Development and validation of an instrument for multidimensional top management support

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Abstract

Purpose – Literature reveals that there is a paucity of instruments to measure multidimensional top management support (TMS). The multidimensionality and the complexity of the TMS cannot be reflected by a single-dimensional construct. The purpose of this paper is to develop and validate an instrument for the measurement of multidimensional TMS.

Design/methodology/approach – In this cross-sectional study, exploratory and confirmatory factor analyses were performed to check the validity and model fitness based on sample data collected from the PMI community. Ordinary least square and structural equation modeling techniques were used to test the research hypotheses and validate multidimensional TMS.

Findings – The findings revealed a significant positive correlation among all dimensions of top management and their significant influence on project success, especially on project efficiency and team dimensions.

Research limitations/implications – Based on the existing knowledge through a coherent and refined process, the development and validation of a top management support questionnaire (TMSQ) made a significant contribution to theories and research methods.

Practical implications – Multidimensional TMS provides an opportunity to ensure provision of apt assistance throughout the implementation of projects for improving organizational performance across the industries.

Originality/value – This study targeted a sample size of 300 to develop and validate an instrument, which is in line with previous research studies on the development and validation of a reliable instrument. To operationalize TMSQ, this study adopted an online survey and received 208 responses (69 percent) from the PMI community.

Keywords Project success, Top management support, Multidimensional, Instrument, Validation, TMSQ

Paper type Research paper

1. Introduction

One of the most important determinants of project success is the top management support (TMS) but the essence of TMS has been discussed in a limited way in the literature (Dong *et al.*, 2009; Staehr, 2010). The individuals working at senior level positions who possess essential leadership and managerial skills are referred to as top management (TM). In the last three decades, TMS as a single dimension has often been explored. Pinto and Slevin (1987) are pioneers in identifying critical success factors where TMS is the most important factor. TMS is a well-known success factor but yet little is known about why sometimes TM chooses to: not support; reduce support; and provide only low levels of support. Also little is known about the types of behaviors and patterns associated with TMS (Boonstra, 2013). A few theoretical studies identified TMS as a set of attitudes and behaviors but did not relate these behaviors with each other (McComb *et al.*, 2008; Naranjo-Gil, 2009).

Pinto and Slevin (1987) developed a 10-item instrument to measure single-dimensional TMS. Subsequently, another instrument for the measurement of single-dimensional TMS containing six items was developed by Yap *et al.* (1992). These measurement scales of TMS developed by Pinto and Slevin (1987) and Yap *et al.* (1992) are widely used in various

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research works. However, these instruments cannot be used to reflect the multidimensionality and the complexity of TMS (Ragu-Nathan *et al.*, 2004). Boonstra (2013) conducted an exploratory study which was limited to identifying and categorizing TMS dimensions. Nonetheless, the development and validation of an instrument to measure multiple dimensions of TMS was not the aim of Boonsta's study. Thus, a paucity of reliable and valid instruments to measure multidimensional TMS exists.

According to Wright *et al.* (2014a), the multidimensional scaling technique offers distinct advantages to perceptual research problems. In accordance with Boonstra (2013), much research is required to analyze various types of TMS, and to identify to what extent these supportive behaviors are interrelated and complementary for the project success. The scarcity of reliable and valid instruments to measure multidimensional TMS exists due to inadequate conceptualization of the multidimensional construct, lack of theoretical development, and lack of operationalization of measures. Therefore, the objective of this study is to develop and validate an instrument to measure multidimensional TMS. This study employed ordinary least squares (OLSs) and structural equation modeling (SEM) methods to test the research hypotheses and validate an instrument for a multidimensional TMS. The study makes a significant contribution to the existing body of knowledge by filling a research gap and providing future avenues for both academicians and practitioners.

The remainder of the study is organized as follows. First, the literature review and theoretical background present the concept and critical synthesis of TMS. Following this, the scale development process, the instrument testing process, and research methods and procedures are discussed. The next section explains the summary of findings, refinement of measurement model, exploratory and confirmatory factor analyses, model fitness, and testing of research hypotheses. Then, implications for theory and practice, limitations, and directions for future research are discussed. Finally, the conclusion is given at the end of this paper.

2. Literature review and theoretical background

Every project is unique and TM can have different leadership roles in projects. TM generally refers to the individuals working as CEO, President, Chairman or Chairperson, Executive Director and other senior officials in organizations (Denis and Denis, 1995). TM provides financial, material, and human resources for successful accomplishment of tasks. For successful delivery of projects, sufficient support is almost always required from TM (Young and Poon, 2013). TM possesses essential leadership and managerial skills to lead and support the projects (Bryde, 2008). Cost and time delays are seen often in projects (Ibbs *et al.*, 2001). Decisions made by TM and/or project managers early in projects have the largest potential for an overall impact on the success or failure of a project (Wright *et al.*, 2014b).

TM involvement is significantly important in achieving project objectives. Cost and schedule overruns are often caused due to lack of support from TM and poor project management practices (Wright *et al.*, 2014a). The completion of a project within the approved budget is ensured by TM through effective project cost management (Kwak and Ibbs, 2002). Cost management is one of the most important determinants of project management success which improves project performance. The costs of future failures can be examined from information gathered during the project execution rather than using average values from past projects (Cui *et al.*, 2004). There is a direct relation between cost, duration, quality, and customer satisfaction (Bayraktar and Hastak, 2009). Thus, the degree of project success should be assessed in terms of time, cost, quality, and scope to determine how a project is successfully implemented (Chung *et al.*, 2009).

Identification of the most critical success factors remains the focus of this research. Pinto and Slevin (1987) conceptualized TMS as a critical success factor that adopts a systematic process of risk management for managing risks in projects (Yoon *et al.*, 2014).

In project management, TMS is a critical factor that adversely affects implementation of projects in an organization (Ziemba and Obłąk, 2013). According to Belassi and Tukel (1996) and Young and Jordan (2008), TMS is ranked among the highest critical factors and is often ranked as the most critical success factor for project success. Critical success factors are most effective when a top-down approach is used in projects. The top-down approach enables the TM to focus on the strategic direction and investment of the organization (Freund, 1988). For ensuring project success, identification of high risk indicators and/or development of mitigation strategies developed by TM significantly minimize the risks involved in projects (Fernandez-Dengo *et al.*, 2012). TMS has been identified as a critical success factor in a number of studies, while a few dominant studies aligned with the focus of research are listed in Table I.

Today, change is a major challenge in projects' environment (Kandil *et al.*, 2014). The significance of TMS has strongly been recognized in project management and change management theories (McComb *et al.*, 2008; Rodgers *et al.*, 1993) which suggests that TM involvement in the project definition and team composition is not a new innovation. March and Simon (1958) suggested that attention or support of senior management is limited in organizations in accordance with the bounded rationality theory. Zwikael (2008) suggested that support and involvement of top management significantly enhances the likelihood of project success. O'Brochta (2008) concluded that TM enhances and complements the relationship with the stakeholders, materialized by the project management. The project management success lies within three distinct authorities: first one is the project manager; second one is the line manager; and the third one is the TM (Kerzner, 2006). TM involves middle management through supportive actions (Trakman, 2010) and best practices to support the project managers. Projects are indirectly influenced by TM associated with political sources who provide guidance and support to the project managers (Kerzner, 2006).

Author (year)	Focus of study
Martin (1982)	Critical success factors of chief MIS/DP executives
Cleland and King (1983)	Systems analysis and project management
Burgelman (1983)	Corporate strategic policy
Lock (1984)	Project management
Pinto and Slevin (1988)	Critical success factors across the project life cycle
Pinto and Slevin (1989)	Critical success factors in R&D projects
Ancona and Caldwell (1992)	External activity and organizational performance in teams
Thite (1999)	Critical success factor in IT project management
Thite (2000)	Leadership styles in information technology projects
Turner and Müller (2005)	Leadership style as success factor in projects
Hayvari (2006)	Project management effectiveness in organizations
Swink and Pandejpong (2006)	NPD project efficiency and performance tradeoffs
Müller and Turner (2007)	Influence of project managers on project success criteria and project success by type of project
Khang and Moe (2008)	Success criteria and factors for international development projects
Humaidi *et al.* (2010)	Factors influencing project
Morris (2013)	Project management in a knowledge perspective
Kuettner *et al.* (2013)	Change factors in enterprise
Dubiel and Ernst (2013)	Success factors in R&D emerging markets
Dwivedi *et al.* (2013)	IT project failures
Munkelt and Völker (2013)	Selecting, implementing and sustainably operating ERP systems
Andrew *et al.* (2013)	Corporate entrepreneurship
Abdollahzadehgan *et al.* (2013)	Critical success factors for adopting cloud computing

Table I. Summary of literature on top management support as a critical success factor

Pinto and Slevin (1987) operationalized the following statements for the measurement of single-dimensional TMS in the context of project success: "Top management understands the amount of resources required to implement the project"; "Top management will support me in a crises"; "Top management has issued their support of the project, in writing, to all managers and organizational members affected by the project"; "I have the confidence of upper management"; "I agree with upper management on the degree of my authority and responsibility for the project"; "Top management provided regular feedback concerning the progress of the project"; "Top management has granted me the necessary authority and supported my decisions concerning the projects"; "Top management shared the responsibility for ensuring the project success"; "Top management was responsive to my requests for additional resources, if the need arises"; and "Top management recognizes the negative consequences of an unsuccessful implementation."

Yap *et al.* (1992) developed six statements to measure single-dimensional TMS: "Top management level of support"; "Top management presence in project meetings"; "Top management involvement in information requirements analysis"; "Top management involvement in reviewing the consultant's recommendations"; "Top management involvement in decision-making"; and "Top management involvement in project monitoring." Pinto and Slevin (1987) and Yap *et al.* (1992) used different statements to measure single-dimensional TMS, based on various aspects associated with the concept, which are not enough to measure multiple dimensions of TMS. From these measurement items, a few statements can be used to measure the dimensions of providing resources and authority, but the dimensions of expertise, power, and structural arrangements cannot be measured by using these existing measurement statements. A large number of studies used various statements to measure TMS as a single-dimensional construct, which have been found in 41 articles based on an extensive literature review. A summary of year-wise articles measuring single-dimensional TMS is given in Table II.

3. Instrument development process

This study aims to develop and validate an instrument for the measurement of multidimensional TMS. In this instrument developing and validating process, five dimensions of TMS were adopted from Boonstra (2013) which were identified on the basis of

Year	Number of articles
1987	1
1988	1
1992	3
1996	1
1998	1
1999	2
2000	2
2001	1
2003	5
2004	3
2006	1
2008	1
2009	3
2010	2
2012	4
2013	9
2014	1
Total	41

Table II. Summary of articles on single dimensional top management support in-depth analyses of five different organizational cases. This study operationalized following five dimensions of TMS: provide resources; structural arrangements; communication; expertise; and power, during the instrument development process. To develop a reliable measurement scale for multiple dimensions of TMS, creation and sorting of items were undertaken in the first step. The purpose of item creation was to check the content validity for the selection of right items for each dimension and item sorting was to ensure the construct validity in terms of convergence and divergence of items.

3.1 Multidimensional framework

For the last three decades, little attention has been given to the development and validation of TMS as a multidimensional construct but as a single-dimensional construct it has largely been explored (see Table II). Boonstra (2013) developed a framework to determine the likelihood of different levels of support, including partial- or low-level support, and further recommended operationalization of a framework to identify potential research gaps in future studies. The availability of support from the senior management is perceived as a valuable aspect of the framework, depending on various factors due to scarce resources. Various types of support given by TM are graphically presented in Figure 1.

3.1.1 Provide resources. "Provide resources" is an important dimension of TMS where adequate human, financial, and material resources are provided for projects. The shortage of adequate resources is a serious constraint in projects. Sufficient resources are required for successful implementation of the project, instituting organizational change, achieving business success, an adaptation of a new system, and encouraging environment to the stakeholders. The performance of projects might be influenced by risk factors associated with resources during the project life cycle (Hastak and Baim, 2001).

3.1.2 Structural arrangements. For achieving project objectives, TM establishes appropriate procedures, processes, and structures for projects. TM institutes system adaptation and technological advancement for improving organizational efficacy. To strengthen the stakeholder's support and implement organizational change, TM establishes an effective controlling mechanism. Besides TMS, technologies are also considered important for successful delivery of the project, especially in the perspective of

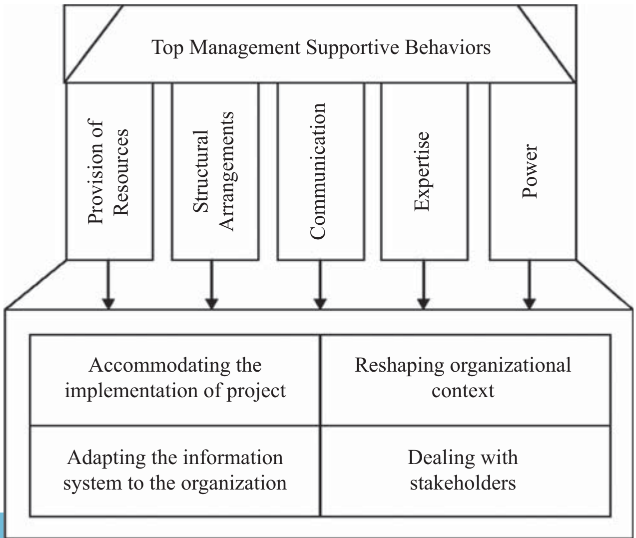

Figure 1. Top management support multidimensional framework

customer satisfaction (Wright *et al.*, 2014b). To make efficient and effective structural arrangements, unnecessary processes and redundant information need to be eliminated (Barriga *et al.*, 2005).

3.1.3 Communication. In projects, communication ensures timely and appropriate creation, collection, dissemination, storage, and disposition of project information. Communication is one of the most critical determinants of project success in organizations. Open and clear communication is required for successful accomplishment of projects (Kwak and Ibbs, 2002). For selling the project to the rest of the organization, TM collaborates with different cluster of stakeholders. TM establishes communication channels to motivate the project team and support project activities. TM initiates potential improvements in the system and their implications in the organization.

3.1.4 Expertise. Expertise in relevant field is equally important for the top managers, middle managers, and project managers. The dimension of expertise focuses on TM knowledge and skills in the field of project management. TM recognizes the implications and changes related to project implementation. TM creates awareness about the interest and power of project stakeholders.

3.1.5 Authority. Authority or power is considered important for the organizations and projects as it enables the individual to perform duties efficiently. TM possesses power and uses it to support the project activities and look after the team members during crises. TM uses its authority to identify the requirements, roles and responsibilities of project stakeholders, and facilitate the system changes (Boonstra, 2013).

3.2 Item creation

To develop a new scale for multidimensional TMS, items were identified at this stage to create a pool of items for each dimension where most of the items were based on the framework of Boonstra (2013). In order to follow the similar patterns of scales used in earlier research, a five-point Likert scale was tended in this study (ranging from "not at all" to "frequently (if not always)." Finally, a pool of items for dimensions of TMS was created from Boonstra's (2013) framework and new items were added, following a rigorous re-evaluation process. Further, confusing or redundant items were rephrased or eliminated.

3.3 Item sorting

The purpose of item sorting was to measure the reliability of the items for each dimension of the construct and the validity of the construct by ensuring coverage of the domain. First, the domain coverage with the support of a panel of two judges was assessed. For this purpose, the Q-sort procedure was applied to sort each item under the relevant dimensions of TMS. To ensure the convergence and divergence of items (construct validity), the degree of "correct" placement of items within different categories was indicated by the Q-sort technique. For both sorting rounds, a different panel of judges from academia and industry was involved. Second, the reliability was ensured on the basis of results from two rounds of the Q-sort technique. At this stage, the reliability and validity were analyzed primarily through qualitative techniques rather than strictly based on quantitative techniques (Straub *et al.*, 2004; Moore and Benbasat, 1991). Finally, the items were reduced to at least five items based on overall findings during the selection process, which resulted in a pool of 26 items for five dimensions.

4. Instrument testing process

The questionnaire was primarily developed in English containing 10 demographic questions, 26 TMS questions developed by the authors, and 25 project success questions adapted from the study of Shenhar and Dvir (2007).

4.1 Pre-test

Prior to the pilot study, a pre-test was conducted over 12 convenient cases to ensure appropriateness of the question's content, the wording, the format and layout, the sequence, the instructions, the question difficulty level, and the range of scale (five-point Likert). Based on responses from the panel of experts, the final version of the questionnaire was refined with a little context-specific adjustment.

4.2 Pilot study

A total of 54 responses were collected from project managers working in the construction industry through an online survey in October 2013. To assess the initial validity of measurement scales, a pilot study was conducted with a sample of $n = 54$, where all 26 items were used in the factor analysis. Exploratory factor analysis (EFA) with a varimax rotation method yielded a five-factor model based on an eigenvalue with a cutoff value of 1. The cumulative variance of 49.87 percent was explained by the refined model of pilot study. The items were loaded on five factors from sub-dimensions of "provide resources, structural arrangements, communication, expertise, and power." The Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were used to evaluate the appropriateness of the factor analysis. The overall measure of sampling adequacy was ensured through KMO Measure of Sampling Adequacy (0.832), and Bartlett's Test of Sphericity (1,091.429, df = 325, significant at $p = 0.000$) which ensured the validity of the instrument and the significance of the TMS dimensions.

In a pilot study, the lowest Cronbach's α value was 0.817 for provision of resources, well above to satisfy the threshold of 0.70. The total correlation of 0.59 exceeded the threshold of 0.40 as recommended by Straub *et al.* (2004). Following Hair *et al.* (2010), this study opted to delete the items not loading on a particular factor (< 0.40) or have cross-loading during the EFA. In a pilot study, factor loading ranged 0.453-0.891. There was no item with factor loadings less than 0.40; in this way, no item was deleted during analysis and all items were retained for the final study. The detail of KMO measure, factor loadings, Barlett's test, and df value of each dimension/sub-construct of TMS is given in Table AI.

5. Methods for main study

5.1 Population and sampling

The population chosen for the current study was the members of the PMI community who were accessed through the PMI website in October 2013. A total of 1,500 PMI community members with their last name starting from a to d and having their e-mail addresses with the profile on PMI website were considered to be contacted for data collection. In accordance with the population and sample formula of Krejcie and Morgan (1970), a sample of 302 respondents is sufficient for a population of 1,500. Therefore, this study targeted a sample size of 300 to develop and validate the instrument, which is similar to previous research studies on the development and validation of a reliable instrument. In total, 208 responses from the PMI community were received which shows 69 percent response rate of the targeted sample size. In line with Hair *et al.* (2010), a sample of 208 responses (69 percent) was sufficient to test and validate the dimensions of TMS which is also in line with earlier studies on tool development (Akter *et al.*, 2013; Amundsen and Martinsen, 2013; Schmiedel *et al.*, 2014).

5.2 Participants and procedure

In the absence of a sector-wise list of the PMI community members to draw a random sampling, the members were contacted via e-mail for participation in the circulated survey. Only PMI community members having their e-mail addresses with their profile on the PMI website were contacted. The four sectors (government, public, for profit, and not for profit) were obtained from demographic questions, as most of the participants working in different organizations belong to these sectors. An online survey was circulated among PMI the community members starting from October 31, 2013 to December 12, 2013. In the first instance, 25 percent response was received. To collect data from the PMI community members, a three-wave follow-up approach was adopted. Subsequently, soft reminders were sent to the participants after a one-week interval for participation in the survey. Following the three-wave follow-up approach, a total of 208 responses were received from the PMI community members.

5.3 Instrument measures

The measurement items developed and tested through the instrument development process were used to measure multidimensional TMS. The details regarding operationalization of measures are discussed as under.

5.3.1 Measures of TMS. This study adopted the following five dimensions to operationalize TMS: "provide resources" with five measurement items; "structural arrangements" with five measurement items; "communication" with six measurement items; "expertise" with five measurement items; and "power" with five measurement items. To measure all the dimensions of support provided by TM, a five-point Likert scale was used: "1 = Not at all"; "2 = Once in a While"; "3 = Sometime"; "4 = Fairly Often"; and "5 = Frequently, if not always." The individual items are listed in each of the following sub-sections.

5.3.1.1 Provide resources. Measurement items: TM provided sufficient resources to complete the project successfully; TM provided sufficient resources to the project team in crises; TM ensured availability of sufficient resources to provide a supportive stakeholder environment for the accomplishment of the project; TM provided sufficient resources to support system adaptations in the organization; and TM provided adequate resources for effective system implementation to institute organizational change.

5.3.1.2 Structural arrangements. Measurement items: TM developed project strategies and structures to adapt to the system in the organization; TM ensured implementation of appropriate project structures to accomplish the project objectives; TM strengthened the stakeholder support in the organization; TM adopted appropriate structures, processes, and controlling procedures to implement organizational change; and TM focused on strategic and structural planning to improve the organizational efficiency and market value.

5.3.1.3 Communication. Measurement items: TM regularly communicated with the project team members to ensure successful project completion; TM tailored communication to promote the significance of project in the organization; TM often deliberated project implications relating to system and organizational change; TM frequently communicated project implications to different clusters of project stakeholders; TM encouraged frequent communication to discuss potential system and organizational changes with various groups of project stakeholders; and TM established an effective communication strategy to enhance project and organizational efficiency.

5.3.1.4 Expertise. Measurement items: TM possessed relevant experience and expertise in project management; TM recognized the importance of project implications, system implementation and organizational change; TM recognized the necessity of system adaptation in the organization; TM recognized the interest and power of project stakeholders; and TM encouraged the project team to enhance project efficiency and organizational performance.

5.3.1.5 Power. Measurement items: TM used its power to implement critical system changes in an organization; TM exercised its authority to support the team members during implementation of project activities; TM often used its power to implement the best project management practices in the organization; TM exercised its authority to define unambiguous roles and responsibilities of project stakeholders; and TM ensured effective system implementation to institute organizational change.

5.3.2 Measures of project success. Following five dimensions operationalized by Shenhar and Dvir (2007) were used to measure project success: project efficiency, impact on customer, impact on team, organizational and business success, and preparing for the future. Thus, Shenhar and Dvir's (2007) "Project Success Assessment Questionnaire" was adopted to measure project success dimensions on a five-point Likert scale (1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; and 5 = Strongly Agree).

5.3.3 Research model and research hypotheses. Following tool development procedures from earlier studies (Akter *et al.*, 2013; Amundsen and Martinsen, 2013; Schmiedel *et al.*, 2014), the measures of TMS were operationalized and validated by testing a set of research hypotheses as presented in the research model (see Figure 2).

5.4 Data analysis

5.4.1 Descriptive statistics. The demographic profile of the respondents represents a diverse cross-section of the population, both in the pilot and main study. The respondents ($n = 208$) of the main study were 78 percent male and 22 percent female, belonging to 47 countries. The respondents have experience of managing projects from less than three years to over 15 years, where 2.4 percent respondents were with less than three years of experience, 13.5 percent respondents were with three to five years, 26 percent respondents were with five to ten years, 24 percent respondents were with 10-15 years, and 34 percent respondents having more than 15 years of experience. Respondents were presently working in the positions of TM (15 percent), middle management (30 percent), lower management (6 percent), project managers (36.5 percent), consultant (2 percent), entrepreneur (4 percent), and others (6 percent). The respondent's qualification level ranged from High School/Associate diploma to PhD Degree (High School = 1 percent, Associate = 1 percent, Diploma = 2 percent, Bachelor degree = 40 percent, Master degree = 48 percent, MS/MPhil = 5 percent, and PhD = 5 percent). The majority of respondents (75.5 percent) were certified PMPs and 24.5 percent were non-certified professionals.

5.4.2 Reliability and validity. The reliability values of TMS dimensions ranged from 0.882 to 0.920 ($n = 208$), which are considered excellent to establish the refined model. Cronbach's α exceeded the threshold of 0.70 for the extracted five-factor model. The minimum value for Cronbach's α was 0.882 for expertise, well above the threshold to satisfy the minimum

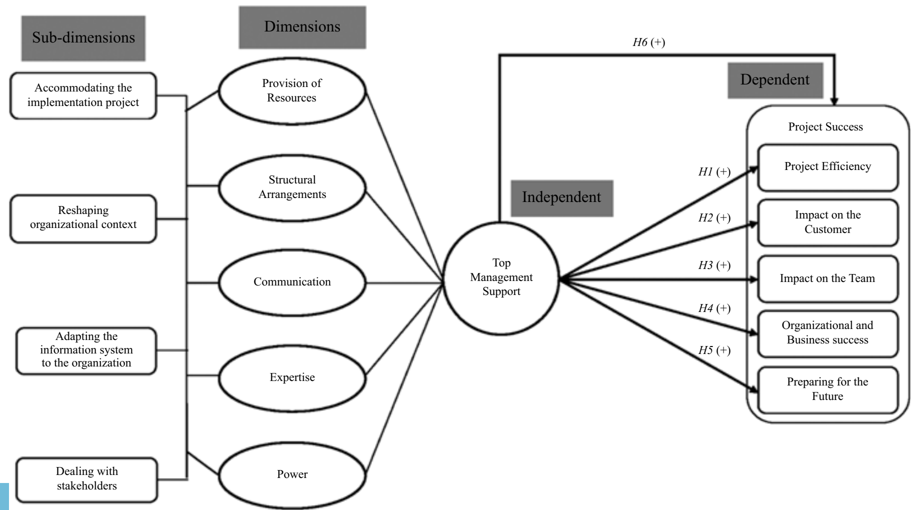

Figure 2.
Research model and hypotheses

requirement of 0.70. The total correlation for the minimum corrected item was 0.70, which was in line with the recommendations of Straub *et al.* (2004). In a nutshell, the initial instrument for TMS was refined to eliminate complexity and ambiguity.

5.4.2.1 EFA. To perform the EFA, principal component analysis employing a varimax rotation method was used as an extraction technique due to the proposed multi-faceted nature of TMS (Conway and Huffcutt, 2003). The factors were expected to correlate, therefore, varimax rotation was chosen. This study employed the following methods to retain the number of factors:scree test (Cattell, 1966); the eigenvalue-greater-than-one rule (Kaiser, 1960); approximate simple structure (McDonald, 1985); parallel analysis (Horn, 1965); and obtained factors interpretability (Gorsuch, 1983). A five-factor model as the most preferred solution was clearly suggested by these methods.

All 26 items of TMS were retained for running the factor analysis. The results of EFA yielded that measurement items of TMS were loaded on five factors based on eigenvalue with a cutoff value of 1. The five-factor model of TMS explained a total variance of 71.23 percent. The factor loadings ranged from 0.543 to 0.891 for all items of TMS, which satisfy the cutoff value of 0.50, as recommended by Hair *et al.* (2010). The values of communalities for all factors of TMS were well above 0.50 as suggested by Hair *et al.* (2010). KMO (0.964) and Bartlett's test yielded significant results (4,781.805, df = 325, $p = 0.000$). A summary of the EFA for each dimension of TMS is presented in Table III.

5.4.2.2 Confirmatory factor analysis (CFA). The pilot study provided little evidence of convergent, discriminant, nomological, and predictive validity for item validation and factor

Variable	Item code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Provide resource	POR1	0.755				
	POR2	0.836				
	POR3	0.631				
	POR4	0.671				
	POR5	0.792				
Structural arrangements	STA1		0.574			
	STA2		0.747			
	STA3		0.891			
	STA4		0.552			
	STA5		0.611			
Expertise	EXP1			0.767		
	EXP2			0.583		
	EXP3			0.543		
	EXP4			0.692		
	EXP5			0.630		
Power	PWR1				0.738	
	PWR2				0.839	
	PWR3				0.850	
	PWR4				0.615	
	PWR5				0.604	
Communication	COM1					
	COM2					0.565
	COM3					0.598
	COM4					0.631
	COM5					0.574
	COM6					0.553
						0.687
Eigenvalue		12.97	1.81	1.47	1.19	1.08
Cumulative % of variance		49.87	56.82	62.48	67.07	71.23

Table III.
Summary of explanatory factor analysis

structure of the TMS scale. CFA was performed to rigorously assess the refined instrument and cross-validation of factor loadings ($n = 208$). The results of the CFA indicated that loadings of all five dimensions of TMS were well above the cutoff value of 0.50, which are given in Table IV.

5.4.3 Correlation analysis. Correlation analysis was performed to determine the strong or weak association among all the dimensions of TMS and their relationship with project success. A significant relationship among all dimensions of TMS was found ($p < 0.001$). "Provide resources" has a strong positive relationship with the dimensions of "communication" ($r = 0.743$; $p < 0.001$), "expertise" ($r = 0.723$; $p < 0.001$), "structural arrangements" ($r = 0.799$; $p < 0.001$), and "power" ($r = 0.700$, $p < 0.001$). The dimension of "structural arrangements" has a strong positive relationship with "expertise" ($r = 0.790$; $p < 0.001$), "communication" ($r = 0.827$; $p < 0.001$), and "power" ($r = 0.798$; $p < 0.001$). The "communication" dimension has a perfect positive relationship with "power" ($r = 0.840$; $p < 0.001$) and "expertise" ($r = 0.852$; $p < 0.001$). Finally, "expertise" dimension has a perfect positive relationship with "power" ($r = 0.843$; $p < 0.001$). In addition, a significant positive relationship was found between TMS and project success dimensions, i.e. "project efficiency" ($r = 0.478$; $p < 0.001$), "impact on the customer" ($r = 0.343$; $p < 0.001$), "impact on the team" ($r = 0.491$; $p < 0.001$), "organizational and business success" ($r = 0.355$; $p < 0.001$), and "preparing for the future" ($r = 0.351$; $p < 0.001$).

5.4.4 Multicollinearity diagnostic. The conditions of multicollinearity were satisfied due to high correlation among the dimensions of TMS through tolerance and variance inflation factor (VIF) as suggested by Hair *et al.* (2010). A summary of the multicollinearity analysis is presented in Table V.

Item	Standardized loading	Squared multiple correlations (R^2)	CR
PWR2	0.912	0.831	5.716
EXP2	0.901	0.813	5.213
STA2	0.891	0.794	6.434
STA3	0.874	0.756	7.023
POR2	0.859	0.737	10.173
POR1	0.856	0.733	10.280
EXP3	0.845	0.713	7.183
PWR3	0.843	0.710	7.941
POR3	0.838	0.702	10.440
COM5	0.836	0.579	7.253
POR4	0.833	0.694	10.173
COM4	0.826	0.627	7.496
STA4	0.814	0.663	8.189
COM6	0.814	0.648	7.617
COM1	0.805	0.648	8.148
PWR1	0.800	0.641	8.579
PWR4	0.794	0.631	8.477
PWR5	0.793	0.629	8.488
COM3	0.792	0.683	7.983
POR5	0.780	0.608	10.173
STA1	0.778	0.605	8.737
COM2	0.761	0.700	8.679
EXP1	0.738	0.545	8.828
STA5	0.734	0.539	8.918
EXP4	0.694	0.482	9.066
EXP5	0.674	0.455	9.172

Table IV. Summary of confirmatory factor analysis

6. Findings and discussion

In research, the primary objective of scientific exploration is the development and validation of a reliable scale. Therefore, the objective of this study was to develop and validate an instrument for the measurement of multidimensional TMS. To make a significant contribution to methods, practice, and theory, this study developed and validated a "Top Management Support Questionnaire (TMSQ)." An initial data screening was performed and no missing values were found due to an online survey with items having the option of "answer required" as a mandatory field. In line with the study of Muthen and Kaplan (1985), the values of Kurtosis were within the threshold value of ± 1.

CFA performed with 26 items indicated a good fit of the model to the data. The values of coefficient α ranged from 0.882 to 0.920 and standard deviation ranged from 0.880 to 0.997 indicating moderate variability in the ratings. The cutoff ranges of fit indices were within the recommended levels with a highly scored value of χ^2 (CMIN/df = 1.730), RMR = 0.023 and RMSEA = 0.059. The mean values of TMS dimension ranged from 3.0221 to 3.4106 indicating that general differences exist in the five dimensions. The factor loadings were well above than the cutoff value of 0.50 for each item of TMS.

6.1 Calibration and cross-validation

We performed calibration and cross-validation through EFA and CFA, respectively. The full wording of 26 items in both the studies remains intact. However, mean and standard deviation values for all items in both studies are presented in Table VI.

6.2 Independent t-tests

To test the differences of means between the pilot study and main study, independent *t*-tests were performed. In demographic variables (i.e. gender, age group, education, position, sector, etc.), no significant differences were found. Likewise, no significant differences were found among the 26 items. Bartlett (1950) test of Sphericity and the KMO measure of sampling adequacy (Kaiser, 1974) ensured the factorability of the EFA correlation matrix. Both studies, correlation matrix are available on request from the corresponding author.

6.3 Model fit

SEM was used to load five dimensions of TMS on a first-factor model. The path diagrams of each dimension produced through the CFA indicated that the factor loadings (standardized regression weights) are significantly above than the cutoff value of 0.50 for each of the indicators. The values of squared multiple correlations (R^2) provided information as to how much variance the common factors account for the observed variables.

Provide resources: In agreement with Lisak and Erez (2015), the dimension of "provide resources" indicated strong standardized loading (0.833 to 0.859) for the first four factors and only item 5 has moderate to strong standardized loading (0.780). The value of squared multiple correlations (R^2) for five factors of "provide resources" ranged from

Table V. Summary of multicollinearity analysis

Variable	Tolerance (min > 0.10)	VIF (max < 10)
Top management support		
Provide resources	0.339	2.947
Structural arrangement	0.222	4.512
Communication	0.219	4.569
Expertise	0.213	4.684
Power	0.260	3.851

Note: VIF, variance inflation factor

Item code	Pilot study		Main study	
	Mean	SD	Mean	SD
POR1	3.852	0.998	3.654	0.995
POR2	3.074	0.929	3.197	1.047
POR3	3.241	1.008	3.240	1.072
POR4	3.519	1.041	3.414	1.100
POR5	3.593	1.158	3.548	1.141
STA1	3.315	1.226	3.250	1.206
STA2	3.407	0.962	3.188	1.191
STA3	3.259	0.975	3.096	1.108
STA4	3.259	1.013	3.207	1.112
STA5	3.315	1.195	3.274	1.111
COM1	3.556	1.003	3.269	1.157
COM2	3.093	1.154	3.067	1.214
COM3	3.296	0.924	3.130	1.166
COM4	3.444	1.003	3.101	1.148
COM5	3.185	0.953	3.111	1.100
COM6	3.167	1.077	3.120	1.129
EXP1	3.037	1.288	2.894	1.270
EXP2	3.167	1.023	3.082	1.128
EXP3	3.204	1.105	3.101	1.157
EXP4	3.611	1.036	3.428	1.123
EXP5	3.185	1.047	3.091	1.170
PWR1	3.167	1.240	3.120	1.236
PWR2	3.111	0.984	3.072	1.054
PWR3	3.352	0.974	3.183	1.070
PWR4	2.963	1.197	2.875	1.152
PWR5	3.037	1.258	2.861	1.234

Table VI. Summary of calibration and cross-validation analysis

0.608 to 0.737. The initial value of χ^2 test was 115.029 with 7 degree of freedom and 16.433 value of CMIN/DF. Five items were used to measure provide resources (see Figure 3). The fit indices were beyond the cutoff ranges with a highly scored χ^2 value of 115.029 ($df = 7$, $p = 0.000$), CMIN/DF of 16.433, and RMSEA of 0.273.

To improve the fit, the modification indices indicated different ways. In accordance with the modification index, a covariance with a double-headed arrow was drawn between POR2 and POR3. The value of RMSEA reduced to 0.052 ($df = 4$, $p = 0.185$) which is very close to

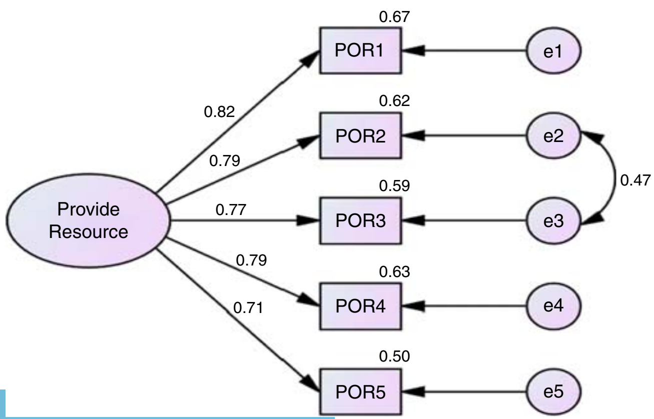

Figure 3. Model fit – provide resources

the 0.05 cutoff value. The final value of χ^2 test reduced to 6.197 which evaluated with 4 degree of freedom and value of CMIN/DF reduced to 1.549 that is quite significant and below the threshold of 5.0. The model fit for provide resources appears quite good. The analysis suggested that the model is a good fit to the data (see Figure 3).

Structural arrangements: The factor loadings for "structural arrangement" were quite significant and well above than the cutoff value of 0.50 for each factor. The second, third, and fourth factors of structural arrangements have a strong standardized loading (0.814 to 0.891) and first and fifth items have moderate to strong standardized loading (0.734 to 0.778). The values of squared multiple correlations (R^2) ranged from 0.539 to 0.794. Five items were used to measure structural arrangements. The initial value of χ^2 test was 14.545, which evaluated with 5 degree of freedom and the value of CMIN/DF was 2.909. The fit indices were beyond the cutoff ranges with a highly scored χ^2 value of 115.029 (df = 7, $p = 0.012$), CMIN/DF of 2.909, and RMSEA of 0.096. To improve the fit, a number of ways were suggested by the modification indices.

According to the modification index, by adding a covariance with double-headed arrow between the STA4 and STA5, the value of RMSEA was reduced to 0.049 (df = 4, $p = 0.185$) which is below the 0.05 cutoff value. The final value of χ^2 test was reduced to 5.972 which evaluated with 4 degree of freedom and value of CMIN/DF reduced to 1.493 that is quite significant and below the threshold of 5.0. The analysis suggested that the model is a good fit to the data (see Figure 4).

Communication: The path diagram displayed the factor loadings of "communication" which were significantly above than the cutoff value of 0.50 for each of the indicators. The first, fourth, fifth, and sixth factors of communication have moderate standardized loadings (0.761 to 0.792) and items second and third have moderate to strong standardized loadings (0.805 to 0.836). The value of squared multiple correlations (R^2) ranged from 0.579 to 0.700. The initial value of χ^2 test was 35.282 which evaluated with 9 degree of freedom and the value of CMIN/DF was 3.920. Six items were used to measure communication. The fit indices were beyond the cutoff ranges with a highly scored value of χ^2 of 35.282 (df = 9, $p = 0.000$), CMIN/DF of 3.920, and RMSEA of 0.119.

To improve the fit, the modification indices of analysis indicated different ways. According to the modification index, by adding covariance with double-headed arrows between the COM2 and COM5, between COM3 and COM4, and between COM5 and COM6, the value of RMSEA reduced to 0.052 (df = 6, $p = 0.154$) which is very close to the 0.05 cutoff value. The final value of χ^2 test reduced to 9.372 which evaluated with 6 degree of freedom and value of CMIN/DF

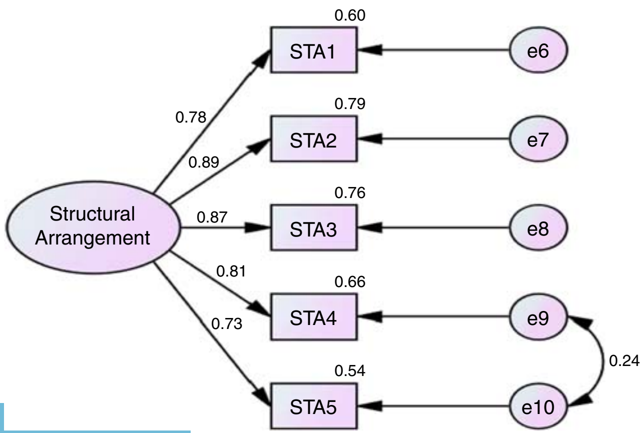

Figure 4.
Model fit – structural arrangements

reduced to 1.562 that was quite significant and below the threshold of 5.0. The validity of the model with good model fit statistics was confirmed from findings (see Figure 5).

Expertise: The standardized regression weights for indicators of "expertise" were well above than the cutoff value of 0.50. The second and third factors of expertise have strong standardized loadings (0.845 to 0.901) and first, fourth, and fifth items have moderate to strong standardized loadings (0.674 to 0.738). The value of squared multiple correlations (R^2) ranged from 0.482 to 0.813. The dimension of expertise was measured by using five items. The initial value of χ^2 test was 10.771 evaluated with 5 degree of freedom and the value of CMIN/DF was 2.154. The fit indices were beyond the cutoff ranges with a highly scored value of χ^2 of 10.771 (df = 5, $p = 0.000$), CMIN/DF of 2.154, and RMSEA of 0.075. To improve the fit, the modification indices indicated different ways.

As per the modification indices by adding a covariance with a double-headed arrow added between the EXP4 and EXP5, the value of RMSEA reduced to 0.049 (df = 4, $p = 0.200$) which is below the 0.05 cutoff value. The final value of χ^2 test reduced to 5.986 evaluated with 4 degree of freedom and value of CMIN/DF reduced to 1.496 that was quite significant and below the threshold of 5.0. The validity of the model with good model fit statistics was confirmed (see Figure 6).

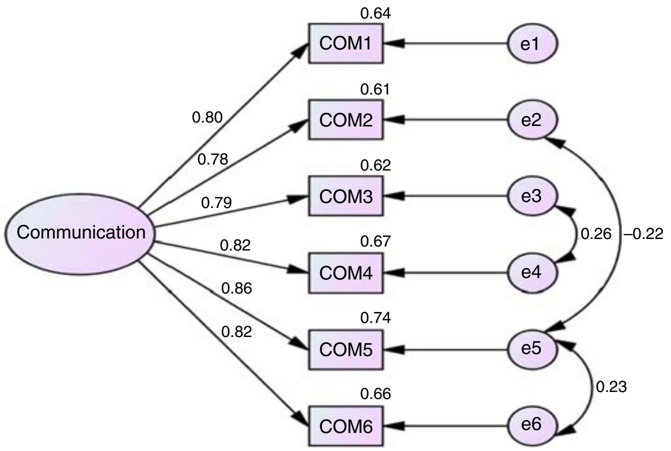

Figure 5.
Model fit – communication

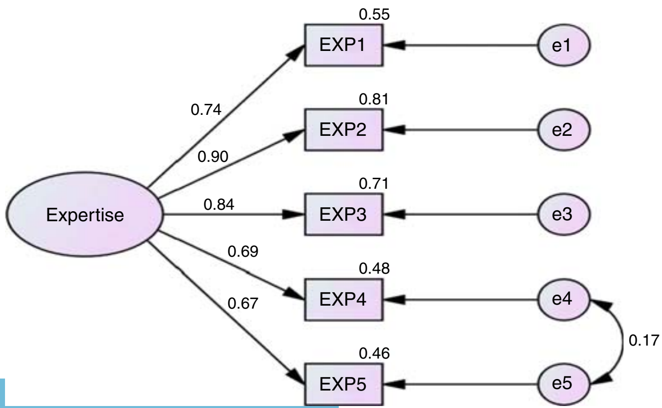

Figure 6.
Model fit – expertise

Power: The analysis indicated significant factor loadings for each indicator of the "power" which were well above than the cutoff value of 0.50. All the factors of power have strong standardized loadings ranging from 0.793 to 0.912. The value of squared multiple correlations (R^2) ranged from 0.629 to 0.831. Five items were used to measure power. The initial value of χ^2 test was 12.453 evaluated with 5 degree of freedom and the value of CMIN/DF was 2.491.

The fit indices were beyond the cutoff ranges with a highly scored χ^2 value of 12.453 (df = 5, $p = 0.029$), CMIN/DF of 2.491, and RMSEA of 0.085. The ways to improve the fit of the data were indicated by modification indices. According to the modification index, by adding a covariance with double-headed arrow between the PWR4 and PWR5, the value of RMSEA reduced to 0.027 (df = 4, $p = 0.332$) which was well below to the 0.05 cutoff value. The final value of χ^2 test reduced to 4.593 evaluated with 4 degree of freedom and value of CMIN/DF reduced to 1.148 that was quite significant and below the threshold of 5.0. The analysis suggested that model is a good fit to the data (see Figure 7).

TMS and Project Success: Following Lisak and Erez (2015), a two-factor model was applied to confirm the factor structure of TMS and project success. Before estimating this model, a first-order factor model of TMS including five dimensions was designed first. All the items significantly loaded on corresponding factors of TMS ($P < 0.001$) and fit indices provided evidence of a good fit (χ^2(CMIN/DF) = 1.805, $p < 0.001$; Tucker Lewis Index = 0.944; Comparative Fit Index = 0.952; and Root Mean Square Error of Approximation (RMSEA) = 0.062), as suggested in the literature regarding higher than 0.90 for CFI and TLI, and lower than 0.07 for RMSEA (Browne *et al.*, 1993; Hu and Bentler, 1999). Similarly, all the items of project success significantly loaded on their corresponding factors ($P < 0.001$) and fit indices provided evidence of a good fit (χ^2(CMIN/DF) = 1.737, $p < 0.001$; Tucker Lewis Index = 0.912; Comparative Fit Index = 0.926; and RMSEA = 0.060), indicating higher than 0.90 for CFI and TLI, and lower than 0.07 for RMSEA. Summary of model fit along with threshold is presented in Table VII.

The overall model fit results for the two-factor model of TMS combined with project success were (χ^2(CMIN/DF) = 1.730, $p < 0.001$; Comparative Fit Index = 0.985; Tucker Lewis Index = 0.978; RMSEA = 0.059) in accordance with guidelines of Hair *et al.* (2010). Therefore, the study found support for a two-factor model structure. The overall model fit for the TMS and project success appears quite good after following the modification indices to improve the model with good fit data.

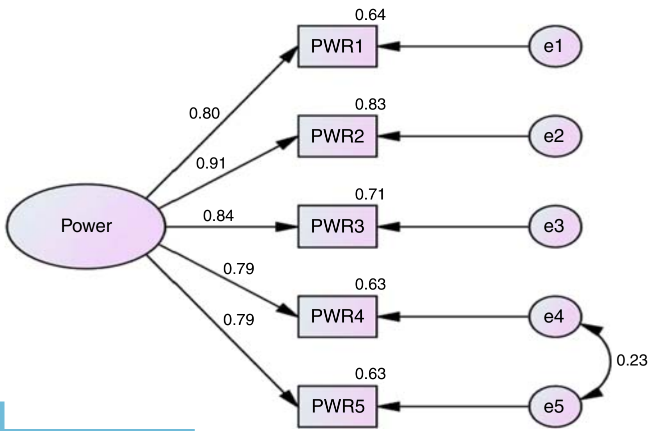

Figure 7.
Model fit – power

6.4 *Hypotheses testing*

To test the research hypotheses (see Figure 2), OLS method was used for regression analysis. In accordance with the guidelines of Hair *et al.* (2010), linearity, normality, homoscedasticity, and multicollinearity conditions were satisfied to perform regression analysis. The findings of the regression analysis indicated a positive and significant influence of TMS on project success. As evident from Table VIII, for *H1*, TMS explained 22.5 percent variance in project efficiency ($\beta = 0.478$, $p < 0.001$; $\Delta F = 61.027$, $p < 0.001$); for *H2*, TMS explained 11.3 percent variance in impact on the customer ($\beta = 0.343$, $p < 0.001$; $\Delta F = 27.494$, $p < 0.001$); for *H3*, TMS explained 23.7 percent variance in impact on the team ($\beta = 0.491$, $p < 0.001$; $\Delta F = 65.441$, $p < 0.001$); for *H4*, TMS explained 12.2 percent variance in organizational and business success ($\beta = 0.355$, $p < 0.001$; $\Delta F = 29.708$, $p < 0.001$); and for *H5*, TMS explained 11.9 percent variance in preparing for the future ($\beta = 0.351$, $p < 0.001$; $\Delta F = 28.858$, $p < 0.001$). In a nutshell, TMS has a significant and positive relationship with project success ($r = 0.517$, $p < 0.01$). For *H6*, regression analysis shows that TMS explained 26.4 percent variance in project success, as shown highly significant by ΔF-value of 75.187 ($p < 0.001$). The standardized β value was positive and highly significant ($\beta = 0.517$, $p < 0.001$). Thus, results substantiated the research hypotheses indicating that support from TM significantly influences on project success. Summary of hypotheses testing is presented in Table VIII.

6.5 *Implications for theory*

This study advances the literature of TMS by developing and validating a reliable multidimensional instrument for measurement of TMS with its five dimensions: provide resources; structural arrangements; communication; expertise; and power. This explanatory study examined the interrelation among the dimensions of TMS as guided by Boonstra (2013). Factor analysis provided adequate support for a theoretical meaningfulness of five-dimensional TMS, labeled as "TMSQ." The psychometric properties of TMSQ were consistent across both the pilot study and main study, to support the generalizability of

Dimension/Index Threshold	CMIN/DF < 5	RMSEA < 0.80	NFI > 0.80	TLI > 0.80	CFI > 0.80	RMR < 0.50	GFI > 0.80	AGFI > 0.80
Provide resources	1.549	0.052	0.990	0.991	0.996	0.021	0.988	0.955
Structural arrangement	1.493	0.049	0.992	0.993	0.997	0.018	0.989	0.958
Communication	2.115	0.073	0.983	0.980	0.991	0.027	0.976	0.929
Expertise	1.496	0.049	0.989	0.991	0.996	0.024	0.989	0.958
Power	1.148	0.027	0.994	0.998	0.999	0.016	0.991	0.968
Top management support	1.805	0.062	0.899	0.944	0.952	0.046	0.842	0.801
Project success	1.737	0.060	0.844	0.912	0.926	0.042	0.869	0.830
Overall model fit	1.730	0.059	0.965	0.978	0.985	0.023	0.949	0.912

Table VII. Summary of model fit indexes

Hypothesis	R	R^2	Adj R^2	F	Sig.	B	t	Sig.
H1	0.478	0.229	0.225	61.027	0.000	0.341	7.812	0.000
H2	0.343	0.118	0.113	27.494	0.000	0.227	5.243	0.000
H3	0.491	0.241	0.237	65.441	0.000	0.356	8.090	0.000
H4	0.355	0.126	0.122	29.708	0.000	0.264	5.451	0.000
H5	0.351	0.123	0.119	28.858	0.000	0.269	5.372	0.000
H6	0.517	0.267	0.264	75.187	0.000	0.291	8.671	0.000

Table VIII. Summary of hypotheses testing

TMSQ in a wider range of organizations and sectors. Thus, this study contributes to the research methods by developing and validating an instrument for multidimensional construct of TMS based on existing knowledge through a coherent and refined framework. The study advances the theory of project management and TMS through operationalization and validation of TMSQ with project success.

6.6 Implications for practice

This study provides numerous implications for organizations, TM, construction managers, and project managers. This study provides empirical evidences to extend theories of TMS by developing and validating a comprehensive model and testing its generalizability across the countries for accomplishing project's success. Findings substantiate that "provide resources, structural arrangements, communication, expertise, and power" should be practiced by TM, to significantly enhance the likelihood of project success. The study also provides compelling evidence that multiple dimensions of TMS may not be equal drivers of all dimensions of project success. Multi-dimensions of TMS should be taken into account by the practitioners during the implementation of projects and improving organizational performance across the industries. The quantitative results provide an opportunity for senior management and practitioners to develop policies and procedures for ensuring provision of apt support from TM during the project lifecycle.

6.7 Limitations and future directions

First, this study was conducted on TMS within the specific domain of the PMI community members belonging to 47 countries. Its replication at specific industry, sector, or country level would further improve the TMSQ instrument and increase the confidence in the research model. Second, the findings are confined to a single point of time as the study was limited to collecting data under a cross-sectional design. Thus, the model may represent the static nature of support. Therefore, to gain a deeper understanding of the nature of support provided and/or required from the TM, a longitudinal study may be useful to evaluate TM supportive behaviors over time. Third, the sample size of 208 from different management positions was enough to validate the instrument, but a larger sample with a specific group of management might produce more comprehensive and sophisticated results to substantiate the TMSQ instrument.

Fourth, "scale validation is as a continuous process" (Nunnally, 1978). Therefore, continued refinement and validation of this scale is suggested. Testing the discriminant validity of TMSQ could be a next fruitful step, to explore any ignored measures of TM supportive behaviors. Future research may explore the impact of complexity, nature and project type by using multidimensional TMS. Fifth, this study operationalized TMSQ with project success; however, TMSQ may be further operationalized with different variables, including organizational performance, organizational success, and project performance across the project life cycle. In addition, it is further suggested to identify unexplored dimensions of TMS by collecting data from senior management for qualitative and quantitative studies. Finally, this study employed OLS and SEM methods, future research may apply PLS path modeling for estimating hierarchical models with formative and reflective parameters.

7. Conclusion

This study presents a comprehensive scale development process to develop an instrument for measurement of multidimensional TMS and operationalize the TMSQ's instrument by examining the influence of TMS on project success. The outcome of this research is a TMSQ instrument to measure five dimensions of TMS with a high degree of reliability and validity.

The CFA suggested a model fit to the data for all dimensions of TMS and project success. Findings validated the multidimensionality of TMS construct and revealed a significant and positive correlation between all the dimensions of TMS. Results suggested that multidimensional TMS significantly influences on project success, especially, in terms of project efficiency and impact on the team. The study provides critical insights for the academicians, researchers, and practitioners on scale development and validation procedures for a multidimensional construct. It further provides opportunities to employ TMSQ in different types of projects, contexts, and cultures across the industry, sector and country levels.

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Further reading

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Appendix

Factor	KMO	Bartlett's test of sphericity	df	Item	Factor loading	Eigenvalue	Cumulative variation
Top management support	0.832	1,091.429	325				
Provision of resources	0.784	107.737	10	POR1	0.755	12.966	49.870
				POR2	0.836		
				POR3	0.631		
				POR4	0.671		
				POR5	0.792		
Structural arrangements	0.774	118.268	10	STA1	0.574	1.806	56.815
				STA2	0.747		
				STA3	0.891		
				STA4	0.552		
				STA5	0.611		
Communication	0.872	135.555	15	COM1	0.565	1.474	62.483
				COM2	0.598		
				COM3	0.631		
				COM4	0.474		
				COM5	0.453		
				COM6	0.687		
Expertise	0.819	119.246	10	EXP1	0.767	1.193	67.071
				EXP2	0.483		
				EXP3	0.543		
				EXP4	0.692		
				EXP5	0.630		
Power	0.860	168.987	10	PWR1	0.738	1.082	71.233
				PWR2	0.839		
				PWR3	0.850		
				PWR4	0.615		
				PWR5	0.604		

Table AI. Summary of validity analysis for pilot study

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