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Top Management Support Fuzzy Set Analysis Finding TMS the Most Important

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ABSTRACT

This paper builds on the work of Young and Jordan (2008) and Poon et al. (2011) to provide stronger empirical evidence that TMS is the most important factor for project success. It adds to the evidence that current practice emphasizing project methodologies may be misdirecting effort. The contribution of this research may be to provide enough evidence to influence top managers and practitioners to re-evaluate the conventional wisdom of the past 40-50 years. Researchers and practitioners, using the fuzzy-set analytical approach are introduced to a method to compare all their project experiences and determine conclusively the most important critical success factors for project success. There are significant implications for board, senior management and project management practice and academia.

Keywords

Top management support, project failure, critical success factor, fuzzy set analysis.

INTRODUCTION

Top management support (TMS) has long been recognised as being important for project success (Doll 1985; Garrity 1963; Lederer et al. 1988; Markus 1981; Rockart et al. 1984; Schmidt et al. 2001). More recently, in a study differentiating project success from project management success, TMS was shown to be the most important factor for project success (Young et al. 2008). The implication is that conventional approaches emphasising project methodologies, user involvement, high level planning and good project staff may be misdirecting effort. A further implication is that TMS through project governance may be the breakthrough that resolves the persistent issue of IT project failure.

These findings have informed the development of Australian Standards AS8015 and AS8106 (Corporate Governance of IT), the first of which has been adopted by the International Standards Organisation as ISO38500. The findings are also consistent with an entire special issue of the International Journal of Project Management (Volume 24, Issue 8) and other research in this area (Kohli et al. 2004; Peppard et al. 2007). However the findings and new Standards have significant implications and it may be difficult to change behaviours at board, senior management and project management levels.

Top managers generally consider projects to be an operational concern and rarely consider projects to be of direct interest (Crawford 2005; Thomas et al. 2002). It is probably difficult for top managers to differentiate new advice from past advice which was little more than lip-service or exhortation (Emery 1990; Izzo 1987; Jarvenpaa et al. 1991; Lederer et al. 1988; Schmitt et al. 1978). Project managers and researchers in turn may struggle to accept that their expert advice has less impact on success than previously believed because a business focus is required rather than a project or technical focus (Thomsett 1989).

Stronger empirical evidence is needed. Case study research is appropriate because descriptive cases are effective in communicating research to influence practice (Benbasat et al. 1999). However Young and Jordan's (2008) evidence is based mainly on five case studies; too few for top managers and practitioners to be strongly influenced to change behaviours. More cases are also needed because research may not account adequately for counter-examples and counterfactuals. Practitioners are unlikely to either change their habits or re-evaluate the conventional wisdom of the past 40-50 years without reconciling their experiences with research.

This paper will address these needs by presenting 10 additional case studies as further evidence to evaluate whether TMS support is the most important CSF. The cases follow Young and Jordan's recommendation to research other types of projects and will replicate their case study protocol to be directly comparable. The fuzzy set methodological approach developed by Poon et al (2011) will be used to overcome the cognitive limits of analysing large numbers of case studies. The fuzzy set approach is particularly appropriate because researchers and practitioners are provided with an approach to compare and reconcile other research and diverse project experiences to unambiguously determine the critical success factors that are most important for project success.

The structure of this paper is as follows. The literature is summarised in the next section. The following sections describe the research methodology, followed by the results. analysis, discussion and conclusion.

SUMMARY OF RELEVANT LITERATURE

Despite more than fifty years of intensive effort, the issue of IT project failure remains unresolved (Sauer 1993; Sauer 1999; Sauer et al. 2009; Tichy et al. 2008). If the widely cited Standish statistics are to be believed, the failure rate has actually deteriorated in the last eight years (Standish 2003; Standish 2009). In addition to this, many are starting to realize that the problem is not isolated to IT projects. Lovallo and Kaheneman (2003) are cited by the Australian Institute of Company Directors to illustrate disappointing results with all types of large capital projects in areas as diverse as manufacturing, marketing, and mergers and acquisitions (AICD 2009).

Much of the research on project success and failure is characterized by surveys of project managers to identify critical success factors (Cooke-Davies 2002; Lucas 1975; Lyytinen et al. 1987; McGolpin et al. 1997; Schmidt et al. 2001). The list of failure factors produced by the Standish Group (1996) could be considered the conventional wisdom because they are widely cited and are consistent with academic research. This conventional wisdom is to focus on project methodologies, user involvement, top management, high level planning and high quality project staff in that order.

Unfortunately the "dimensions thought to be important have [had] no consistent impact on the success of computing" (Kraemer et al. 1986). An enormous number of largely untested methodologies have been proposed and adopted (Checkland 1981; Clegg et al. 1997; Strassmann 1995) but half to two thirds of projects are still abandoned or implemented without any perceptible benefits (Willcocks and Margetts 1994, Standish 1999, 2003). Despite this, the number of success stories reported are almost twice the number of failures (Falconer et al. 1999; Rocheleau 2000) and the conclusion after fifty years of intensive research is that IT success/failure remains a poorly understood phenomenon (Sauer 1999; Sauer et al. 2009; Tichy et al. 2008).

One major problem with the conventional wisdom is the failure to differentiate between project management success (on-time on-budget on-quality) and project success (realization of expected outcomes) (Baccarini 1999; Cooke-Davies 2002; de Wit 1985). Project management success does not automatically lead to project success (Markus et al. 2000). The widespread use of project methodologies has not provided the expected results with as few as 10% of projects actually delivering all of what is promised and fewer than a third of projects delivering any business benefits at all (Clegg et al. 1997; Willcocks 1994; Young 2006). The Project Management Institute (PMI) has concluded a major study stating the value of project management is in the eye of the beholder and were not able to demonstrate unequivocally that project management actually adds value (Thomas et al. 2008). Methodologies such as PRINCE2 or PMBOK have been found to be mature but ineffective without project governance and top management support (Sargeant 2010).

Young and Jordan (2008) argue that progress is being held back by our conception of success and failure and the number of possible factors involved. They add that few have progressed beyond the early insight that project success or failure might be attributable more to organizational than technical or project management issues (Lucas 1975). Their research recognized that the conventional wisdom must be incomplete and they redirected effort to look for major areas of neglect rather than to improve existing approaches. To make the search more manageable, they took the Standish critical success factors as a proxy for conventional wisdom and condensed them into five major categories. These categories are summarized in Table 1 in the order of importance when project success is considered the primary objective. The original weightings based on responses of project managers in the Standish studies are also presented for comparison.

If top management support is indeed the most important CSF, there is a problem because prescriptions for top management support (TMS) are not well developed (Bassellier et al. 1998). Some advice imposes very demanding requirements simply to improve goals of little direct interest to top managers such as technical quality or user satisfaction (Brandon 1970; Dinter 1971; Doll 1985; Izzo 1987). Other prescriptions for communication, enthusiasm, involvement and participation appear to be little more than exhortation (Emery 1990; Izzo 1987; Lederer et al. 1988; Schmitt et al. 1978). And, as noted earlier, there are counter-examples suggesting top management involvement may not always be useful (Collins et al. 1997; Keil 1995; Mähring 2002).

SF category	**Critical Success Factors (*weightings from Standish 2006)***	**Conventional weighting (Standish 2006)**	**Importance for project success (Young & Jordan 2008)**
Top Management Support (TMS)	Top Management Support (16)	16	1
User	User involvement (19) Ownership (6)	25	2
Project Methodologies	Clear statement of requirements (15) Proper planning (11) Smaller project milestones (6)	32	3
High Level Planning	Realistic expectations (10) Clear vision & objectives (3)	13	4
Staff	Competent staff (8) Focussed and hard working (3)	11	5

Table 5 Young and Jordan's (2008) Critical success factors for project success

METHODOLOGY

Resolving the issue of the nature and importance of TMS is difficult because it is an organizational phenomenon where the boundaries between the phenomena and context are not clearly evident. Case study research provides a distinct advantage over alternatives such as surveys, archival research, historical analysis and experiments because there is a 'how' or 'why' question being asked about a contemporary set of events over which the investigator has little or no control (Yin 2003). Descriptive case studies have particular value because they are recognised to be an effective means of communicating contributions to practice (Benbasat et al. 1999).

However, case study research becomes unwieldy when there are more than 10-15 cases. This is a significant limitation because more than 10-15 cases may be needed to convince top managers and the project management community that a significant change in practice is required.

This paper will address this issue by applying a fuzzy-set theoretic based methodology to case studies developed using qualitative techniques. In doing so, the paper will replicate Poon et al. (2011) and validate their approach to overcome the numerical limitation for the analysis of multiple case studies. In overcoming this limitation researchers and practitioners will be provided with an approach to compare reported and directly experienced projects, and unambiguously determine the critical success factors that have critical importance for success. The foundation will therefore be established to resolve with confidence the issue of which CSF has the highest importance, and therefore discover whether the conventional approaches to project management are misdirecting effort.

The methodology will firstly summarise how Poon et al's (2011) fuzzy set methodology will be applied and then describe how Young and Jordan's case study protocol was replicated to develop additional cases for analysis.

Qualitative Comparative Method

The qualitative comparative method in social science is a technique first pioneered by Charles Ragin in 1987 for solving the problems caused by making causal inferences on the basis of only a small number of cases. The original goal of this technique was to 'integrate the best features of case-oriented approach with the best features of the variable-oriented approach' (Ragin, 1987, p.84). Hence, this approach could provide an avenue to produce some level of generalization from data gathered from different in-depth cases. Although the qualitative comparative method is in essence a case-sensitive approach, it also embodies the strengths of the quantitative approach.

According to Rihoux (2006), the key operations of this technique rely on Boolean algebra, which requires that each case be reduced to a series of variables (conditions and an outcome) and hence, allows replication.

In this particular study, the analysis will be based on set relations, which is to identify commonalities across a number of cases (Ragin and Rihoux 2004). This method is particularly useful if the focus is on a relatively small number of purposely selected cases (Vaughan, 1986). The set-theoretic analysis is different to the more common analysis of correlation. The key difference is that the correlation approach is symmetrical by design, while the set-theoretic perspective is fundamentally asymmetrical. This distinction is important because set-theoretic analysis, like qualitative research, more generally focuses on uniformities and near uniformities, not on general patterns of association between study factors and outcome (Ragin 2008).

Fuzzy-set assessment of necessary & sufficient

Firstly conditional claims for analysis will be identified through two forms of conditions: necessary and sufficient.

- A *necessary* condition or factor (A) must be satisfied for an outcome (O) to be true (i.e. $O \subseteq A$). However, even if A is a necessary condition for O it does not mean that A guarantees O.
- On the other hand a *sufficient* condition (A) is a condition that if satisfied, assures the outcome O (i.e. $A \subseteq O$). If we claim that "A is a sufficient condition for O," then A guarantees O.

Normally researchers describe necessity or sufficiency in an absolute or perfect sense. The advantage of fuzzy-set theory is that degrees of necessity and sufficiency can be evaluated rather than having to assume a perfect relationship.

Fuzzy sets were first introduced by Zadeh in 1965 and the key concept is that elements or objects belonging to a set can have different degrees of membership (Zadeh 1965). This is an extension of classical set theory by allowing continuous values between 0 and 1 instead of dichotomous values. The fuzzy logic "membership score" is considered as a continuous value of the condition (A) or outcome (O) variable.

This is applied in this research by creating a truth table (Table 3) by assessing the relative success of a project and the degree to which each critical success factor (CSF) was addressed. The relative success of the outcome and the adequacy of each CSF is mapped to a fuzzy score between 0 and 1 according to a description of a case (0.1 is given to poor, 0.3 to fair, 0.5 to average, 0.7 to good, and 0.9 to excellent).

Outcome: Assessment of the outcome is on the degree to which expected benefits were realized (rather than traditional emphasis on on-time, on-budget).

Conditions (CSFs): 5 critical success factors will be assessed: top management support (TMS), project methodology, user involvement, high level planning and adequacy of staff.

1. The assessment of adequacy of *TMS* is based on factors such as commitment, sustainability of top manager's position along projects life and speed of response to issues.
2. The assessment of adequacy of *Project methodology* is based on whether they have adopted any project management methodology, if they have customized the selected methodology to fit their requirements and also on how much they have followed the particular methodology.
3. The assessment of adequacy of *user involvement* is based on how much the users have been involved with the project starting from the initiation phase, the quality and quantity of communication and whether the project manager has taken the users feedback into account.
4. The assessment of the adequacy of high level planning is based on having realistic expectations of the outcome and the clarity of understanding of the expectations.
5. Assessment of the adequacy of Staff is based on whether they are motivated focused and hard working.

Fuzzy-set calculation of importance

Next, the importance of conditions will be analysed. Considerations of length prevent a complete exposition of the mathematics of necessary and sufficient conditions using fuzzy logic values. In simple terms when a factor A is

necessary for an outcome O, the fuzzy logic value of A will be greater than or equal to the fuzzy logic value of O (A>=O). When a factor is *sufficient* for an outcome, fuzzy logic value of O will be greater than or equal to the fuzzy logic value of A (O>=A).

Conditions can be assessed as *necessary* or *sufficient*, but this will not describe the relative importance of a factor. To assess the *importance* of conditions for an identified outcome, Geortz (2003) adds two central questions to assess the importance of necessary or sufficient conditions: trivialness and relevance. Geortz (2003) states that most researchers apply statistical analysis on different factors in order to understand the relevancy between them. However, he believes that less attention has been given to the trivialness of those factors.

According to Downs (1989), for any phenomenon there are an infinite number of necessary conditions. For example in order to pass an exam we need to satisfy the many conditions such as gravity, electricity, pen, etc. In this case gravity is a trivial necessary condition because it is constant across all cases. Geortz and Braumoeller (2000) extend this idea and argue that a trivial necessary condition is a condition that is always present in every single case across the universe. It is obvious that the more trivial a condition gets, the less important it becomes, because it is constant across all cases. Geortz (2003) describes the idea of relevance as simply, "more important". A factor becomes more important if it is less trivial and more necessary (i.e. the extent to which the presence of A leads to the desired outcome O). A relevant necessary condition is also considered sufficient.

The following are the equations to measure the dimensions of importance developed by Geortz (2003):

Trivialness:

(1) The measure of trivialness of necessary condition A (given O⊆A or O≤A), T_{nec} is the average distance from a_i to 1.00 standardized by how far o_i is from 1.00, i.e. $T_{nec} = \frac{1}{N}\sum(1 - a_i)/(1 - o_i)$

(2) The measure of trivialness of *sufficient* condition can be written as: $T_{suf} = \frac{1}{N}\sum(o_i/\, a_i)$

The closer T_{nec} and T_{suf} get to one, the less trivial (more important) it becomes and the further away it gets from one, the more trivial it becomes.

Relevance:

(3) The measure of relevance of a *necessary* condition can be written as: $R_{nec} = \frac{1}{N}\sum(o_i/\, a_i)$.

(4) The measure of relevance of *sufficient* condition can be written as: $R_{suf} = \frac{1}{N}\sum(1 - o_i)/(1 - a_i)$

Importance:

(5) The average measure of Trivialness and Relevance indicates the relative importance of a condition.

Case Study Protocol

Cases are developed by following the replication logic of Young and Jordan's (2008) multiple-case study design. The unit of analysis is a single IS project in the context of the benefits delivered to an organisation.

The cases were prepared by final year business informatics students at the University of Canberra. The case study was their major assessment task in their final subject: Business Informatics Case Studies. The class consisted of both undergraduate and postgraduate students and only the highest quality cases were accepted for analysis.

For rigour the student researchers were trained over a 14 week semester. They participated in a weekly facilitated discussion to learn how to differentiate between project management and project success, understand Yin's (2003) case study research method in detail and review Young and Jordan's (2008) original five case studies. Ongoing mentoring was provided throughout the semester and intermediate and final presentations were held to guide development of the final case.

Rigour in data collection was maintained by requiring multiple sources of evidence (interviews, project documentation, observation), following or adapting the same interview instrument used by Young and Jordan (2008). In addition, there was normally intensive participation of key informants. Interviewees mostly included project sponsors, top managers, members of the project team and stakeholders from multiple levels within the organisation. A few high profile cases were prepared on the basis of the extensive documentation that was already available in the public record. All case study organisations, except those already on the public record, were given the option to have their case anonymised. This anonymity, the opportunity for participants to provide feedback and the two class feedback sessions provide some assurance that the cases are credible and have guarded themselves against bias.

Each case was written up chronologically and then analysed by each student researcher on both a qualitative basis and quantitatively using the fuzzy logic rules described in section 3.1. The fuzzy set values were then independently assessed by the authors. The results were compared and discrepancies discussed until consensus was reached.

RESULTS

In total there are 15 cases. Ten are additional cases conducted by student-researchers. A full version of the new case studies are available on request and the original five cases are available as a publication from Standards Australia (Standards Australia 2006).

To manage length the key qualitative details of each case have been summarized in Table 2. Three cases were considered failures, seven were partial successes and five delivered all the expected benefits (The original cases are shaded in grey).

The values in the truth table (Table 3) are the fuzzy set values agreed by consensus between the student researchers and the authors.

Case	TMS **(A_1)**	User involvement **(A_2)**	Project Methodology (A3)	High Level Planning (A4)	Staff **(A_5)**	**Relative Success (O)**
Tech-Serv	0.1	0.3	0.1	0.9	0.7	**0.1**
Tech-Media	0.3	0.3	0.9	0.7	0.9	**0.3**
ABS	0.5	0.3	0.9	0.7	0.9	**0.5**
Agency	0.7	0.5	0.3	0.7	0.3	**0.7**
SkyHigh	0.9	0.9	0.9	0.9	0.9	**0.9**
Edge: Centrelink & FaCS	0.1	0.7	0.5	0.9	0.7	**0.1**
AusService	0.3	0.5	0.7	0.9	0.7	**0.2**
SolarCo	0.3	0.9	0.1	0.3	0.5	**0.3**
Web hosting: Support cent	0.2	0.9	0.8	0.9	0.7	0.5
JCA-DEEWR	0.5	0.3	0.7	0.3	0.5	**0.5**
GovWEB	0.1	0.9	0.6	0.3	0.5	**0.6**
PMS Grants Mngt system	0.7	0.7	0.9	0.9	0.9	**0.8**
SpeedyISP	0.8	0.9	0.3	0.9	0.3	**0.8**
ATO Change Program	0.9	0.7	0.9	0.9	0.5	**0.9**
Web hosting: Billing syste	0.9	0.9	0.8	0.9	0.9	0.9

Table 6. Fuzzy-set scores of relative success and adequacy of each CSF.
Criteria: Poor=0.1, Fair=0.3, Average=0.5, Good=0.7, Excellent=0.9

		CRITICAL SUCCESS FACTOR				
	Case	**TOP MANAGEMENT SUPPORT**	**USER INVOLVEMENT**	**PROJECT METHODOLOGY**	**HIGH LEVEL PLANNING**	**PROJECT STAFF**
Success	**Web Hosting Coy:** *Billing system merger*	Full support	Users interested; ownership	Four phase; adjusted to suit project goals	Realistic expectations; detailed vision and objectives	Very competent staff; will to finish project
	SkyHigh	Strong sponsor; strong CEO involvement; top managers involved	Users very involved; high ownership; unreasonable demands	Detailed consideration of organisation to customise vendor methodology	Realistic expectations; clear vision and objectives	Very competent staff; highly motivated
	ATO: *Change Program*	Strong executive involvement; Top managers heavily involved	Users very involved in early stages. Less ownership in latter stages	Utilized well established 'Tier 2' PM principles throughout	Realistic expectations; clear vision and objectives	Very competent staff; but high level turnover and fairly low retention
	PMS: *Grants Management System*	Highly motivated red-faced Executives; Strong sponsor; Grants Oversight Group convened	Users involved for corporate level requirements; program requirements not fully met	Established track record of using PMBOK PRINCE2. Driven by IT gave business areas confidence	Clear vision and objectives	Low turnover; Very competent; Motivated
	SpeedyISP	Strong sponsor; championed by top management; some top managers involved but others very hostile	Users very involved; high ownership; unreasonable demands/wanted lots of extra features	No formal methodology; "common sense" approach	Realistic expectations; clear vision and objectives	Range of skills and experience; highly motivated
Partial success	**Agency**	Very strong sponsor; CEO not interested; no top manager interest	Little user involvement; low ownership	Tried to follow consultant methodology but Agency lacked resources	Realistic expectations; detailed vision and objectives	Junior staff *(described as 2nd eleven);* highly motivated
	GovWEB	No Sponsor; no CEO involvement; Top Management changed a lot; Top Managers in conflict	Users very involved; showed ownership; no manager to push issues through	Successfully implemented agile; poor project plan	Poor objective definition; unrealistic expectations	Lacked needed skills; motivated; diligent; willing to learn

	CRITICAL SUCCESS FACTOR				
Case	**TOP MANAGEMENT SUPPORT**	**USER INVOLVEMENT**	**PROJECT METHODOLOGY**	**HIGH LEVEL PLANNING**	**PROJECT STAFF**
Web Hosting Coy: *Support system merger*	Limited fractured support	Hard to adjust to constant changes	Four phase; adjusted to suit project goals	Realistic expectations; clear strategy; detailed vision of objectives	Competent staff; motivated to succeed
ABS	Sponsor resigned; CEO passive; top managers passive	Some user involvement; some ownership	No information	Realistic expectations; evolving vision and objectives	Competent staff,
DEEWR: *JCA project*	Strong desire from TM involvement in project; vital project information wasn't communicated always by PM's	No user involvement during project implementation; user recommendations were considered after the production release	Has appropriate methodology; however wasn't always followed	Unrealistic expectations; clear vision; no overall benchmark for determining success	New but competent staff; motivated to succeed;
Solar Co	Strong support from OM & BM but early resignations; little initial support from GM; political issues (GM often working against OM & BM; OM retaining info); proliferation of 'us and them' culture; rapid change caused distraction & lack of time for TMS; different leadership styles were incompatible with some staff	LCSG assistance and ownership; clear requirements; customers (users) involved in renegotiation and supply changes	No PM documentation or methodology (no program management); no risk or quality management; no specific PM	Some important unrealistic expectations: funding / capability of staff / time to complete job / nature of the project and necessary approach	Good staff (motivated; competent) vs. bad staff (bad attitude; unmotivated; semi-competent); old vs. new cultures
TechMedia	Strong sponsor; CEO not involved enough; some top managers involved but one very passive	Users very involved; some ownership	Followed consultant methodology	Realistic expectations; detailed vision and objectives	Best staff picked for project; highly motivated

		CRITICAL SUCCESS FACTOR				
	Case	**TOP MANAGEMENT SUPPORT**	**USER INVOLVEMENT**	**PROJECT METHODOLOGY**	**HIGH LEVEL PLANNING**	**PROJECT STAFF**
Failure	**AusService**	Project not driven strategically from the top; left to business line managers to implement their own strategy	Users initially incredibly happy and lots of business buy in and ownership; but far too much time and money was spent. Then changed to limit user involvement (but drastically reduced the success of the project).	Originally; no formal methodology followed then strict project methodologies were introduced. Project management success (cost/scope/schedule) improved; but expected business results not realised.	Strategy was exactly what the organisation needed and was aligned with organisation vision	began with largely untrained and inexperienced project team of business users. Project team then replaced with experienced and formally trained staff.
	Edge: Centrelink & FaCS	Both the Steering Committee and Senior Executive committee failed to perform their roles; No ownership until the end of the project	Users were very involved; Three User acceptance test were performed (users provided feedback); Training was provided for Centrelink staff on each release	Centrelink and facs did not have a methodology and Project Plan; Softlaw developed a methodology for the project	Edge and facs knew what they needed to achieve from the project; Realistic expectations; It was aligned with "Get it Right" strategy of facs portfolio	It was the largest project Softlaw has undertaken; Softlaw did an experimental prototype of Edge (1997); before they won the tender for the real project; Delivered all deliverables as per contract
	TechServ	No sponsor; no CEO involvement; no top manager interest	No user involvement; low ownership	Informal methodology; "jam it in & fix it later"	Realistic expectations; clear strategy	Competent staff; motivated to succeed

Table 7. Summary of cases – qualitative details

ANALYSIS AND DISCUSSION

Trivialness

To determine the trivialness of each CSF, either equation 1 or equation 2 from section 3.1.2 is applied according to whether the factor was considered necessary (A>=O) or sufficient (O>=A). The result is shown in Table 4 with importance of the original cases shown in grey, the new cases in white and overall in yellow.

	TMS (A1)	User involvement (A2)	Project Methodology (A3)	High Level Planning (A4)	Staff (A5)
Tech-Serv	1.00	0.78	1.00	0.11	0.33
Tech-Media	1.00	1.00	0.14	0.43	0.14
ABS	1.00	0.60	0.20	0.60	0.20
Agency	1.00	0.71	0.43	1.00	0.43
SkyHigh	1.00	1.00	1.00	1.00	1.00
Edge: Centrelink & FaCS	1.00	0.33	0.56	0.11	0.33
AusService	0.88	0.63	0.38	0.13	0.38
SolarCo	1.00	0.14	0.33	1.00	0.71
Web hosting: Support centr	0.40	0.20	0.40	0.20	0.60
JCA-DEEWR	1.00	0.60	0.60	0.60	1.00
GovWEB	0.17	0.25	1.00	0.50	0.83
PMS Grants Mngt system	0.88	0.88	0.50	0.50	0.50
SpeedyISP	1.00	0.50	0.38	0.50	0.38
ATO Change Program	1.00	0.78	1.00	1.00	0.56
Web hosting: Billing system	1.00	1.00	0.89	1.00	1.00
Trivialness (original cases)	1.00	0.82	0.55	0.63	0.42
Trivialness (new cases)	0.83	0.53	0.60	0.55	0.63
Trivialness (overall)	**0.89**	**0.63**	**0.59**	**0.58**	**0.56**

Table 8 Trivialness of each CSF

Relevance

To determine the trivialness of each CSF, either equation 3 or equation 4 from section 3.1.2 is applied according to whether the factor was considered necessary (A>=O) or sufficient (O>=A). The result is shown in Table 5 with importance of the original cases shown in grey, the new cases in white and overall in yellow.

	Relevance				
Case	TMS (A1)	User involvement (A2)	Project Methodology (A3)	High Level Planning (A4)	Staff (A5)
Tech-Serv	1.00	0.33	1.00	0.11	0.14
Tech-Media	1.00	1.00	0.33	0.43	0.33
ABS	1.00	0.71	0.56	0.71	0.56
Agency	1.00	0.60	0.43	1.00	0.43
SkyHigh	1.00	1.00	1.00	1.00	1.00
Edge: Centrelink & FaCS	1.00	0.14	0.20	0.11	0.14
AusService	0.67	0.40	0.29	0.22	0.29
SolarCo	1.00	0.33	0.78	1.00	0.60
Web hosting: Support centr	0.63	0.56	0.63	0.56	0.71
JCA-DEEWR	1.00	0.71	0.71	0.71	1.00
GovWEB	0.44	0.67	1.00	0.57	0.80
PMS Grants Mngt system	0.67	0.67	0.89	0.89	0.89
SpeedyISP	1.00	0.89	0.29	0.89	0.29
ATO Change Program	1.00	0.33	1.00	1.00	0.20
Web hosting: Billing system	1.00	1.00	0.50	1.00	1.00
Relevance (original cases)	1.00	0.73	0.66	0.65	0.49
Relevance (new cases)	0.84	0.57	0.63	0.70	0.59
Relevance (overall)	**0.89**	**0.62**	**0.64**	**0.68**	**0.56**

Table 9 Relevance of each CSF

Importance

To determine the importance of each CSF, we summarise the calculations of trivialness and relevance from Table 4 and Table 5 and average them to calculate the importance. The result is shown in Table 6 with importance of the original cases shown in grey, the new cases in white and overall in yellow.

	TMS (A1)	User involvement (A2)	Project Methodology (A3)	High Level Planning (A4)	Staff (A5)
Trivialness (original cases)	1.00	0.82	0.55	0.63	0.42
Relevance (original cases)	1.00	0.73	0.66	0.65	0.49
Importance (original cases)	**1.00**	**0.77**	**0.61**	**0.64**	**0.46**
Trivialness (new cases)	0.83	0.53	0.60	0.55	0.63
Relevance (new cases)	0.84	0.57	0.63	0.70	0.59
Importance (new cases)	**0.84**	**0.55**	**0.62**	**0.62**	**0.61**
Trivialness (overall)	0.89	0.63	0.59	0.58	0.56
Relevance (overall)	0.89	0.62	0.64	0.68	0.56
Importance (overall)	**0.89**	**0.62**	**0.61**	**0.63**	**0.56**

Table 10 Relevance of each CSF

A comparison of the new cases against the original five cases and against all 15 cases as a whole continues to identify TMS as significantly less trivial, more relevant and more important than the other factors. The relativities of the other factors was not consistent but considering all 15 cases as a whole, the order of importance is high level planning, user involvement, project methodologies, followed by project staff. The relative importance may be better understood by plotting the trivialness and relevance of each CSF graphically as shown in Figure 1.

It appears all factors are non-trivial and relevant, an unsurprising result considering that these factors represent the traditional wisdom. However, TMS appears to be significantly more important than the other factors. This finding validates and strengthens Young and Jordan's (2008) conclusion that TMS is the most important CSF. One suspects that further data gathered through additional case studies or reconciling to practitioner experience will not significantly change the results.

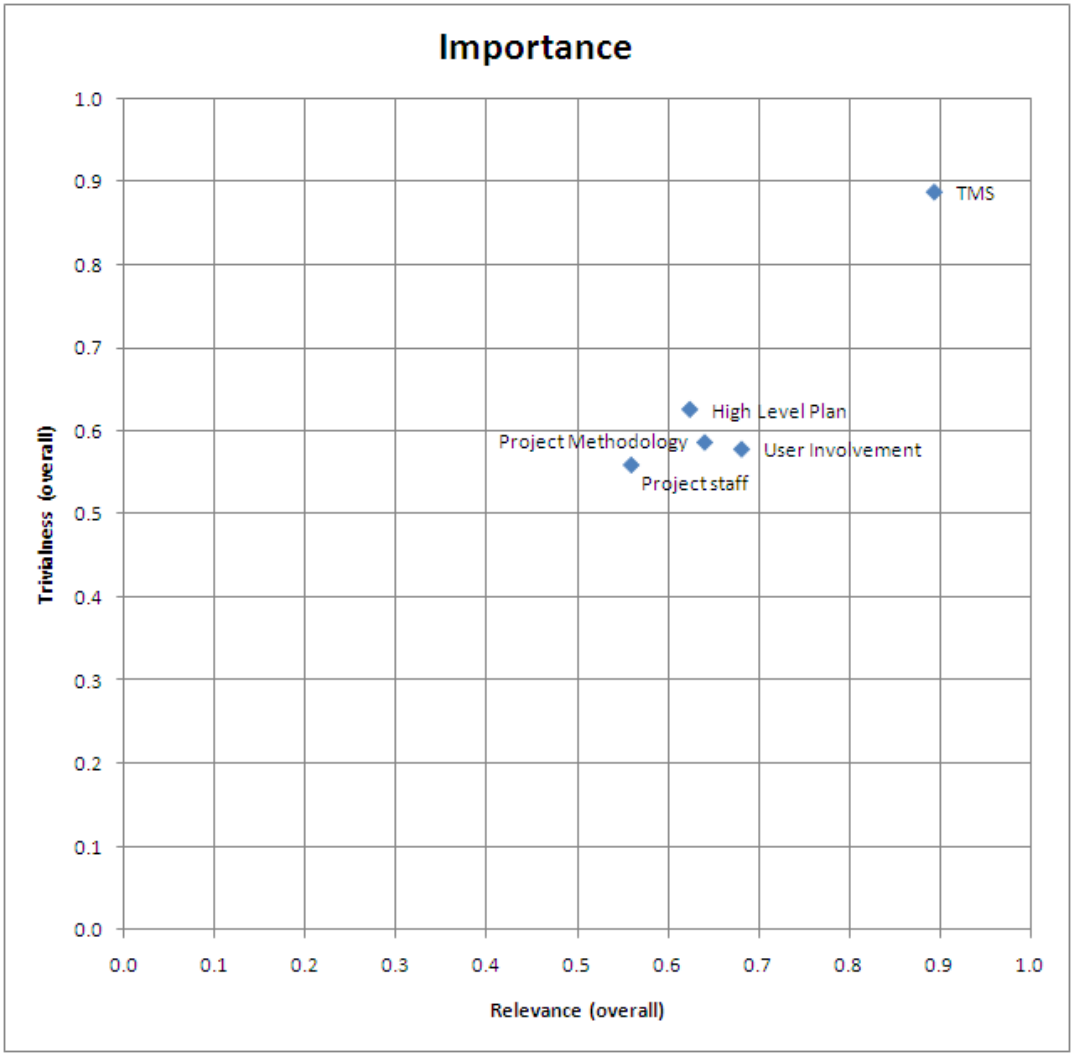

Figure 3 Relative importance of CSFs

To a lesser degree the data also suggests project staff may be slightly less important than the other three factors which are roughly equal in importance (user involvement, high level planning, project methodology). Graphically presenting the fuzzy-set values of the 15 case studies with trend lines supports this conclusion (Figures 2-5). TMS correlates strongly with project success but all the other factors have much more variability. User involvement and project management have stronger positive slopes, high level planning has a slightly positive slope while project staff appears to have a negative slope. One interpretation is that these other factors are most likely to be necessary but not sufficient for project success.

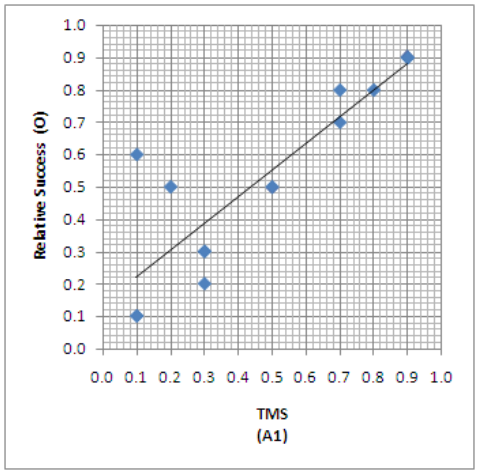

Figure 4 Project Success vs. TMS

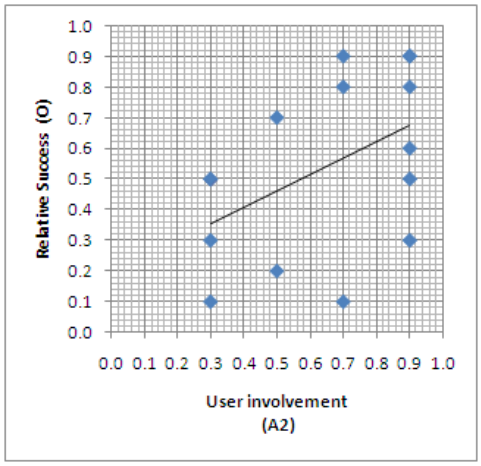

Figure 5 Project Success vs. User involvement

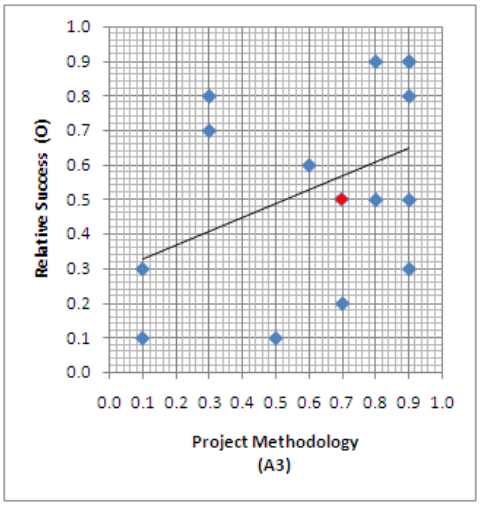

Figure 6 Project Success vs. Project Methodology

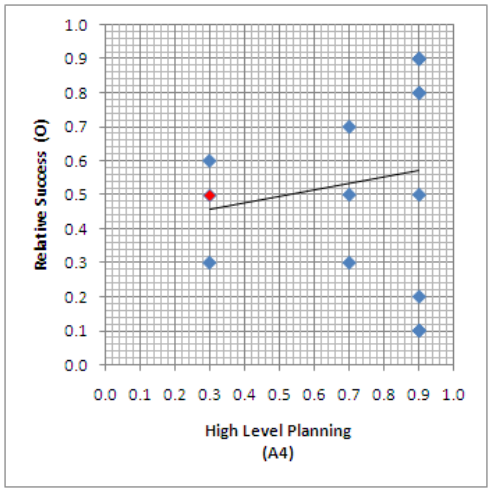

Figure 7 Project Success vs. High level planning

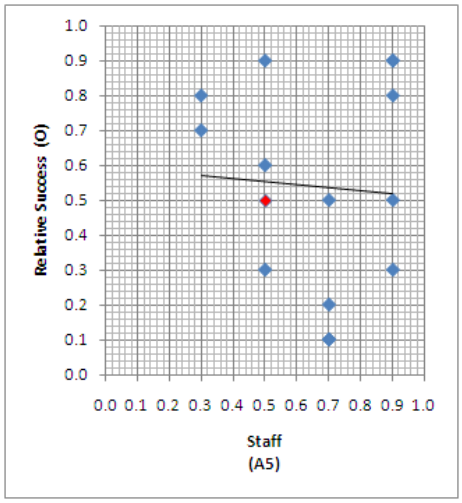

Figure 8 Project Success vs. Project Staff

CONCLUSION

This paper has built on the work of Young and Jordan (2008) and Poon et al. (2011a) and provides much stronger empirical evidence that TMS is significantly more important for project success than factors emphasised in traditional practice. It adds to the evidence that current practice emphasizing project methodologies may be misdirecting effort. It may also explain how effort should be redirected to overcome the problem of IT project failure. This is a pressing issue with large social and financial implications.

TEN ADDITIONAL CASE STUDIES WERE ADDED TO THE FIVE CASES PREVIOUSLY PREPARED BY YOUNG AND JORDAN (2008). THE NEW CASES INCLUDED COUNTER-EXAMPLES AND COUNTERFACTUALS AND REPLICATED YOUNG AND JORDAN'S CASE STUDY PROTOCOL TO BE DIRECTLY COMPARABLE.

The contribution of this research may be to provide enough evidence to influence top managers and practitioners to re-evaluate the conventional wisdom of the past 40-50 years. Researchers and practitioners, using the fuzzy-set analytical approach have been introduced to a method to compare all their project experiences and determine conclusively the most important critical success factors for project success. The approach has particular merit because it overcomes the cognitive limits of analysing large numbers of case studies and experiences.

There are significant implications for board, senior management and project management practice and academia. Three of these implications were previously highlighted by Young and Jordan (2008):

(1) Boards and top managers may have to accept that they personally have the most influence on whether a project succeeds or fails.

(2) Boards, top managers and their advisors may have to accept that the current expert advice has less impact on success than previously believed.

(3) The AIS Special Interest Group on IT Project Management working group developing an IT project management curriculum and other owners of project management standards (PMI, APM, PRINCE2) may need to modified their contributions to allow for or incorporate the findings by addressing top managers specifically.

The major limitation of this research is the calibration of the fuzzy scores for the CSFs and project outcomes. More people were involved in deciding the fuzzy scores than in previous studies but there were still relatively few participants. Although the fuzzy scores were assessed independently by the authors and student researchers, and consensus sought when there were discrepancies, bias could not be avoided. Authors are aware of the limitation and suggest more experts be involved in deciding the fuzzy scores in future studies. The cases in this research can also be made available for independent analysis.

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