

Forecasting Success on Large Projects: Developing Reliable Scales to Predict Multiple Perspectives by Multiple Stakeholders Over Multiple Time Frames

Rodney Turner, SKEMA Business School, Université Lille Nord de France, Lille, France

Roxanne Zolin, School of Management, Queensland University of Technology, Brisbane, Australia

ABSTRACT ■

Our aim is to develop a set of leading performance indicators to enable managers of large projects to forecast during project execution how various stakeholders will perceive success months or even years into the operation of the output. Large projects have many stakeholders who have different objectives for the project, its output, and the business objectives they will deliver. The output of a large project may have a lifetime that lasts for years, or even decades, and ultimate impacts that go beyond its immediate operation. How different stakeholders perceive success can change with time, and so the project manager needs leading performance indicators that go beyond the traditional triple constraint to forecast how key stakeholders will perceive success months or even years later. In this article, we develop a model for project success that identifies how project stakeholders might perceive success in the months and years following a project. We identify success or failure factors that will facilitate or mitigate against achievement of those success criteria, and a set of potential leading performance indicators that forecast how stakeholders will perceive success during the life of the project's output. We conducted a scale development study with 152 managers of large projects and identified two project success factor scales and seven stakeholder satisfaction scales that can be used by project managers to predict stakeholder satisfaction on projects and so may be used by the managers of large projects for the basis of project control.

KEYWORDS: project success criteria; project success factors; project failure factors; leading performance indicators; stakeholders; project complexity

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INTRODUCTION ■

Large projects have an impact that can go well beyond the immediate completion of the project (Eweje, Turner, & Müller, 2012; Xue, 2009). Success is perceived not just by the traditional view of completing the work to time, cost, and quality, but also by whether the project delivers the desired outcome—that is, to deliver to the parent organization desired new capabilities and business objectives (Office of Government Commerce, 2007; Xue, 2009)—and whether it achieves the desired longer-term impacts (Xue, 2009), including delivering the parent organization's strategic objectives (Eweje et al., 2012), and desired future development of the business (Shenhar & Dvir, 2007). Large projects will have a wider range of stakeholders making judgments about whether the project and its output, outcome, and impact have achieved the desired objectives, and these stakeholders will make those judgments over the months, years, and even decades following project completion.

The perception of success by a project's stakeholders often has little to do with whether the project was completed on time, at cost, and with the desired quality. There are well-known cases of projects that were substantially late and overspent but were later perceived to be very successful. The Sydney Opera House and Thames Barrier (Morris & Hough, 1987) are two examples. Meanwhile, other projects have been completed on time and at cost but have left their investors dissatisfied because they have failed to deliver the desired benefits. The Sydney Cross-City Tunnel for road traffic is one example. What this illustrates is that the wretched golden triangle of project success (time, cost, and quality) is an inadequate indicator of project success, and that success is not just related to completion of the project's scope of work, but also to the achievement of business objectives (i.e., the project delivers the desired outputs, outcomes, and impacts, that different stakeholders assess these different levels of project success, and that they do so over different time frames).

The aim of this research is to develop a set of leading performance indicators for large projects that can be measured during project delivery to predict project success. Project success is measured not just by completion of the scope of work to time, cost, and quality, but also by performance of the project's outputs, outcomes, and impacts, and thereby the achievement of the desired business objectives, as assessed by different stakeholders over

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different timescales. The leading performance indicators may be (as suggested by Turner, 2002) measures of the success criteria that can be monitored during project delivery, and also may be related to the project's success factors (or failure factors) and be symptoms that the project is on track or going off the rails. We expect that there may be combinations of the leading performance indicators that should set the alarm bells ringing. It may be that a given failure factor on its own may not be a cause for concern, but that failure factor in combination with another may be a cause for concern.

We are undertaking this research to address the following research questions:

1. How can we assess the success of large projects in a more comprehensive way that takes into account the views of multiple stakeholders over multiple time frames over the life of the product the project produces?
2. What measures of performance during project delivery (leading performance indicators) will provide a valid and reliable forecast of this assessment during project delivery?

In order to address this, we have undertaken several steps:

1. We developed a project success model reflecting the perception of the performance of the project's output, outcome, and impact by different stakeholders over different timescales.
2. We identified a set of success and failure factors and leading performance indicators that can be measured by the project manager and project team during project execution that can potentially forecast those different perceptions of performance.
3. We conducted a scale development study to evaluate the ability of those leading performance indicators to act as valid and reliable indicators of the future perception of project success.

In the next section, we review the literature on project success and, based on that, develop a new model that judges the success of a project by the assessment by various project stakeholders about the performance of the project's output, outcome, and impact in the months and years following the project. We identify success or failure factors that can facilitate or mitigate against the achievement of the desired outcomes, and potential leading performance indicators to act as predictors of future stakeholder perception. We describe the scale development study we conducted

and the results of that study. We identified two project success factor scales and seven stakeholder satisfaction scales that provide new measures that can be used to forecast the perception of stakeholders about project success and may be used by the managers of large projects as the basis of project control.

A New Model for Project Success

In this section, we review relevant literature on project success and, based on that, develop a more comprehensive model of project success that indicates how different stakeholders perceive the performance of the project's output, outcome, and impact over different timescales by combining the work of several authors.

Turner (2009, first edition 1993) identified that project success may be perceived differently by different stakeholders over different timescales (see Table 1). He suggested that the project participants, including the project manager, the project team, and suppliers, judge success on completion of the project (at its end). The operators of the project's output and the consumers of the product it produces judge success in the months following the end of the project based on how well it achieves its immediate business objectives. The

Measure of Success	Stakeholder	Timescale
The project increases the shareholder value of the parent organization	Shareholders	End plus years
The project generates a profit	Board	End plus years
The project provides the desired performance improvement	Sponsor	End plus years
The new asset produced by the project works as expected	Owner	End plus months
The new asset produces a product or provides a service that consumers want to buy	Consumers	End plus months
The new asset is easy to operate	Operators	End plus months
The project is finished on time, to budget, and with the desired quality	All	End
The project team had a satisfactory experience working on the project and it met their needs	Project team	End
The contractors made a profit	Contractors	End

Table 1: Different perceptions of success by different stakeholders over different timescales, after Turner [2009].

investors or financiers of the project judge success in the years following the end of project based on how well it achieves corporate strategy and delivers desired business development.

Shenhav and Dvir (2007) extend Turner's (2009) model (Table 2). They identify five categories of project success:

1. Efficiency,
2. Impact on the team,

3. Impact on the customer,
4. Business success, and
5. Preparing for the future.

In this model, the users, consumers, and investor are in one sense swept into one entity, called the customer. However, business success and preparing for the future are of interest to the investor rather than the other two. Shenhav and

Dvir (2007, like Turner, 2009) suggest that the criteria to the left are judged at the end of the project, those in the middle in the months following the project, and those to the right years later.

Westerveld (2003) and Westerveld and Gaya-Walters (2001) in their project excellence model also identified that several stakeholders have an interest in project success (Figure 1). They

Efficiency	Impact on Team	Impact on Customer	Business Success	Preparation for the Future
Meeting schedule	Team satisfaction	Meeting requirements	Sales	New technology
Meeting cost	Team morale	Meeting specification	Profits	New market
Yield, performance, functionality	Skill	Benefit to the customer	Market share	New product line
Other defined efficiencies	Team member growth	Extent of use	ROI, ROE	New core competency
	Team member retention	Customer satisfaction	Cash flow	New organizational capability
	No burnout	Customer loyalty	Service quality	
		Brand name recognition	Cycle time	
			Organizational measures	
			Regulatory approval	

Table 2: Model of project success, after Shenhav and Dvir (2007).

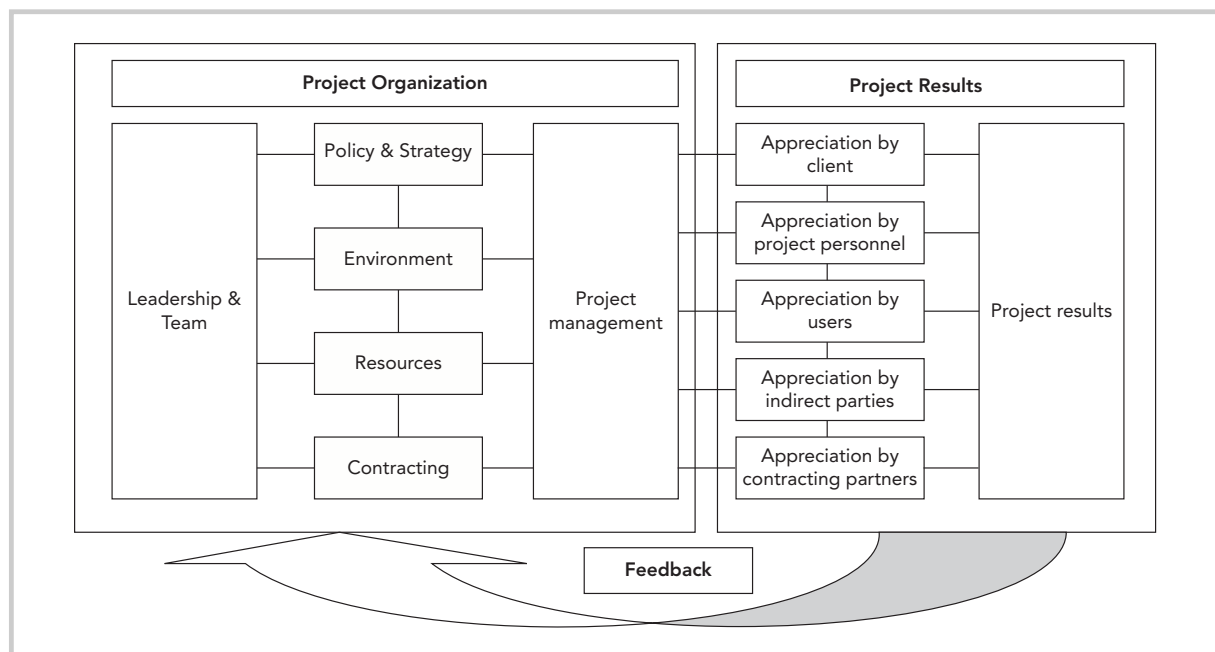


Figure 1: Project Excellence Model, after Westerveld and Gaya-Walters (2002).

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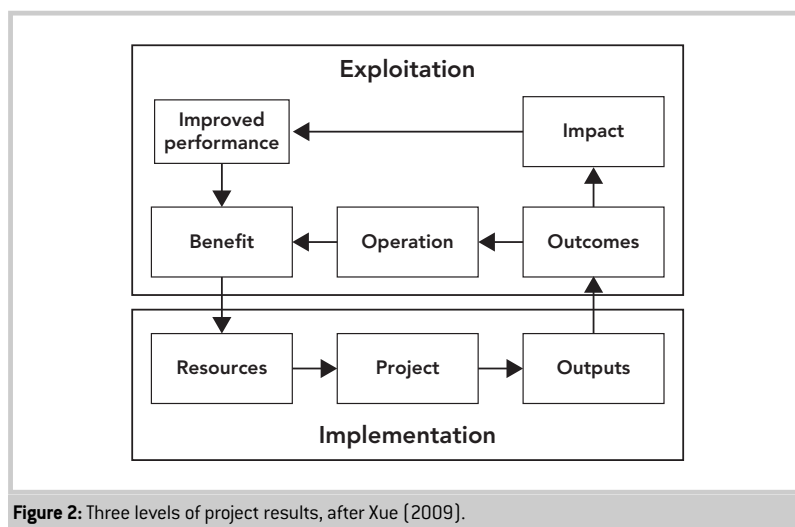


Figure 2: Three levels of project results, after Xue (2009).

suggested that project success can be measured by:

- appreciation by the client,
- appreciation by the project team,
- appreciation by the users,
- appreciation by the contractors, and
- appreciation by the other interested parties.

While the model suggests that the different stakeholders may appreciate success in different ways, it does not suggest that the different stakeholders may make judgments over different timescales.

We propose that these concepts can be integrated into a single model showing how different stakeholders perceive success in different ways over different timescales.

Different Timescales

The Asian Development Bank (ADB) has developed a results-based monitoring and evaluation system for projects it is sponsoring in China (Xue, 2009). Based on the W.K. Kellogg Foundation Logic Model Development Guide (2004), this system identifies three levels of results, or objectives, assessed over differing time frames (Figure 2):

- **Project output:** The new asset delivered by the project, commissioned at the end of the project. It is sometimes

called the project deliverable or project objective (Turner, 2009). Its successful achievement will be judged at the end of the project.

- **Project outcome:** The new capabilities that operation of the new asset gives to the investing organization (Office of Government Commerce, 2007). These enable the parent organization to do new things, solve problems, or exploit opportunities to achieve its business objectives and generate benefit. Its successful achievement can be judged in the months after the project, although it is expected that it will provide benefit for years.
- **Impact:** The long-term performance improvement that it is expected the new capabilities will enable the parent organization to achieve. This will enable the parent organization to attain its strategic goals (Eweje et al., 2012) and its longer-term development objectives (Shenhar & Dvir, 2007). It will be judged years after the end of the project.

This model (Figure 2) focuses on project and business objectives. Modern developments also incorporate social and environmental objectives. For instance, the triple bottom line associated with sustainability (Henriques &

Richardson, 2004) includes economic, environmental, and social objectives. Many of the projects studied by Xue (2009) included social and environmental as well as economic objectives in their desired outcomes and impacts. We will therefore continue to refer to the outcome and impact and the desired business objectives but assume that these may include economic, environmental, and social objectives as suggested by the triple bottom line.

Different Stakeholders

Henriques and Richardson (2004) and Xue (2009) introduced several different types of stakeholders. We propose that based on their work, we can identify eight different types of stakeholders (see Table 3). We also propose that these eight stakeholders will have different interests in the project's outputs, outcomes, and impacts as shown in Table 3, and so have different ways of judging project success over different timescales. Westerveld (2003) suggests one stakeholder is the client. Turner (2009) suggests that the client can be split into two—the sponsor and the owner—and these we propose as the first two stakeholders:

- **The owner or investor:** This is the person or group who pays for the project. They effectively buy the project's output (new asset), pay for its operation after the project, and obtain the benefit to repay their investment. Turner (2009) suggests that this group is only interested in the project's impact years after the project. Here we suggest that they will be interested that the project's output should be delivered to time and cost and with appropriate features and levels of performance so that it repays their investment. Their interest in the outcome will be that the asset continues to perform, and the operating costs and revenue will be such that they can make a profit. They will also be interested in the reputation of the asset (Khang & Moe, 2008) and customer loyalty so they continue to receive their revenue stream. Their

Results Timescale	Project Output End of Project	Project Outcome Plus Months	Impact Plus Years
Investor or owner	Time Cost Features Performance	Performance Profit Reputation Consumer loyalty	Whole life value New technology New capability New competence New class
Project executive or project sponsor	Features Performance Time and cost	Performance Benefits Reputation Relationships Investor loyalty	Future projects New technology New capability New class
Consumers	Time Price of benefit Features	Benefit Price of product Features Developments	Competitive advantage Price of product Features Developments
Operators/users	Features Performance Documentation Training	Usability Convenience Availability Reliability Maintainability	New technology New capability New competence New class
Project manager and project team	Time Cost Performance Learning Camaraderie Retention Well-being	Reputation Relationships Repeat business	Job security Future projects New technology New competence
Senior supplier (design and/or management)	Completed work Time and cost Performance Profit from work Safety record Risk record Client appreciation	Performance Reputation Relationships Repeat business	Future business New technology New competence
Other suppliers (goods, materials, works, or services)	Time Profit Client appreciation	Reputation Relationships Repeat business	Future business New technology New competence
Public	Environmental impact	Environmental impact Social costs Social benefits	Whole life social cost-benefit ratio

Table 3: The new model of project success.

interest in revenue, operating costs, and profit will extend over the years to the whole life value the new asset provides. Shenhar and Dvir (2007) also suggest that their interest in the impact covers the new technology, competence, and capability the asset provides. We also suggest the asset

may be the first of a new class of product. The owner may receive the finance they use from a financier, who could be considered a separate stakeholder. Table 1 identifies one specific financier: the shareholders of the parent organization. Another may be a bank. For our purposes, we suggest

that the financier will share the owner's interests. In PRINCE2 (Office of Government Commerce, 2009), the owner is the senior managers who mandate the project.

- The project sponsor or project executive: These are senior managers from the owner or user organization who,

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prior to the project, identify the need for the new asset and the potential benefit it will bring. They persuade the investor to provide the finance for the project and during the project will continue to sponsor and support the project to win financial and political support for it. At the end of the project, they are concerned that the new asset should have the desired features and perform to solve the problem or exploit the opportunity identified. Their concern with time and cost will be that the new asset should potentially provide the investor with a profit or benefit. Their concern over the coming months will be that the new asset is performing to provide the predicted benefits, and so the support they have given the project is justified, and they are maintaining their reputation (Khang & Moe, 2008) and relationship with the investor (Turner & Müller, 2006). In the long term, they will want to gain support for future projects, and be interested in the new technology and new capabilities the new asset is providing the organization with (Shenhar & Dvir, 2007). PRINCE2 (Office of Government Commerce, 2009) calls this role the project executive.

The second stakeholder Westerveld (2003) identifies is the users. Turner (2009) differentiates between the operators (the group that operates the project's output on behalf of the owner) and the consumers (the people who buy the product or use the service that the project output makes or provides, and so pays the money that provides a return to the owner). Shenhar and Dvir (2007) include the consumers in the client. Thus, we can identify two more stakeholders:

- The consumers: These are the people or group who buy the product the new asset produces. They effectively obtain the benefit from the project's outcomes and pay for that benefit. This provides the investor with its revenue stream. The consumers' interest

in the output is the time that they begin to receive the product or benefit, and the price they pay for it. The price will reflect the cost of the project and of operating the new asset. They will be buying the features the new asset provides. This interest will continue throughout the life of the asset (Shenhar & Dvir, 2007; Turner, 2009). Over the years, they may also be interested in whether or not the benefit provided by the asset will provide them with a competitive advantage.

- The operators or users: These are the people or group who operate the asset on behalf of the owner. On completion, they will be interested in the features and performance of the asset, and in the documentation and training they are given. During early operations, their interest will be in the usability and convenience of the asset, and its availability, reliability, and maintainability (ARM). Over the years, they will be interested in the new technology, capability, competence, and class (Shenhar & Dvir, 2007). PRINCE2 (Office of Government Commerce, 2009) only identifies "users" and is primarily referring to this group of people.

Westerveld (2003) identifies the project team as a stakeholder. Shenhar and Dvir (2007) also identify the impact on the team. This introduces the fifth stakeholder group.

- The project manager and project team: At the end of the project, they are of course concerned with achieving the triple constraint, whether the work was completed to time and cost and the new asset performs. However, they will also be concerned with their learning from the project and the camaraderie from working on it, their future career moves, and their personal well-being (Reid, 2007; Turner, Huemann, & Keegan, 2008; Turner, Keegan, & Crawford, 2003). In the months following the project, they will be concerned with the reputation of their work (Khang & Moe, 2008) and

the maintenance of relationships and whether they get repeat business (Turner & Müller, 2006). Over the years, they will also be concerned with their job security (Turner et al., 2008), their future projects, and the development of new technology and competence (Shenhar & Dvir, 2007).

Project management is often written from the perspective of the client only (Shenhar & Dvir, 2007). However, as identified by Westerveld (2003) and Turner (2009), the contractor or supplier has an interest in project success. We identify two types of suppliers: the main contractor and subcontractors or material suppliers.

- The senior supplier: This group is senior management in the lead contractor. They may be from within the engineering or information systems department of the owner organization; they may be the consultant in the traditional (FIDIC, remeasurement) contract, or they may be a managing or prime contractor (Turner, 1995, 2003). At the end of the project, they are concerned that the work of the project should be completed to time and cost and that they will have made a profit from the work. They will also be interested in the safety record and risk record for the project. During operation, they will be concerned that the asset will perform as expected, to maintain their reputation as a prime contractor (Khang & Moe, 2008) and so they will maintain client or investor loyalty (Turner & Müller, 2006). In the years following, they will be interested in the new technology, competence, capability, and class (Shenhar & Dvir, 2007) and whether the success of this project increases the chance of future projects. PRINCE2 (Office of Government Commerce, 2009) calls this role the senior supplier, and Turner and Keegan (2001) and Turner (2009) call this role the steward.

- Other suppliers: These are people or groups who provide goods, materials, works, or services. Immediately after

the project, they will be concerned with whether the project finished on time so that they get paid promptly, and whether they made a profit. Over the coming months, their interest will be in their reputation (Khang & Moe, 2008) and repeat business (Turner & Müller, 2006). Over the years, they will continue to be interested in repeat business (Turner & Müller, 2006) and the development of new technology (Shenhar & Dvir, 2007)

The last group of stakeholders is identified by Westerveld (2003) but not by Shenhar and Dvir (2007). Westerveld (2003) refers to "other interested parties." Turner (2009) refers to bystanders but does not include them in Table 1. We focus in particular on the public.

- The public: The last stakeholder we consider is the public. Their concern throughout the life of the asset will be with environmental and social impacts (Atkinson, 1999). If the project is publicly funded, they may also be concerned about whether it is representing value for money, so that they know that their taxes have been well spent.

Forecasting Project Success

We have proposed that the success of the project can only be fully evaluated by the stakeholders in the months and years following completion of the project (Table 3). However, the project manager and project team have to make judgments during project execution about whether the project will be successful, and inevitably they focus on the immediate goals: whether the work will be completed to time, cost, and quality. However, to truly forecast whether the project will be successful, they need to be able to predict how the various stakeholders will judge success in the months and years following the project, and so they need control parameters (leading performance indicators) that will help them to make that judgment. Our aim is to develop leading performance indicators, metrics

that can be used to predict project success as suggested by Table 3 during the life of the project. There are at least two reasons for doing this:

1. So that the project team can take control decisions during project execution to direct the project toward achievement of project success as judged by the various stakeholders in the months and years following the project, and not (just) to complete the work to time, cost, and quality.
2. So that the project team can identify as early as possible if it is unlikely that they will be able to achieve the project goals within the range of resources the stakeholders are willing to commit. In other words, if the project goals cannot be achieved, the sooner the project is cancelled, the fewer resources will be wasted.

Turner (2002) suggested that leading performance indicators will be measures of the success criteria that can be monitored during project execution. However, Andersen, Birchall, Jessen, and Money (2006) showed that there is a direct relationship between project success (or failure) factors and the achievement of project success. Similar work was done by Yu, Flett, and Bowers (2005), Jacobson and Choi (2008), and Khang and Moe (2008). Based on the work of these authors and the contents of Table 3, we have developed a list of success or failure factors that will facilitate or mitigate against the achievement of the success criteria as perceived by the different stakeholders, and a list of indicators of stakeholder satisfaction that are premeasures of the stakeholders' success criteria shown in Table 4. The elements of Table 4 are the items that formed the basis of our scale development study. The success and failure factors were the basis of our project success factor scales, and the leading performance indicators were the basis of our project managers' assessment of stakeholder satisfaction scales.

Scale Development Study

We conducted a scale development study to determine whether the elements of Table 4 could be used to develop reliable measures to monitor project success factors and the project managers' perceptions of stakeholders' satisfaction. Although the items in the scales had been previously tested by research, and research indicates that project managers understand stakeholders' perceptions on important issues (Zolin, Cheung, & Turner, 2012), there was no certainty that the project managers' assessment of the stakeholders' satisfaction would form a reliable scale. Therefore, we needed to retest the reliability of all scales, which would also provide a smaller set of measures that can be used during the project to predict project outputs based upon stakeholder satisfaction.

Scale Development Process

In developing new scales and the questions used to measure them, we followed DeVellis's eight steps for scale development. The goal of the factor analysis was to condense the large number of items into a smaller number of reliable scales. Our aim was to develop two scales: a project success factor scale and a stakeholder satisfaction scale. The project success factor scale was populated with items from the second column of Table 4, which was constructed from the following nine input scales containing 31 items. For each scale, we show the number of items and a sample question:

1. Rich project information (six items): Project participants have an open and efficient way of informing each other as necessary.
2. Stakeholder endorsement of project plans (four items): All the organizations involved in the project effort have agreed to provide the project with sufficient resources.
3. Well-structured and formal project approach (four items): The project has its own management plan for control, which is used in an appropriate way.

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Project Stakeholders	Success and Failure Factors (Jacobson & Choi, 2008)	Stakeholder Satisfaction Indicators (Yu et al., 2005)
Investor or owner	Clear and accepted purpose Specific plan Open communications Stakeholder endorsement Early stakeholder influence Interested owner (Andersen et al., 2006; Khang & Moe, 2008; Turner & Müller, 2004)	Satisfaction with specifications Relationship with prime contractor Prototype performance Earned value Net project execution cost
Project executive or project sponsor	Open communications Political support	Stakeholder satisfaction Efficiency and effectiveness Profits Strategic goals Organizational learning
Consumers	Clear specifications Open communications Acceptance (Pinto & Slevin, 1988)	Satisfaction with specifications Relationship with sponsor Prototype performance
Operators/users	Clear specifications Commitment Open communications (Andersen et al., 2006)	Satisfaction with specifications Prototype performance
Project manager and project team	Clear and accepted purpose Specific plans Commitment Open communications Respect and trust Collaboration Political support Expert advice and review Risk awareness Clear roles and responsibilities Leadership style (Müller & Turner, 2007; Pinto & Slevin, 1988; Turner, 2009)	Pride in work Job satisfaction Recognition Personal growth Skill growth Contacts Reputation Top management support Retention Morale Stress, frustration, and time pressure (Bryde, 2005; Turner et al., 2008)
Senior supplier (design and/or management)	Open communications Risk awareness Respect and trust Collaboration	Managed risk Safety record Stakeholder satisfaction Efficiency and effectiveness Contract compliance Profits Strategic goals Organizational learning Reduced waste (Atkinson, 1999; Shenhar & Dvir, 2007)
Other suppliers (goods, materials, works, or services)	Commitment Open communications Respect and trust Collaboration	Business goals Contract compliance Profit (Atkinson, 1999; Shenhar & Dvir, 2007)
Public	Transparency Accountability Community outreach Political support	Opportunity cost Social impacts Environmental impacts (Atkinson, 1999; Yu et al., 2005)

Table 4: Project success and failure factors and indicators of stakeholder satisfaction for the project stakeholders in Table 3.

4. Strong project commitment (five items): The project executors conform to the planned cost schedule for all activities.
5. Early stakeholder influence (three items): All key participants have been engaged in producing the business plan, or have had the opportunity to influence it.
6. Well-understood and accepted project purpose (three items): If the project fulfills its goals, the results will be of great value to the end users.
7. Clear project constraints (three items): The final date of project completion is clearly defined for this project.
8. Project execution flexibility (two items): The project goal and its terms can be changed if conditions make it necessary.
9. Influence over ongoing project processes (two items): All participants can influence both decision making and responsibility allocation in the project.

The stakeholder satisfaction scale was populated with items from the third column of Table 4, which was constructed from the following nine input scales containing 60 items:

1. Project manager (satisfaction, etc.) (ten items): Has the project provided you with pride in your work?
2. Project owner (six items): Has appropriate specifications? (they are satisfied with them)
3. Project customer (four items): Has appropriate specifications? (they are satisfied with them)
4. Project operator (four items): Has developed appropriate documentation and training?
5. Project executives (ten items): Has allowed the project executive/project sponsor to profit?
6. Project contractor (nine items): Has demonstrated contract compliance?
7. Project supplier (three items): Helps the supplier achieve its appropriate business goals?
8. Public stakeholders (three items): Is creating good value for money?

9. Project participants (eleven items): The project participants have opportunities to learn from this project.

The survey contained a larger number of items that are relevant to the content of interest so it can function as a rich source from which scales can emerge. We also included some additional questions in the questionnaire to help detect various response biases (such as negative affect) and determine the validity of the final scale. In most cases, a 5- or 7-point Likert scale was employed.

Pilot Study

First we conducted a pilot study, the purpose of which was to ascertain the readability and appropriateness of survey questions. The pilot study involved eight project managers or program directors from the Australian Defence Materiel Organisation (DMO) and was conducted in a telephone interview format. The questionnaire was refined based on the comments received. The final questionnaire was again checked by two DMO staff at the senior management level and management support level prior to execution for the main study.

Main Study

An online survey tool was used. The study involved project managers or program directors nominated by the DMO. A total of 237 DMO project managers or program directors were invited to participate in the questionnaire survey. After two e-mail reminders were sent, we received 152 completed questionnaires, so the overall response rate was about 64%. The 152 returned questionnaires consisted of 50 respondents from air projects, 40 from joint projects, 31 from land projects, and 31 from sea projects.

Factor Analysis

Exploratory factor analysis was used to reduce the number of items in the two scales. Cronbach's alpha was used to ascertain the construct validity and reliability of the two scales. Questions

that detract from the Cronbach's alpha measure of the scale, or those that do not load optimally on the scale's factor, were dropped from the scale. Our cut-off was an alpha of 0.70, but two very close items were retained in case these items might score higher in future research. We conducted a rotated Varimax factor analysis using all success factor items. We repeated the process using the perceptions of stakeholder success items. These analyses were conducted using Eigenvalues greater than 1. This analysis converged within 11 iterations. We then took each factor and tested to ensure they loaded on one factor and, if so, calculated the Cronbach's alpha. Where a scale loaded on more than one factor, we tested the loadings and Cronbach's alpha for each subscale. The resulting project success factor scales are reported in Table 5, and the stakeholder satisfaction scales are reported in Table 6.

Results

We found two project success factor scales, which each loaded on only one factor and had a Cronbach's alpha higher than 0.7. Based upon the items in each scale, we chose appropriate names for the scales. The scale's alpha is provided in parentheses:

1. Project Planning (0.850)
2. Stakeholder Engagement (0.822)

We also found seven stakeholder satisfaction scales:

1. Stakeholder satisfaction (0.914)
2. Project executive satisfaction (0.907)
3. Product satisfaction (0.887)
4. Product efficiency (0.924)
5. Satisfaction with specifications (0.877)
6. Project manager satisfaction (0.875)
7. Contractor satisfaction (0.948)
8. Supplier profitability (0.947)
9. Public stakeholder satisfaction (0.951)

Discussion

Large, complex projects often fail to meet project output objectives of time,

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Input Scale	Scale Name • Items	Alpha Loading
	1. Success in Project Planning	0.850
Rich Project Information	• The project has well-established information and communication routines.	0.778
Rich Project Information	• All key project information is gathered and distributed efficiently.	0.764
Well-Structured and Formal Project Approach	• The project has its own management plan for control, which is used in an appropriate way.	0.767
Well-Structured and Formal Project Approach	• Project control is executed by good managerial or technical methods.	0.798
Well-Structured and Formal Project Approach	• Planning tools or similar aids are used in an effective way in project planning.	0.753
Clear Project Constraints	• The project is well described and coordinated with activities in other projects.	0.687
	2. Key Participants Engaged	0.822
Early Stakeholder Influence	• All key participants have been engaged in producing the business plan or have had the opportunity to influence it.	0.898
Early Stakeholder Influence	• All participants have been given the opportunity to air their views on the project's goal or mission.	0.898
Early Stakeholder Influence	• All key people engaged in the project know who has decided its terms of references.	0.793

Table 5: Project success factor scales.

cost, and quality. In the past, this has been considered project failure, although stakeholders may still reap huge benefits over time, thus categorizing the project as a success in the long run. Likewise, other projects finish on time and at cost, and so are said to be a success, but fail to deliver the desired benefits to the stakeholders. This indicates that the iron triangle of TCQ (time, cost, and quality) is an indicator of project performance but not the best measure of project success. Thus, to fairly and accurately evaluate project success, one needs to consider the views of multiple stakeholders over multiple time frames.

We developed a model of project success that addressed the views of multiple stakeholder groups from the end of the project (outputs) to shortly after the project (outcomes) to the longer term (impacts). We conducted a scale development study to determine what project success factors and stakeholder satisfaction indicators that could be measured during the life of the project could form reliable scales to

predict project outputs. We found only two project success factor scales: project planning and stakeholder engagement. The project planning scale measures the existence of well-established information and communication routines and tools, key project information gathered and distributed efficiently, and appropriate project control. Stakeholder engagement indicates that stakeholders have been given the opportunity to air their views, influence the project plans, and know what has been decided.

In contrast, we found nine stakeholder satisfaction indicators. Stakeholder satisfaction addresses the major goals of the owner, executive, contractor, and suppliers. A high score on this scale would indicate that these central stakeholders are in general satisfied with the success of the project. The project executive satisfaction scale indicates the project executive is satisfied with issues like stakeholder satisfaction, project performance, efficiency and effectiveness, and achievement of the executive's goals. Product satisfaction indicates the

customer and operator prototype works and the product performs well. Product efficiency indicates that the owner, contractor, and customer think the prototype works and the product performs efficiently. Satisfaction with specifications indicates the owner and customer and operator are satisfied with the specifications for the product. Project manager satisfaction indicates that the project manager gets pride, satisfaction, recognition, growth, contacts, and top management support. Contractor satisfaction indicates the contractor believes stakeholders will be satisfied, the project is effective, and there has been compliance with the contract. Supplier profitability indicates that the suppliers have been allowed to make a profit. Public stakeholder satisfaction indicates that, from the public perspective, the project has balanced social costs and benefits and has acceptable environmental impacts.

Longitudinal research is needed to determine if these success factors and indicators predict project outputs,

Stakeholder Group	Scale Name • Items	Alpha Loading
	1. Stakeholder Satisfaction	0.914
Owner	• Has a good relationship with the prime contractor?	0.813
Owner	• Has good performance?	0.804
Owner	• Has appropriate earned value?	0.881
Executive	• Has allowed the project executive/project sponsor to profit?	0.870
Contractor	• Has achieved stakeholder satisfaction?	0.840
Contractor	• Has helped the senior supplier achieve their appropriate business goals?	0.940
Supplier	• Helps the supplier achieve their appropriate business goals?	0.908
Contractor	• Has a good safety record?	0.929
	2. Project Executive Satisfaction	0.907
Executive	• Has achieved stakeholder satisfaction?	0.869
Executive	• Has achieved satisfactory performance efficiency?	0.907
Executive	• Has achieved satisfactory performance effectiveness?	0.840
Executive	• Helps the project executive/project owner achieve their appropriate business goals?	0.801
Executive	• Has stakeholder satisfaction?	0.872
	3. Product Satisfaction	0.887
Customer	• Has a useful prototype?	0.951
Operator	• Has a useful prototype?	0.972
Operator	• Has good performance?	0.878
	4. Product Efficiency	0.924
Owner	• Has a useful prototype?	0.943
Contractor	• Has achieved performance efficiency?	0.876
Contractor	• Has managed risk appropriately?	0.992
Customer	• Has good performance?	0.979
	5. Satisfaction With Specifications	0.877
Owner	• Has appropriate specifications? (they are satisfied with them)	0.802
Customer	• Has appropriate specifications? (they are satisfied with them)	0.925
Customer	• Has a good relationship with the project owner?	0.815
Operator	• Has appropriate specifications? (they are satisfied with them)	0.881
	6. Project Manager Satisfaction	0.875
Project Manager	• Pride in your work?	0.759
Project Manager	• Job satisfaction?	0.863
Project Manager	• Recognition?	0.768
Project Manager	• Skill growth?	0.790
Project Manager	• Contacts?	0.672
Project Manager	• High morale?	0.795
Project Manager	• Attracts top management support?	0.652
	7. Contractor Satisfaction	0.948
Contractor	• Has achieved stakeholder satisfaction?	0.921
Contractor	• Has achieved performance effectiveness?	0.964
Contractor	• Has reduced waste?	0.977
Supplier	• Has demonstrated contract compliance?	0.981
Contractor	• Has demonstrated contract compliance?	0.970
	8. Supplier Profitability	0.947
Contractor	• Has achieved performance efficiency?	0.911
Contractor	• Has allowed the supplier to profit?	0.976
Supplier	• Has allowed the supplier to profit?	0.972
	9. Public Stakeholder Satisfaction	0.951
Public	• Has balanced social costs and benefits?	0.977
Public	• Has acceptable environmental impacts?	0.977

Table 6: Project managers' perceptions of stakeholder satisfaction indicators.

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outcomes, and impacts. There are a number of practical and theoretical implications of this study.

Practical Implications

For practitioners, the evaluation of project success will be more difficult due to the necessity of considering the perspectives of different stakeholder groups. But this cost is offset by the second implication: better management decisions and, more important, better "Go-No/Go-GoBack" decisions during the life of the project. After project closeout, using this richer method of evaluating success will provide more perspicacious post-action reviews and lessons learned. Finally, it is hoped this more sophisticated method of evaluating success will create greater appreciation of actual project achievements among stakeholders and the general public. There may also be practical benefits to policy development in improving the way project success factors are assessed by stakeholders. Evaluations of project success by stakeholders are inherently subjective and cannot be summarized naively into the iron triangle without under- or overestimating project success at critical points in the project life cycle. This model of project success makes clear the connections between factors that can be measured during the life of the project and long-term impacts of interest to stakeholders.

Academic Implications

Our major contributions are the recognition of stakeholders as the evaluators of project success combined with our method of evaluating project success across a range of time frames. These contributions are operationalized in our model of project success (see Table 3). By acknowledging the central role of the various stakeholder groups in determining project success, we increase our understanding of the importance of stakeholder management. The work of this article also further enhances our understanding of project success, and we hope will initiate

research into leading performance indicators that can be used by project managers to forecast the way stakeholders will perceive the project in the months and years following project completion. It is important that project managers are able to make decisions during project execution that will truly guide the project toward project success. We believe we have initiated the development of such leading performance indicators, but the ones we have developed still have a fairly narrow time horizon. More research is needed to test the ability of these scales to predict long-term project success. ■

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Rodney Turner is a managing consultant at EuroProjex Ltd and academic director of the PhD in project and programme management department at SKEMA Business School in Lille, France. He is an adjunct professor at the University of Technology Sydney and the Kemmy Business School in Limerick, Ireland. He is the author or editor of 16 books, and more than 30 peer-reviewed journal articles. He is editor of the *International Journal of Project Management*. He is vice president, Honorary Fellow, and former chairman of the United Kingdom's Association for Project Management, and former president and chairman of the International Project Management Association. His research interests are leadership and human resource management in project-oriented organizations; the management of projects in small and medium-sized enterprises; the success of complex projects; and governance, ethics, and trust on projects.

Roxanne Zolin, PMP, is an associate professor in the School of Management at the Queensland University of Technology. She helped develop and teach their executive master's program in complex project management. She obtained a PhD in construction engineering management from Stanford University, where she also holds a master's degree in sociology.