are modified and some items are combined to form the questionnaire contents mentioned above. Then SEM analysis and Cronbach's α are conducted on the questionnaire contents, as shown in the following:

3.2.1 SEM analysis

Through SEM analysis with LISREL software, the obtained results and relation path diagram cannot be presented here due to too many items in the scale. However, the degree of freedom and chi-square statistics of the entire model are listed from the analysis report, with the degree of freedom of 2043, chi-square value of 11171.83, and P value of 0.0, which indicates that there exists obvious difference between the hypothesis model and the observed values. In addition, other adaptation indicators of NFI, NNFI, and CFI are all more than 0.95, which indicates that each item and dimension is well structured. The factor loading of each item at each level is, as follows:

(1) In terms of the factor loading of each item of cognitive competence performance for project initiation, where the factor loadings from Item 01 to Item 05 are, respectively, 0.58, 0.56, 0.54, 0.55, and 0.57.

(2) In terms of the factor loading of each item of cognitive competence performance for project planning, the factor loadings from Item 01 to Item 10 are, respectively, 0.53, 0.50, 0.51, 0.57, 0.50, 0.51, 0.52, 0.54, 0.52, and 0.50.

(3) In terms of the factor loading of each item of cognitive competence performance for project control and management, the factor loadings from Item 01 to Item 10 are, respectively, 0.52, 0.55, 0.53, 0.58, 0.55, 0.52, 0.54, 0.53, 0.57, and 0.60.

(4) In terms of the factor loading of each item of cognitive competence performance for project closing, the factor loadings from Item 01 to Item 05 are, respectively, 0.62, 0.61, 0.62, 0.60, and 0.64.

(5) In terms of the factor loading of each item of technical competence performance for project initiation, the factor loadings from Item 01 to Item 05 are, respectively, 0.57, 0.58, 0.55, 0.56, and 0.54.

(6) In terms of the factor loading of each item of technical competence performance for project planning, the factor loadings from Item 01 to Item 10 are, respectively, 0.52, 0.51, 0.52, 0.56, 0.50, 0.51, 0.50, 0.53, 0.51, and 0.52.

(7) In terms of the factor loading of each item of technical competence performance for project control and management, the factor loadings from Item 01 to Item 10 are, respectively, 0.53, 0.52, 0.55, 0.57, 0.56, 0.53, 0.54, 0.53, 0.56, and 0.58.

(8) In terms of the factor loading of each item of technical competence performance for project closing, the factor loadings from Item 01 to Item 05 are, respectively, 0.58, 0.60, 0.61, 0.57, and 0.62.

(9) In terms of the factor loading of each item of attitude competence performance of the project, the factor loadings from Item 01 to Item 10 are, respectively, 0.61, 0.58, 0.60, 0.58, 0.63, 0.60, 0.57, 0.60, 0.62, and 0.60.

(10) In terms of the factor loading of each item of moral ethic competence performance of the project, the factor loadings from Item 01 to Item 10 are, respectively, 0.54, 0.55, 0.52, 0.57, 0.55, 0.56, 0.58, 0.55, 0.58, and 0.54.

3.2.2 Cronbach's α analysis

(1) In terms of the reliability of the overall dimension of the cognitive competence performance of project initiation, the dimension α value is 0.86, which indicates the decision making

performance of the project supervisor has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.64, which indicates that the internal consistency of each dimension is relatively high.

(2) In terms of the reliability of the overall dimension of the cognitive competence performance of project planning, the dimension α value is 0.85, which indicates the control and management performance of the project supervisor has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.58, which indicates that the internal consistency of each dimension is relatively high.

(3) In terms of the reliability of the overall dimension of the cognitive competence performance of project control and management, the dimension α value is 0.86, which indicates the emergency response performance of the project supervisor has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.63, which indicates that the internal consistency of each dimension is relatively high.

(4) In terms of the reliability of the overall dimension of the cognitive competence performance of project closing, the dimension α value is 0.88, which indicates the cost management business among the project work has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.69, which indicates that the internal consistency of each dimension is relatively high.

(5) In terms of the reliability of the overall dimension of the cognitive competence performance of project initiation, the dimension α value is 0.87, which indicates the decision making performance of the project supervisor has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.66, which indicates that the internal consistency of each dimension is relatively high.

(6) In terms of the reliability of the overall dimension of the cognitive competence performance of project planning, the dimension α value is 0.86, which indicates the control and management performance of the project supervisor has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.64, which indicates that the internal consistency of each dimension is relatively high.

(7) In terms of the reliability of the overall dimension of the cognitive competence performance of project control and management, the dimension α value is 0.86, which indicates the emergency response performance of the project supervisor has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.64, which indicates that the internal consistency of each dimension is relatively high.

(8) In terms of the reliability of the overall dimension of the cognitive competence performance of project closing, the dimension α value is 0.87, which indicates the cost management business among the project work has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.68, which indicates that the internal consistency of each dimension is relatively high.

(9) In terms of the reliability of the overall dimension of attitude competence performance of a project, the dimension α value is 0.88, which indicates the emergency response performance of the project supervisor has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.69, which indicates that the internal consistency of each dimension is relatively high.

(10) In terms of the reliability of the overall dimension of moral ethic competence performance of a project, the dimension α value is 0.88, which indicates the cost management business among the project work has a certain degree of internal consistency. In addition, the correlation value of each item, as well as the overall construct item, are all greater than 0.68, which indicates that the internal consistency of each dimension is relatively high.

To sum up, the four dimensions and items of Taiwan's project management competence performance scale in this study can all be retained, which can be the measurement used for the general situations of competence performance in industry, government, and academic fields in Taiwan, as well as a reference indicator for the evaluation of project management personnel performance, human resources management, and proposing talent development strategies.

4 Conclusion

A total of 80 items for the "Taiwan Project Management Competence Performance Scale" are established, including 30 items of "Project Management Cognitive competence Performance", with 5 items of cognitive competence performance of project initiation, 10 items of cognitive competence performance of project planning, 10 items of cognitive competence performance of project control and management, and 5 items of cognitive competence performance of project closing in terms of the connotation; secondly, it includes 30 items of "Project Management Technical Competence Performance", with 5 items of technical competence performance for project initiation, 10 items of technical competence performance of project planning, 10 items of technical competence performance of project control and management, and 5 items of technical competence performance of project closing in terms of connotation; thirdly, it includes 10 items of "Attitude Competence Performance of Project"; fourthly, it includes 10 items of "Moral Ethic Competence Performance of Project".

The results of this study shall be used for subsequent performance measurements of project management personnel, as well as a reference indicator for the development of project management competence and career development. It can be used in IPMA and PMI international project management communities, for the promotion of project management education and training all over the world, and for the certification of Project Management Professional (PMP). The study results can be integrated into the auditing and certification of project management competence to gradually import a knowledge system of project management, including best practices experience, and a competence baseline for project management organization and operation of all fields. A complete operational mechanism is constructed for project management in order to improve the maturity of project management organization and operation, and shape a project management culture for organizations, which has deep and wide functions and values for strengthening the benefits of project management.

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