Spring 1-1-2012

External Environment as a Critical Success Factor in World Bank Projects

Marc Hassan
University of Colorado at Boulder, marc.j.hassan@gmail.com

EXTERNAL ENVIRONMENT AS A CRITICAL SUCCESS FACTOR IN WORLD BANK PROJECTS

by

MARC HASSAN

B.S., University of Pennsylvania, 2008

A thesis submitted to the

Faculty of the Graduate School of the

University of Colorado in partial fulfillment

of the requirements for the degree of

Master of Science

Department of Civil, Environmental, and Architectural Engineering

2012

This thesis entitled:
External Environment as a Critical Success Factor in World Bank Projects
written by Marc Hassan
has been approved for the Department of Civil, Environmental, and Architectural Engineering

____

Bernard Amadei

____

Rajagopalan Balaji

____

Rita Klees

Date ____________________

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

Hassan, Marc (M.S., Civil, Environmental, and Architectural Engineering)

External Environment as a Critical Success Factor in World Bank Projects

Thesis directed by Professor Bernard Amadei and Professor Rajagopalan Balaji

Over the past few decades, the proportion of international development projects that have been successful has remained low across development agencies. In recent years, researchers have explored Critical Success Factors for international development projects in an attempt to explain and fix this disappointing project performance. Most of the research has been concerned with project-level factors, such as quality of monitoring, coordination and design, and many of these factors have been shown to be positively related to success. However, projects do not take place in a bubble; they are part of a complex system made up of people, governments and nature. Therefore, this study considers factors of the larger external environment, such as governance and economy. Using project data from the World Bank's Independent Evaluation Group and country-level indicators from various sources, Principal Component Analysis identifies five components that describe World Bank projects: Governance, Industrialization, Economical, Technical, and Environmental. Regression shows that good governance and a high level of industrialization are strongly related to better project performance. This study explores these relationships for various project sectors and regions. Finally, this research concludes that unfavorable external conditions can be offset by improved World Bank supervision, which is associated with substantially higher project success rates.

ACKNOWLEDGMENTS

I would like to thank my advisors, Bernard Amadei and Rajagopalan Balaji, for their ideas, guidance and assistance, without which I would not have been able to complete this thesis. I would also like to acknowledge Rita Klees for her feedback and participation on the Advisory Committee.

Finally, I am grateful to my friends and family for their unending love, support and enthusiasm during this process.

CONTENTS

TABLES

FIGURES

I INTRODUCTION

I.1 Background

Over the last several decades, international development project success (or lack thereof) has been a topic of discussion amongst aid organizations, donors and independent researchers. Poor project performance, resulting in disappointed stakeholders and donors, dates back to the 1950s, but aid organizations and governments have yet to solve this problem [1]. In recent years, ratings by the Independent Evaluation Group indicate that World Bank project success rates have hovered around 52%, an unacceptable track record considering the amount of aid dollars going into these projects [2]. Other development banks perform with similarly low rates; for example, the Asian Development Bank reported in 2012 that 68% of its projects in recent years have been successful, well below its target of 80% [3]. With such a high level of project failure, society's long-term goals of alleviating global poverty, improving health and encouraging human development seem even harder to achieve.

While the Project Management literature is full of analysis on general project success, international development projects are considered unique due to their complex objectives and diverse stakeholders; thus, this literature falls short. Until the last decade or so, success criteria and Critical Success Factors (CSFs) for international development projects have been inadequately understood by project implementers [1, 4, 5].

The recent International Development Project Management (IDPM) literature has established that certain project-level aspects of international development projects (supervision, coordination, etc.) are crucial in leading to successful projects [1]. However, little has been written about the significance of a project's external environment (governance, economics, social attitudes, etc.) in yielding good performance.

I.2 Research Question

How are external environment (governance, economics, social factors, etc.) and project success related when it comes to World Bank international development projects, and how might the World Bank respond to this relationship to improve project success rates? This research looks at several categories of external environment and how each is (or is not) related to project success, particularly in certain project sectors.

I.3 Research Method

This thesis addresses the research question through a statistical approach. Using data from the World Bank's Independent Evaluation Group, the World Bank Databank and other sources, five principal aspects of the external environments of World Bank projects were extracted through Principal Component Analysis. Then, regression analyses were performed to explore how these five components might explain project success or failure. These results were then compared to the importance of World Bank supervision, which is known to be strongly linked to project success [5].

This research concludes with recommendations for the World Bank as to environmental conditions to consider during planning and how they might counteract the ill effects of poor environmental conditions through controllable aspects of their implementations.

I.4 Success Criteria

The question of how to define project success is discussed throughout the international development project management (IDPM) literature. Matsumura identifies several success criteria that have shown up repeatedly, including achievement of objectives, satisfaction of beneficiaries, visible impact, building of institutional capacity and sustainability. The World Bank uses a narrower definition of success: “the extent to which the operation’s major relevant objectives were achieved, or are expected to be achieved, efficiently.” Therefore, the World Bank considers relevance of objectives, efficacy of achievements and efficiency in realizing those achievements as the principal measures of success [6].

The Independent Evaluation Group (IEG) at the World Bank is tasked with evaluating the success of World Bank projects. After completion of a project, World Bank Task Managers complete an Implementation Completion Report (ICR) outlining project impacts, finances, sustainability and monitoring & evaluation. Through an independent review of the ICR (this has been done for about a quarter of all World Bank projects), the IEG codifies ten Likert-scale indicators of project performance, including World Bank supervision, sustainability and outcome. This outcome rating takes into account all aspects of project performance in fulfilling the World Bank’s success definition above.

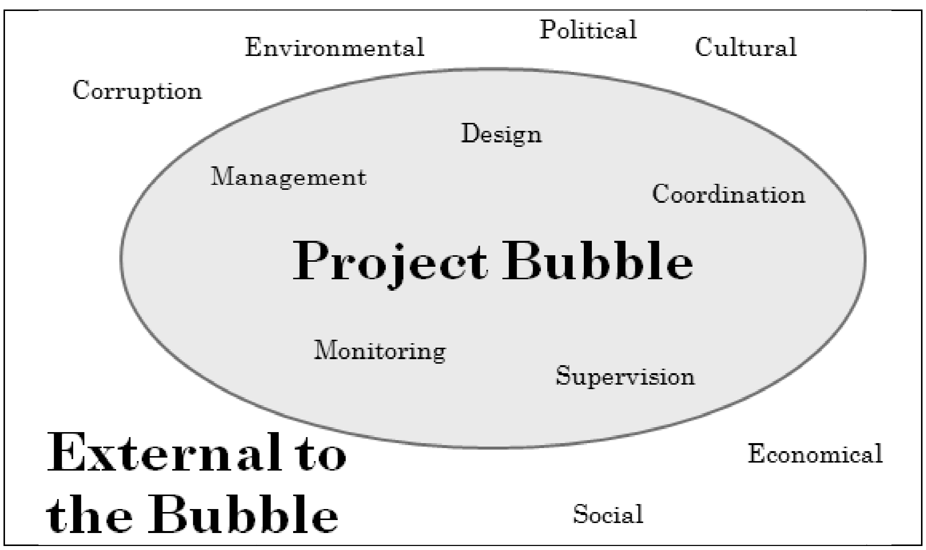
I.5 Critical Success Factors

Critical Success Factors (CSFs) are project-level or external factors that influence project success (Figure 1). Kwak defines CSFs as the “internal and external, visible and invisible factors that influence the environment and create a high amount of risk in accomplishing the project objectives.” Belassi and Tukel group CSFs into four categories:

factors related to the project, factors related to the project team, factors related to the organization and factors related to the project environment. These, in turn, affect client acceptance, availability of resources and effective implementation, which lead to success or failure [7].

The IDPM literature has dealt mainly with project-level factors, for example, quality of design, effective consultation with stakeholders, strong management and consistent monitoring of progress. Kilby shows that World Bank projects with high supervision are successful at a significantly higher rate [5]. Ika et al. demonstrate a positive relationship between World Bank project success and each of monitoring, coordination, design and training [1].

Figure 1: Critical Success Factors Internal and External to the Project Bubble



While the IDPM literature has identified several project-level CSFs as important, there has been little consideration of how the environment outside the project bubble affects development project success. For example, Ika et al. identify 23 factors that are related to project success; however, only one of these ("Favorable political, eco, social, and cultural conditions") is concerned with the environment external to the project itself. Ika et al. go on to say that the research "fails to explicitly account for the all-important micro/macro-political context for World Bank projects and does not consider power and influence issues without which it is not entirely possible to understand CSFs" [1]. Despite this caveat, the IDPM literature is light on analysis of these issues.

I.6 External CSFs

CSFs related to the external environment have been shown to impact international development project success. Chauvet et al. conclude that World Bank projects in post-conflict countries tend to have a higher rate of success than in countries at peace and identify post-conflict situations as opportunities for successful implementation of certain types of projects [4]. An analysis of how multiple CSFs contribute to international development project success has not yet been done.

Table 1: CSF categories proposed by Kwak [8]

Factor	**Composition**
Political	Political instability, war, revolution, government accountability
Legal	Regulatory policy, role of local courts
Cultural	Different cultural backgrounds of stakeholders, misfit of objectives
Technical	Technological capacity, human capital
Managerial/ Organizational	Project management, resource allocation, planning, communication
Economical	Economic conditions, regulatory changes
Environmental	Pollution, use of natural resources
Social	Ethnic hostility, religious fragmentation
Corruption	Lack of regulatory institutions, bribery
Physical	Natural disasters, terrorism

Kwak proposes ten categories for CSFs in international development projects, which are shown in Table 1 [8]. Note that each of these categories is external to the project itself, except Cultural and Managerial/Organizational. It is this set of external CSF categories that informs the research herein.

II DATA

II.1 World Bank IEG Ratings Dataset

In November 2011, the World Bank's Independent Evaluation Group released to the public a dataset containing evaluations of nearly 10,000 World Bank projects since the 1960s [2]. The dataset provides high-level project data (name, country, approval year, exit year, etc.)[1] and performance indicators (outcome, quality of Bank supervision, quality of Monitoring & Evaluation plan, etc.) for each project. AidData, an initiative that aims to improve aid information transparency and research on aid effectiveness, commended IEG by announcing, "We are not aware of any other donor that has published such comprehensive project implementation and evaluation data" [9]. Because of its size, this dataset enables researchers to make conclusions with greater statistical confidence than in the past.

The IEG Ratings dataset includes 9,854 projects in 156 countries and 10 sectors from 1956 through 2010. The median project cost is $30M and the median project duration is 7 years. The outcomes of 9,680 of those projects have been rated by IEG's evaluators between 1973 and 2012. Based on IEG's review, each project gets a score between "highly unsatisfactory" (1) and "highly satisfactory" (6). This 6-point scale is reduced to a binary scale for the purposes of this research, where a score of "highly satisfactory" (6) or "satisfactory" (5) is labeled as Successful and "moderately satisfactory" (4), "moderately unsatisfactory" (3), "unsatisfactory" (2) or "highly unsatisfactory" (1) is labeled as Unsuccessful. The inclusion of "moderately satisfactory" in the Unsuccessful grouping is done to alleviate potential upward bias in how the World Bank evaluates its own projects

[1] Project sector data was taken from the World Bank Projects and Operations database [14].

[4, 9]. Certainly, this choice of grouping affects the findings of this research; future work might consider looking at how other groupings affect these findings.

Table 2: Descriptive statistics of World Bank projects

	Number of projects (% of total)	Project success rate, % of projects
All Projects	**9680**	**57%**
Sector*		
Agriculture, fishing and forestry	1994 (21%)	55%
Public administration, law and justice	1356 (14%)	45%
Transportation	1238 (13%)	69%
Industry and trade	1080 (11%)	59%
Energy and mining	1053 (11%)	64%
Education	858 (9%)	63%
Finance	650 (7%)	59%
Health and other social services	644 (7%)	42%
Water, sanitation and flood protection	637 (6%)	55%
Information and communications	170 (1%)	74%
Region*		
Africa (AFR)	2815 (29%)	48%
Latin America & Caribbean (LCR)	1958 (20%)	58%
East Asia & Pacific (EAP)	1558 (16%)	71%
Europe & Central Asia (ECA)	1296 (14%)	60%
South Asia (SAR)	1173 (12%)	58%
Middle East & North Africa (MNA)	880 (9%)	57%
Decade (year of project approval)		
1950s	3 (0%)	100%
1960s	242 (2%)	87%
1970s	1913 (20%)	73%
1980s	3011 (31%)	57%
1990s	3180 (33%)	52%
2000s	1325 (14%)	42%
2010s	6 (0%)	83%

*Sectors and Regions as defined by World Bank [10]

According to IEG and the chosen binary grouping of success herein, 57% of the near 10,000 World Bank projects in the dataset were successful. Transportation projects have the highest success rate (69% were successful), while Health projects have the lowest (42% were successful). Although projects in Africa have made up 29% of projects (more than any other region), projects in Africa have a success rate of only 48%.

Table 3: Project success rates by sectors and regions

	AFR	LCR	EAP	ECA	SAR	MNA	**All**
Agriculture	43% (N=615)	54% (N=295)	66% (N=374)	63% (N=165)	60% (N=370)	56% (N=175)	**55% (N=1994)**
Administration	35% (N=514)	47% (N=321)	53% (N=117)	59% (N=256)	48% (N=83)	34% (N=65)	**45% (N=1356)**
Transportation	67% (N=400)	66% (N=269)	82% (N=238)	66% (N=131)	57% (N=90)	72% (N=110)	**69% (N=1251)**
Industry	51% (N=249)	57% (N=209)	68% (N=150)	62% (N=215)	63% (N=144)	55% (N=113)	**59% (N=1080)**
Energy	54% (N=218)	64% (N=211)	83% (N=201)	57% (N=169)	59% (N=173)	69% (N=81)	**64% (N=1053)**
Education	56% (N=279)	65% (N=180)	85% (N=149)	53% (N=58)	59% (N=94)	57% (N=98)	**63% (N=858)**
Finance	42% (N=145)	59% (N=150)	65% (N=108)	71% (N=122)	66% (N=58)	62% (N=67)	**59% (N=650)**
Health	29% (N=199)	50% (N=155)	51% (N=76)	46% (N=89)	48% (N=67)	41% (N=58)	**42% (N=644)**
Water	61% (N=142)	57% (N=139)	63% (N=110)	51% (N=81)	36% (N=67)	52% (N=98)	**55% (N=637)**
Information	65% (N=54)	76% (N=29)	71% (N=35)	90% (N=10)	78% (N=27)	88% (N=15)	**74% (N=170)**
All	**48% (N=2815)**	**58% (N=1958)**	**71% (N=1558)**	**60% (N=1296)**	**58% (N=1173)**	**57% (N=880)**	57% (N=9680)

Particularly, projects in the Public administration and Health sectors underperformed significantly in Africa (35% and 29% success rates, respectively). Projects in East Asia & the Pacific outperformed the other regions with a 71% success rate. Also, project success rate steadily decreased between the 1960s and 2000s, from 87% to 42%.

IEG evaluations of World Bank projects have met with some criticism in the past, namely that the method of evaluation is not rigorous and that project success depends on expectations inherent in the objectives rather than the success of implementation (for example, projects with low expectations may meet objectives more easily). However, the evaluation procedure has been developed significantly over the years and has been generally accepted [1, 4, 5]. For these reasons, the assigned outcomes have been accepted for this research.

II.2 External CSF Data

In order to show a relationship between external environment and project success, various measures of external environment needed to be collected for each project. This was achieved through the exploration of country-level, annual indicators from various sources, including the World Bank Databank. These indicators were chosen to reflect a cross-section of some of the CSF categories in Table 1.

Table 4: Initial list of chosen sources and indicators

World Bank – World Development Indicators	**World Bank – Worldwide Governance Indicators**
GDP per capita	Voice and Accountability
Gini Index (wealth dispersion)	Political Stability
GDP growth	Government Effectiveness
Internet users per capita	Regulatory Quality
Mobile users per capita	Rule of Law
Population density	Control of Corruption
Population growth	**The Fund For Peace – Failed States Index**
Urban population growth	Demographic Pressures
Rural population growth	Refugees and IDPs
Official exchange rate	Group Grievance
Natural resources rents (% of GDP)	Human Flight
Inflation	Uneven Development
Consumer Price Index (CPI)	Poverty and Decline
Electricity consumption per capita	Legitimacy of the State
Real interest rate	Public Services
Primary school enrollment	Human Rights and Rule of Law
Physicians per capita	Security Apparatus
Health expenditure per capita	Factionalized Elites
Unemployment	External Intervention
Employment in industry	**UN Development Program – International Human Development Indicators**
Employment in services	Human Development Index (HDI)
Employment in agriculture	**Alesina et al. – Fractionalization**
Roads (% paved)	Ethnic Fractionalization
Agricultural land (% of land)	Language Fractionalization
CO_2 emissions per capita	Religious Fractionalization
CO_2 emissions per $ GDP	

See APPENDIX A – Indicator Details for indicator and source details.

A caveat of this research is that country-level, annual indicators are only an average over a country for a year; they do not reflect regional differences or events within a country or year. However, in order to examine a large number of projects statistically, there must be data on external environment to go with those projects, and the data that is available is by country and year. Additionally, although projects may occur on a more local basis, World Bank projects involve lending to large governments and organizations, where country-wide indicators are applicable.

III METHODOLOGY

III.1 Data Compilation

Once the indicator data were collected, they could be merged with the IEG ratings dataset. Based on project country, year of approval and year of exit, an average for each indicator could be assigned for the life of each project. A few indicators had to be removed from the analysis at this point due to insufficient data. For example, fractionalization measures were only collected in one or two years for each country, which was not enough to span a large portion of the World Bank projects. Fractionalization and Failed States Index indicators were removed, which reduced the number of candidate indicators from the 48 indicators listed in Table 4 to 33.

III.2 Principal Component Analysis

While the 33 candidate indicators may have individual relationships with project success, many of them may also be highly correlated with each other. Organizing them into a smaller number of independent categories allows most of the variability in the data to be explained using fewer variables. After scaling all indicators so they have zero mean and unity variance, Principal Component Analysis (PCA) is a commonly-used method that teases out the most explanatory parts of the data, creating orthogonal "components" that explain the data variability succinctly [11]. The components are linear combinations (whose coefficients are called "loadings") of a subset of indicators. Ideally, PCA results in a small set of indicators (4-6) that explain a large percentage (greater than 70%) of data variance.

III.3 Varimax Rotation

Frequently, the first several components of interest from PCA have overlapping loadings that make the components difficult to interpret. In order to counter that, this set of components is then rotated in space and the orthogonality condition of PCA is relaxed to create "clean" components whose loadings do not overlap [11]. Ideally, the rotated components would have some real-world meaning; in the case of this research, the components would hopefully correspond to CSF categories identified above.

III.4 Logistic Regression

Once the components are chosen, regression analysis can be used to explain their relationship with project success. Because project success has been converted to a binary variable, logistic regression using the generalized linear model (as opposed to linear regression) should be used [4]. Logistic regression fits a linear model of the regressors (independent variables) to the logit (log odds) function of a binary response (dependent variable). Logistic regression fits the coefficients beta in the model:

$$\text{logit}(Success) = \ln \frac{p(Success)}{1 - p(Success)} = \beta_1 Comp_1 + \beta_2 Comp_2 + \ldots + \beta_n Comp_n$$

This method provides the user with a probability of the response being 1 given the values of the regressors. It allows the user to assess the relative importance of each regressor in contributing to the response. In this research, project success (unsuccessful or successful) is the response and the CSFs are the regressors. Logistic regression models on sectoral and regional subsets of data can be fit to observe differences in project sectors and regions.

III.5 Predictive Model

The suite of logistic regression models can be used by the World Bank to predict the probability of project success given a set of input values (indicators) and project sector. Cross-validated skill scores of these prediction models are measures of how well the model will predict new values, and these are explained and computed in section IV.4 Model Diagnostics. The predictive model should be used according to the following steps, where the values that should be used for the matrices and vectors mentioned below are provided in APPENDIX B – Predictive Model Inputs.

Step 1: Estimate input values

Collect the set of input values into a column vector. The exact values to be used are defined in the section IV.7 Predictive Model.

$$v = \begin{bmatrix} \text{Input 1} \\ \text{Input 2} \\ \vdots \\ \text{Input } n \end{bmatrix}$$

Step 2: Compute vector of external CSF values from PCA loadings

Before the PCA, all data points were scaled so that the indicators would each have zero mean and unity variance. This step must be recreated for prediction of new points.

$$v_{scaled} = Q_{1/\sigma}(v - q_{\mu})$$

The loadings from the PCA can then be applied to the scaled indicators vector.

$$v_{CSF} = (Q_{PCA})^T v_{scaled}$$

Step 3: Form the sector vector

This is a row vector with just a 1 corresponding to the number of the sector as listed in Table 3. For example, a project in the Administration sector would have a sector vector of

$$s = \begin{bmatrix} 0 & 1 & 0 & \cdots & 0 \end{bmatrix}$$

Step 4: Compute the logit function value

$$l = \log(\tfrac{p}{1-p}) = sC_1 v_{CSF} + c_2$$

Step 5: Compute the probability of success (inverse of logit function)

This is the project's probability of success given the input values.

$$p = \Pr(\text{Success} = 1) = \frac{l}{1+l}$$

III.6 Software

All analysis described in this chapter took place in the R 2.14.1 software environment. A summary of the R commands used can be found in APPENDIX C – R Commands.

IV RESULTS

IV.1 Principal Component Analysis

After scaling the indicators to zero mean and unity variance, Principal Component Analysis was used to identify four to six orthogonal components comprised of some or all of the 33 candidate indicators. A stepwise method was used in which indicators that did not load strongly on any of the first four, five or six components were removed one at a time. The PCA loadings showed some overlap amongst the first several components, making them hard to interpret, as shown in Table 5.

Table 5: Principal Component Analysis (loadings before Varimax) of external CSFs

	PC1	PC2	PC3	PC4	PC5
Gini Index (wealth dispersion)		–.268	–.471		–.164
Government Effectiveness	–.346	–.274	.127		.170
Regulatory Quality	–.342	–.275			
Rule of Law	–.293	–.257	.282		.229
Control of Corruption	–.321	–.311	.103		.154
Internet users per capita	–.265		–.215	.504	–.134
Mobile users per capita	–.230	.122	–.229	.531	–.177
Population density			.449	.147	–.309
Population growth	.299	–.289		.142	.297
Urban population growth	.308	–.200		.140	.332
Natural resources rents (% of GDP)	.160	.272	–.240		.370
Inflation			–.190	–.429	–.132
Electricity consumption per capita	–.353	.259	–.145		
Real interest rate		–.250	–.293	–.310	–.377
Agricultural land (% of land)			.383		–.362
CO_2 emissions per capita	–.314	.290		–.127	.269
CO_2 emissions per $ GDP		.426	.124	–.282	.110
Variance Explained	**30%**	**17%**	**12%**	**9%**	**7%**

N = 2842, Kaiser-Meyer-Olkin = 0.72, total variance explained = 75%, no rotation.
See APPENDIX A – Indicator Details.

A Varimax rotation was done to create “clean” components with no overlap. Finally, five clean components comprised of 17 indicators, accounting for 75% of data variance and with loadings above a cutoff of .370 were chosen [11]. The five components corresponded to Governance, Industrialization, Economical, Technical and Environmental CSF categories, four of five of which fit the definitions of CSF categories identified in Table 1.

Table 6: Principal Component Analysis (loadings after Varimax) of external CSFs

	PC1	PC2	PC3	PC4	PC5
Governance CSF					
(ω=.96; var=30%)					
Rule of Law	.499				
Government Effectiveness	.486				
Control of Corruption	.484				
Regulatory Quality	.429				
Industrialization CSF					
(ω=.89; var=17%)					
Population growth		–.466			
Electricity consumption per capita		.433			
CO_2 emissions per \$ GDP		.424			
Urban population growth		–.419			
CO_2 emissions per capita		.413			
Economical CSF					
(ω=.94; var=12%)					
Real interest rate			–.615		
Gini Index (wealth dispersion)			–.505		
Inflation			–.374		
Technical CSF					
(ω=.75; var=9%)					
Internet users per capita				.652	
Mobile users per capita				.624	
Environmental CSF					
(ω=.91; var=7%)					
Population density					–.533
Agricultural land (% of land)					–.520
Natural resources rents (% of GDP)					.459

N = 2842, Kaiser-Meyer-Olkin = 0.72, total variance explained = 75%, Varimax rotation, McDonald's Omega > 0.75 [12]. See APPENDIX A – Indicator Details.

The absolute value of the loading indicates the degree to which that indicator contributes to the CSF. A negative loading means that the indicator diminishes the CSF;

for example, each of the loadings for the Economical CSF is negative because each of those (high interest rate, high wealth dispersion and high inflation) corresponds to poor economic conditions.

The loadings were used to assign scores in the five CSFs to each project, where a higher score indicates higher quality of that CSF. Certainly, the indicators identified as important to the components are not the only factors that contribute to the components; for example, the Technical score of a project's external environment can be described by many more factors than mobile and Internet use. However, the indicators chosen were meant to serve as proxies for the full picture in the absence of more representative indicators. Future work in this research will necessitate expanding the list of indicators to arrive at more complete scores for each component.

During the PCA, the sample size of the analysis was reduced substantially (from 9680 to 2842 projects), as projects missing one or more important indicators could not be included. As most of the missing data was for projects before 1980, this PCA and the subsequent regression analyses are based mainly on projects that took place after 1980; however, the proportions of projects in each sector and region do not change significantly as a result.

IV.2 CSF Observations

As expected, the five CSFs show low correlation with each other. The only component that shows a significant relationship with time is the Technical CSF, which, being composed solely of mobile and Internet use, increases temporally, as expected. Additionally, examination of the CSFs by region and sector shows that some regions and sectors have significantly different CSF values.

Table 7: Descriptive statistics of CSF values

	N	Gov. CSF	Ind. CSF	Econ. CSF	Tech. CSF	Env. CSF
AFR	333	**–1.60**	**–1.97**	–0.01	**–0.66**	0.48
LCR	768	**0.48**	–0.37	**–1.17**	0.28	0.26
EAP	549	0.13	–0.29	0.53	–0.30	–0.07
ECA	663	0.18	**2.45**	0.45	**0.61**	0.00
SAR	329	–0.15	–1.07	**0.67**	–0.60	**–1.52**
MNA	200	0.06	–0.99	0.53	–0.33	**0.80**
Agriculture	350	0.08	–0.41	0.03	–0.19	–0.15
Administration	597	**–0.25**	0.13	**–0.11**	**0.24**	**0.20**
Transportation	332	0.07	–0.12	0.04	–0.03	–0.09
Industry	218	–0.00	**0.70**	0.09	–0.23	–0.17
Energy	273	0.27	0.45	0.10	–0.21	–0.15
Education	282	–0.05	**–0.50**	0.02	–0.06	0.03
Finance	168	0.17	0.22	0.07	–0.02	–0.01
Health	332	–0.13	–0.07	–0.03	0.22	0.03
Water	251	0.04	–0.26	–0.05	–0.14	0.08
Information	39	**0.63**	–0.12	**0.25**	**–0.30**	**–0.27**
Mean		–0.005	–0.010	0.004	–0.013	–0.005
Std. Dev.		1.73	1.76	1.11	1.23	1.04

Shows the mean CSF value for each sector and region, as well as the overall means and standard deviations for each CSF**. Bold** indicates a maximum or minimum mean for that CSF.[2]

Table 7 points to some valuable observations. On average, projects in Latin America have tended to take place in countries with better governance than projects in Africa; projects in South Asia have tended to take place in better economic conditions than projects in Latin America; Industry and trade projects have tended to take place in more industrialized nations than education projects. Some of these observations may not be surprising, which serves to validate the base legitimacy of these CSFs and how they have been computed.

[2] Welch two-sample t-tests show significant differences between maximum and minimum means for each CSF (p-value<.05). Normality of CSFs is assumed for these tests.

IV.3 Logistic Regression

With the five CSF scores computed and a binary success value for each project, logistic regression was used to examine each CSF's contribution to project success.

Table 8: Output of logistic regression for 5 external CSFs

	Estimate	Std. Error	z	p-value	Sig.[3]	Std. Estimate
(Intercept)	.0837	.0383	2.18	.029	*	
Governance	.1838	.0254	7.23	4.8e–13	^	.3179
Industrialization	.1110	.0244	4.55	5.5e–6	^	.1954
Economical	–.0418	.0365	–1.14	.253	N.S.	–.0464
Technical	–.1762	.0346	–5.09	3.6e–7	^	–.2167
Environmental	–.0739	.0391	–1.89	.059	*	–.0769

N = 2842, Deviance chi-square p-value < 0.001, Count R^2 = 0.60.[4] Std. Estimate is the standardized coefficient estimate.

The results of the logistic regression indicate that, over all the World Bank projects in the study, the Governance, Industrialization and Technical CSFs contribute the most significantly to project success, the Environmental CSF contributes to a lesser extent, and the Economical CSF does not contribute significantly. In the most general sense, these results confirm that there is a significant relationship between external environment and project success; particularly, good governance and a high level of industrialization over the course of a project are associated with success.

IV.4 Model Diagnostics

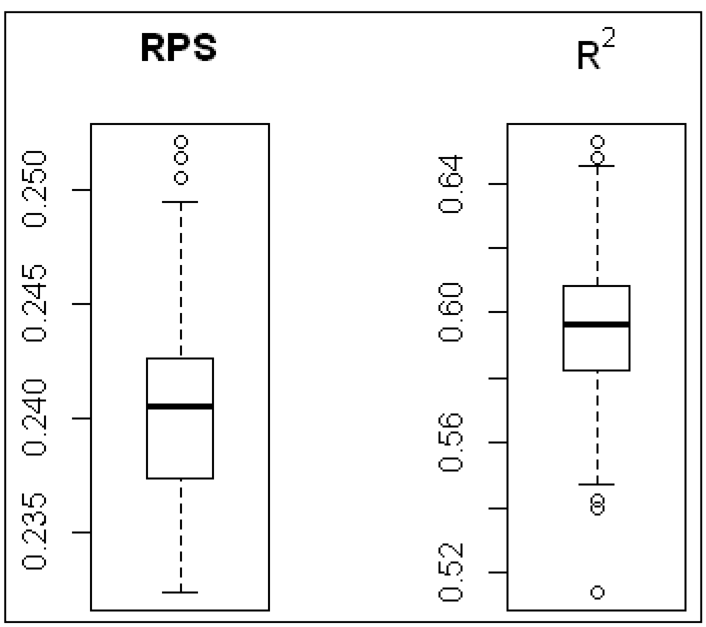
Model skill can be assessed using several measures. A Count R^2 value of 0.60 indicates that the logistic model correctly fits the observed level of success for about 60% of

[3] Significance of regressors denoted by z-score p-value ranges of ^ = (0, .01), * = (.01, .1), ~ = (.1, .2), N.S. > .2.

[4] Hosmer recommends the difference between the null deviance and the residual deviance, which is distributed as a chi-square statistic, and Count R^2 (percentage of correctly predicted responses) as measures of goodness-of-fit in logistic regression [12].

projects. While this does not show a very high skill, it is an improvement over the null model, which correctly fits the observed value 52% of the time. The deviance statistic recommended by Hosmer has a p-value of less than 0.001, which indicates that the logistic model is a significant improvement over the null model [13]. Another measure of skill is the Cross-Validated Rank Probability Score, in which 15% of data is dropped, a model is built on the remaining 85% of data and the new model is used to predict the dropped data. The mean square error between the fitted values and the observed values for the dropped data is recorded, and this is simulated 500 times. The median mean square error of the simulations is a measure of model skill, where a result close to zero indicates a skillful model. This model has a 99% cross-validated RPS confidence interval of (0.233, 0.250) with a median of 0.24, which is useful in comparing this model to others. The null model performs at 0.25, so this model is better than the null model. A similar method provides a 99% confidence interval for the cross-validated Count R^2 of (0.55, 0.64).

Figure 2: Cross-Validated Rank Probability Score and Count R^2



Boxplots showing median (staple), middle 50% (box) and middle 99% (whiskers).

A multinomial regression was also performed using a 3-point scale for project success, as opposed to the binary scale used so far. In some cases, this may have resulted in higher predictive skill; however, the multinomial model correctly fitted only 53% of data and arrived at a mean RPS of 0.19 using the method of dropped points. This indicates that the multinomial model is on par with the binomial model; thus, the simpler binomial model is sufficient.

The estimated coefficients of the logistic regression reveal the extent to which each CSF contributes to project success. With all CSFs held at their means, the model predicts that a project will have a 52% likelihood of being successful. Increasing the value of the Governance CSF by one standard deviation increases the likelihood to 60%, while decreasing it by one standard deviation decreases the likelihood to 44%. Similarly, a standard deviation increase or decrease of the Industrialization CSF leads to a range of 47% to 57% likelihood of success. As the Governance CSF has a high regression coefficient and high standard deviation compared to the other CSFs, a standard deviation change in its value has a larger effect on project success than a standard deviation change in any other CSF. This standardization method of scaling the regressor coefficients by their standard deviations helps identify the CSF that most influences project success, and these standardized coefficients are shown in Table 8. By this reasoning, the Governance CSF makes the biggest contribution to the model's determination of project success, followed by the Environmental and Industrialization CSFs.

IV.5 Differences in Project Sectors and Regions

Using the same principal components found earlier, individual logistic regression analyses were performed for each of the ten sectors and six regions. The standardized regression coefficients are shown in Table 9.

Table 9: Significant standardized regression coefficients for 5 external CSFs

	N	Gov	Ind	Econ	Tech	Env	Model Sig.[5]
AFR	333	0.455 *					~
LCR	768	0.403 ^			–0.244 ^		^
EAP	549	0.158 ~				–0.323 ^	^
ECA	663	0.173 *	0.197 *		–0.248 ^	–0.172 *	^
SAR	329	0.484 *		0.459 ^			^
MNA	200	0.834 ^	–0.470 *				^
Agriculture	350	0.297 *					*
Administration	597	0.443 ^	0.434 ^		–0.259 ^		^
Transportation	332	0.356 ^			–0.602 ^	–0.272 *	^
Industry	218						N.S.
Energy	273	0.310 *	0.272 *	–0.216 ~	–0.232 *		*
Education	282	0.643 ^		0.346 ^	–0.388 ^		^
Finance	168						N.S.
Health	332	0.224 *	0.217 ~	–0.327 *	–0.223 ~		*
Water	251	0.349 *	0.284 ~	–0.221 ~	–0.342 *		^
Information	39		1.002 ~		–0.701 ~	1.175 *	*

Deviance chi-square p-value < .2 and Count R^2 > .6 for all models, z-score p-value < .2 for all regressors.[6]

Individual logistic regression analyses were also performed for sector-region combinations. The adequate models and their significant CSFs are summarized in Table 10.

[5] Model adequacy denoted by deviance chi-square p-value ranges of ^ = (0, .01), * = (.01, .1), ~ = (.1, .2), N.S. > .2.

[6] Significance of regressors denoted by z-score p-value ranges of ^ = (0, .01), * = (.01, .1), ~ = (.1, .2), N.S. > .2.

Table 10: Significant CSFs by sector and region

	AFR	LCR	EAP	ECA	SAR	MNA	All
Agriculture				+ Gov ~ **+ Env *** N=49 ~	**+ Gov *** – Ind * + Tech * – Env * N=67 ~		**+ Gov *** N=350 *
Administration	**+ Gov *** – Tech * N=96 ~	**+ Gov ^** – Tech ~ N=209 ^	**+ Gov ~** + Tech ~ N=62 *	**+ Ind *** + Econ ~ – Env * N=179 *		+ Gov * **+ Env ~** N=26 *	**+ Gov ^** + Ind ^ – Tech ^ N=597 ^
Transportation			**– Tech ~** N=97 ~	**– Tech ^** – Env ~ N=65 ^	**+ Gov *** – Ind * – Env * N=34 ^		+ Gov ^ **– Tech ^** – Env * N=332 ^
Industry							
Energy		+ Gov * **– Ind ^** N=39 ^	**+ Tech ~** N=73 *		**– Env ~** N=42 ~		**+ Gov *** + Ind * – Econ ~ – Tech * N=273 *
Education	**– Ind *** + Tech ~ N=33 *	**+ Gov *** – Ind ~ + Econ ^ – Tech ^ N=88 ^	**+ Gov ~** – Tech * N=55 *	**+ Ind *** N=29 *	**+ Econ ^** – Tech * N=67 ^	**+ Gov *** – Ind * N=32	**+ Gov ^** + Econ ^ – Tech ^ N=282 ^
Finance		**+ Gov *** – Ind * N=50 *			+ Gov ~ – Ind ~ **+ Tech ~** N=12 *		
Health	**+ Gov *** + Econ * N=42 ^				+ Econ ~ **– Tech ~** N=44 *		+ Gov * + Ind ~ **– Econ *** – Tech ~ N=332 *
Water			**+ Ind *** – Tech * N=70 ^			**+ Gov ~** N=24 ~	**+ Gov *** + Ind ~ – Econ ~ – Tech * N=251 ^
Information							+ Ind ~ – Tech ~ **+ Env *** N=39 *
All	**+ Gov *** N=333 ~	**+ Gov ^** – Tech ^ N=768 ^	+ Gov ~ **– Env ^** N=549 ^	+ Gov * + Ind * **– Tech ^** – Env * N=663 ^	**+ Gov *** + Econ ^ N=329 ^	**+ Gov ^** – Ind * N=200 ^	**+ Gov ^** + Ind ^ – Tech ^ – Env * N=2842 ^

Blank cells indicate no significant model was found. +/– signs indicate whether the CSF relationship with success is positive or negative. Significance symbols next to CSFs indicate regressor significance (as in Table 8) and symbols next to sample sizes indicate model adequacy (as in Table 9). **Bold** indicates the most important regressor (based on standardized regression coefficients). Deviance chi-square p-value < .2 and Count R^2 > .6 for all models, z-score p-value < .2 for all regressors.

Several observations can be made about which CSFs show stronger relationships with which sectors and regions. The Governance CSF has a significant positive relationship with success in 7 out of 10 project sectors and in all regions, in general. Particularly, Administration projects show this relationship in 4 out of 6 regions. It is also the most important regressor in 5 sectors and 4 regions. In Africa, the Governance CSF is the only important one, meaning the low rate of success may be explained mostly by poor governance. The Industrialization CSF has a significant positive relationship with success in 5 out of 10 project sectors, in general, but in some cases – for example, Agriculture projects in South Asia or Education projects in Latin America – Industrialization has a negative relationship with success. The Technical CSF shows a negative relationship to success in most cases; however, this is most likely due to the fact that this CSF increased while project success decreased over time.

These observations provide a glimpse into how project success and external environment, particularly governance, are interrelated. While the focus of this research is on the general identification of these relationships, future research should involve justifying these quantitative relationships with case studies.

IV.6 Supervision

The aforementioned results suggest that, in most project sectors, poor governance may be associated with lower rates of project success. Before starting a new project, the World Bank should consider whether poor governance is reason enough to abandon the project; however, the World Bank might instead improve certain controllable aspects of their implementation. One such aspect that has been analyzed in the literature is Quality of Bank Supervision [1, 5]. Certainly, other controllable aspects of a project, such as design and coordination, could also be considered here; however, this analysis is meant to demonstrate, in general, that unfavorable external conditions may be offset by these other aspects during project planning or implementation. Future work should address which other controllable aspects can offset predicted project performance losses.

Kilby demonstrates that a substantial improvement in Quality of Bank Supervision in World Bank projects may have a substantial impact on project success. He also concludes that the cost of the extra supervision is worth the improvement in performance and that the impact of supervision is consistent across regions and sectors [5]. Therefore, the potential for increased supervision to counteract performance losses related to poor external conditions is explored below.

Quality of Bank Supervision is a 1 to 6 Likert rating included in the IEG Ratings dataset and is based on several measures of supervision quality (frequency and duration of supervisory visits, size and composition of supervision team). This data was taken as is for the full set of projects. A logistic regression that included the five CSFs and Quality of Bank Supervision was performed, with the results shown in Table 11.

Table 11: Output of logistic regression for 5 external CSFs and supervision

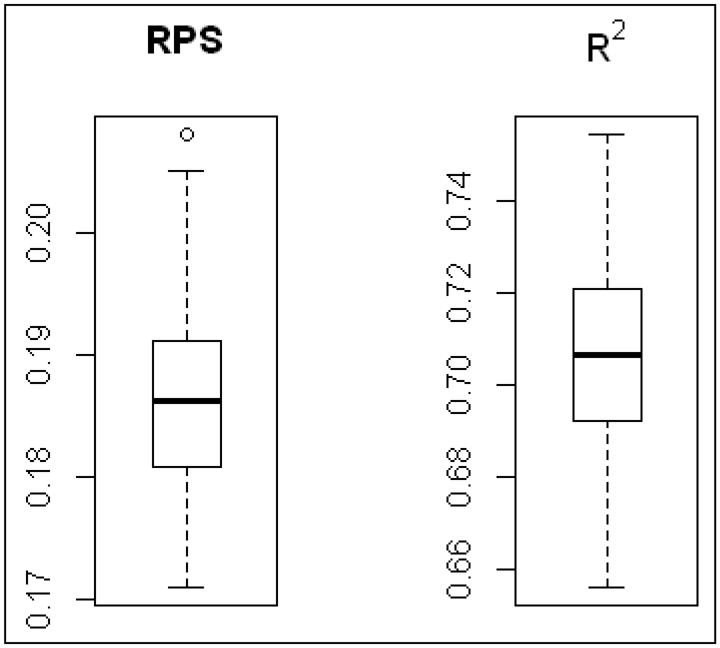
	Estimate	Std. Error	z	p-value	Sig.	Std. Estimate
(Intercept)	–6.045	.3693	–16.4	< 2e–16	^	
Governance	.2120	.0293	7.23	4.9e–13	^	.3668
Industrialization	.0387	.0277	1.40	.163	*	.0681
Economical	.0044	.0415	.11	.915	N.S.	.0049
Technical	–.1433	.0391	–3.66	2.5e–4	^	–.1763
Environmental	–.0269	.0448	–.60	.549	N.S	–.0280
Supervision	1.304	.0749	17.4	< 2e–16	^	1.474

N = 2796, Deviance chi-square p-value < .001, Count R^2 = 0.70. Std. Estimate is the standardized coefficient estimate.

This analysis indicated that Governance, Industrialization, Technical and Supervision CSFs are all significantly related to project success. After standardizing the regression coefficients, it was found that Supervision contributes 4 times as much as governance to the likelihood of project success; that is to say, an increase of one standard deviation in the Governance CSF is equivalent to an increase of a quarter of one standard deviation in Supervision. The implication of this is that very poor governance or very low industrialization during a project can be counteracted by a relatively small increase in supervision by the World Bank. Even in the unfavorable case of the external CSFs being one standard deviation below their means, an increase in Supervision from the mean (4.55) to the highest score (6) causes the model's prediction of success to skyrocket from 32% to 75%. Not only is this a testament to the importance of supervision to project success, but it also puts the significance of external environment in context. Although the relationship between external environment and project success has been inferred, it can be substantially alleviated by World Bank investment in project supervision.

The model including Supervision has a 99% RPS confidence interval of (0.17, 0.20) with a median of 0.19 and a 99% Count R^2 confidence interval of (0.66, 0.75) and a median of 0.70. This model clearly outperforms the original logistic model in terms of predictive power, as it has lower cross-validated RPS and higher cross-validated Count R^2.

Figure 3: Cross-Validated Rank Probability Score and Count R^2 (with Supervision)



Boxplots showing median (staple), middle 50% (box) and
middle 99% (whiskers).

Table 12 shows the relative importance of supervision by regions and sectors. In Administration projects, for example, Quality of Supervision is much more important than the Governance CSF. However, in Education projects, governance is just as important. In general, though, supervision is at least twice as important as any of the external CSFs. Again, project success can be improved significantly by a high level of supervision, even in the case of unfavorable external conditions.

Table 12: Significant standardized coefficients for 5 external CSFs and supervision

	N	Gov	Ind	Econ	Tech	Env	Sup	Model Sig.
AFR	328	0.512 *	–0.351 *				1.622 ^	^
LCR	745	0.433 ^			–0.138 ~		1.541 ^	^
EAP	542	0.495 ^				–0.196 ~	1.282 ^	^
ECA	656	0.175 ~	0.148 ~				1.510 ^	^
SAR	327	0.436 ~		0.485 ^			1.502 ^	^
MNA	198	0.862 ^	–0.501 *				1.518 ^	^
Agriculture	346	0.454 ^					1.642 ^	^
Administration	582	0.439 ^	0.252 *				2.005 ^	^
Transportation	326	0.374 *			–0.542 ^	–0.344 *	0.886 ^	^
Industry	212	0.241 ~					1.356 ^	^
Energy	269	0.321 *	0.216 ~	–0.480 ^			1.494 ^	^
Education	279	0.715 ^		0.385 *	–0.399 *		0.998 ^	^
Finance	161						1.368 ^	^
Health	331						3.275 ^	^
Water	251	0.346 *		–0.272 ~	–0.291 ~		1.316 ^	^
Information	39		1.798 ~			1.621 ~	2.657 *	^

Deviance chi-square p-value < .01 and Count $R^2 > .67$ for all models, z-score p-value < .2 for all regressors.

IV.7 Predictive Model

Using this model in a predictive sense will allow the World Bank to estimate a new project's success based on project sector, estimates of external environment and anticipated project supervision. The model predicts binary outcome correctly about 70% of the time, which may not meet the World Bank's standards for a predictive model; however, these guidelines may provide a framework for using an expanded predictive model in the future.

The list of 17 indicators to be used as model inputs is shown in APPENDIX A – Indicator Details in Table 13, with the particular indicator codes that should be referenced at the sources listed in Table 15. The indicators must be estimated in the same way as the values used in this study for this predictive model to work. For each indicator, an average for that indicator should be estimated over the course of the project. For example, if the indicator has been decreasing for the past decade, it may be reasonable to assume that it will continue that way. Also, a value of Quality of Bank Supervision (on a 1-6 scale) should be estimated (or the mean of 4.55 should be used). The values should be collected to form the input vector for the model.

$$v = \begin{bmatrix} \text{Indicator 1} \\ \text{Indicator 2} \\ \vdots \\ \text{Indicator 17} \\ \text{Supervision} \end{bmatrix}$$

Once the input vector has been formed, the steps in section III.5 Predictive Model should be followed to arrive at the probability of success of this project.

V CONCLUSION

V.1 Recommendations

The trends observed in this research highlight some underlying relationships between external environment and project success. Most significantly, governance is strongly related to project success. Certainly, the fact that there is a relationship between governance and success will come as no surprise to World Bank evaluators and project managers, who know that corruption and government instability will undermine a project; however, the predictive model outlined here provides a quantification of this relationship, which may prove valuable.

The most pertinent recommendation to come out of this research is to be wary of entering into projects in countries with low control of corruption, low government effectiveness, low regulatory quality and low rule of law. These four indicators make up the Governance CSF, which has been shown to have a strong positive relationship with project success. When these indicators are unfavorable, likelihood of success is also low. This is particularly true in the Middle East, North Africa and Sub-Saharan Africa, where project success is low and governance is unfavorable (logistic regression has shown that these two facts are strongly related). Conversely, in East Asia, governance is favorable and project success rate is high.

Considering project sector, governance appears to be most important in Education, Administration and Water projects. Ineffective governance that leads to misappropriation of funds will perhaps affect these types of projects first. Particularly in these cases, attention should be paid to governance and corruption before beginning a project.

Another CSF that seems to be important to success is Industrialization; countries that are more industrialized (or are becoming more industrialized) tend to see better project performance. This is particularly true in Energy projects, where greater industrialization may indicate a higher capacity and demand for energy expansion.

Somewhat surprisingly, the main indicators of economically favorable conditions were either eliminated at the Principal Component Analysis or discounted in the regressions. Both GDP per capita and GDP growth might be used as proxies for likelihood of development (or indicators that development is occurring); however, this analysis found that these indicators were not important components in explaining the variability in World Bank projects. Inflation and interest rate were found to be important components, but they were not found to be important predictors of success, in general. Therefore, economic conditions should not play a large role in deciding whether or not to abandon a project.

Although a poor external environment may detract from a project's success, it would be unreasonable for the World Bank to desert all of its projects in countries with poor governance. Instead, the World Bank should consider the relationship between governance and project success when making decisions about controllable aspects of the project, such as supervision, which has been found to be a major predictor of success. By providing an above-average level of supervision in unfavorable external conditions, the World Bank can offset these unfavorable conditions and greatly improve project performance. Similarly, a favorable external environment may permit a lower level of supervision while maintaining a desired probability of project success. Also, while supervision has been the controllable aspect considered in this research (as it was the data that was available), there are undoubtedly many other aspects of a project that could be enhanced to offset unfavorable external conditions, such as design, coordination and timing. A more robust study that includes many external *and* internal CSFs is left for future work.

V.2 Limitations

This study is limited by several factors. The largest of these is the sensitivity of the results to the choice of indicators that make up the CSFs. While the original list of indicators was meant to capture the cross-section of a location's external environment, this list may have been incomplete. Additionally, many of these indicators had to be eliminated due to insufficient data, leaving an even smaller pool of indicators. In the end, 17 indicators were used as proxies for the whole picture, but this may not have been an appropriate group to capture the five CSFs. With so many ways of measuring and quantifying environment, there is bound to be a different set of indicators that would produce different results.

This analysis is also sensitive to the chosen binary grouping of the six levels of success. With a different grouping, success rates and findings might change drastically.

The loss of over two-thirds of the projects due to a lack of indicator data, mostly before 1980, means that a large piece of the puzzle may be missing from these results. While the sample size of projects was sufficiently large for the analysis, it may have been better to have a sample spread over a wider period of time.

Two assumptions that may have limited the value of the study were that indicators by country and year were sufficient to explain success at a project level and that the average of an indicator over the life of a project should be used to explain success. The country-year indicator assumption was made partly out of necessity (this is the only kind of data available) and partly due to the nature of World Bank projects (country-wide averages may capture the nature of large-scale funding). However, taking the average of an indicator over the project life-cycle may not have been a valid assumption. It is possible that external environment only matters at the start of the project, so maybe the indicator value in the first year should have been used. Exploration of this could be its own study.

A limitation of the chosen logistic model is its somewhat low predictive power; it may be hard to justify action based on a model that predicts correctly only 70% of the time. This low skill might indicate that the model is missing some crucial explanatory variables. A more comprehensive model that includes internal (coordination, design, etc.) alongside external CSFs might predict project success better.

The steady decline in project success over the last few decades may be a sign of evaluation bias, as opposed to an actual decrease in success over time. As the World Bank's standards have gone up over the years, their success ratings may have been held to these higher standards. The logistic model does not take this bias into account.

V.3 Future Work

This research provides a foundation for exploring how external environment may be related to project success; however, there are several ways for this study to be expanded. The most significant of these would be to expand the original list of indicators. A list of indicators chosen by an expert in World Bank success factors would certainly look different than the list used here, and the study might reach different, more informed conclusions. With different indicators, a different set of principal components might explain more data variance and the predictive power of the logistic regressions might be higher.

Additionally, this study mostly ignored the project management category of CSFs. Certainly, project-level aspects such as design, coordination and stakeholder input are at least as important as external environment in explaining project success. While this study considered supervision, a more comprehensive analysis including several internal and external factors might reveal other valuable insights.

Finally, the question of whether and how external environment *influences* project success remains unanswered. Even though governance is related strongly to project success, does a productive political climate cause better performance, and by what mechanisms? These questions would be best answered with case studies that demonstrate or refute a cause and effect relationship.

REFERENCES

[1] L. A. Ika, A. Diallo and D. Thuillier, "Critical success factors for World Bank projects: An empirical investigation," *International Journal of Project Management,* vol. 30, no. 1, pp. 105-116, 2012.

[2] "World Bank Project Performance Ratings," Independent Evaluation Group, [Online]. Available: http://ieg.worldbankgroup.org/content/ieg/en/home/ratings.html. [Accessed 23 October 2012].

[3] "Development Effectiveness Review 2011 Report," Asian Development Bank, 2012.

[4] L. Chauvet, P. Collier and M. Duponchel, "What explains aid project success in post-conflict situations?," World Bank, 2010.

[5] C. Kilby, "Supervision and performance: the case of World Bank projects," *Journal of Development Economics,* vol. 62, no. 1, pp. 233-259, 2000.

[6] K. Matsumura, "Causes of poor performance in World Bank water and sanitation projects," MS Thesis, University of Colorado at Boulder, 2012 (Draft).

[7] W. Belassi and O. I. Tukel, "A new framework for determining critical success/failure factors in projects," *International Journal of Project Management,* vol. 14, no. 3, pp. 141-151, 1996.

[8] Y. H. Kwak, *Critical success factors in international development project management,* Washington, DC, 2002.

[9] "Newly Released World Bank Dataset a Step Forward for Aid Transparency," AidData, 2 November 2011. [Online]. Available: http://blog.aiddata.org/2011/11/newly-released-world-bank-dataset-step.html.

[10] "World Bank Project Sectors," [Online]. Available: http://siteresources.worldbank.org/PROJECTS/Resources/WBsectors_eff_OCT03.doc. [Accessed 23 October 2012].

[11] "Principal Component Analysis," [Online]. Available: http://support.sas.com/publishing/pubcat/chaps/55129.pdf. [Accessed 23 October 2012].

[12] R. E. Zinbarg, W. Revelle, I. Yovel and W. Li, "Cronbach's Alpha, Revelle's Beta, McDonald's Omega: Their relations with each and two alternative conceptualizations of reliability.," *Psychometrika,* vol. 70, no. 1, pp. 123-133, 2005.

[13] D. W. Hosmer, Applied Logistic Regression, Wiley-Interscience Publication, 2000.

[14] A. Alesina et al., "Fractionalization," *National Bureau of Economic Research,* vol. w9411, 2003.

[15] "World Bank Projects & Operations," World Bank, [Online]. Available: http://data.worldbank.org/data-catalog/projects-portfolio. [Accessed 23 October 2012].

APPENDIX A – Indicator Details

Table 13: Indicator details

	Source	Indicator	CSF	Code	Description
1	WGI	Rule of Law	Gov	Rule of Law (RL)	Captures perceptions of the extent to which agents have confidence in and abide by the rules of society: contract enforcement, property rights, the police, the courts, crime.
2	WGI	Government Effectiveness	Gov	Government Effectiveness (GE)	Captures perceptions of the quality of public services, civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
3	WGI	Control of Corruption	Gov	Control of Corruption (CC)	Captures perceptions of the extent to which public power is exercised for private gain, including petty and grand forms of corruption and "capture" of the state by elites and private interests.
4	WGI	Regulatory Quality	Gov	Regulatory Quality (RQ)	Captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
5	WDI	Population growth	Ind	Population growth (annual %) (SP.POP.GROW)	Annual population growth rate.
6	WDI	Electricity consumption per capita	Ind	Electric power consumption (kWh per capita) (EG.USE.ELEC.KH.PC)	Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants.
7	WDI	CO_2 emissions per $ GDP	Ind	CO2 emissions (kg per 2000 US$ of GDP) (EN.ATM.CO2E.KD.GD)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement.
8	WDI	Urban population growth	Ind	Urban population growth (annual %) (SP.URB.GROW)	Urban population refers to people living in urban areas as defined by national statistical offices.
9	WDI	CO_2 emissions per capita	Ind	CO2 emissions (metric tons per capita) (EN.ATM.CO2E.PC)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement.
10	WDI	Real interest rate	Econ	Real interest rate (%) (FR.INR.RINR)	Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.
11	WDI	Gini Index (wealth dispersion)	Econ	GINI index (SI.POV.GINI)	Gini index measures the extent to which the distribution of income or expenditure of individuals or households within an economy deviates from a perfectly equal distribution.
12	WDI	Inflation	Econ	Inflation, consumer prices (annual %) (FP.CPI.TOTL.ZG)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.
13	WDI	Internet users per capita	Tech	Internet users (per 100 people) (IT.NET.USER.P2)	Internet users are people with access to the worldwide network.
14	WDI	Mobile users per capita	Tech	Mobile cellular subscriptions (per 100 people) (IT.CEL.SETS.P2)	Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network.
15	WDI	Population density	Env	Population density (people per sq. km of land area) (EN.POP.DNST)	Population density is midyear population divided by land area in square kilometers.
16	WDI	Agricultural land (% of land)	Env	Agricultural land (% of land area) (AG.LND.AGRI.ZS)	Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures.
17	WDI	Natural resources rents (% of GDP)	Env	Total natural resources rents (% of GDP) (NY.GDP.TOTL.RT.ZS)	Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.

Table 14: Unused indicators

Source	Indicator
WDI	GDP per capita
WDI	GDP growth
WDI	Rural population growth
WDI	Official exchange rate
WDI	Consumer Price Index (CPI)
WDI	Primary school enrollment
WDI	Physicians per capita
WDI	Health expenditure per capita
WDI	Unemployment
WDI	Employment in industry
WDI	Employment in services
WDI	Employment in agriculture
WDI	Roads (% paved)
WGI	Voice and Accountability
WGI	Political Stability
FSI	Demographic Pressures
FSI	Refugees and IDPs
FSI	Group Grievance
FSI	Human Flight
FSI	Uneven Development
FSI	Poverty and Decline
FSI	Legitimacy of the State
FSI	Public Services
FSI	Human Rights and Rule of Law
FSI	Security Apparatus
FSI	Factionalized Elites
FSI	External Intervention
UNDP	Human Development Index (HDI)
Frac	Ethnic Fractionalization
Frac	Language Fractionalization
Frac	Religious Fractionalization

Table 15: Indicator source details

Source	Name	Location
WDI	World Bank – World Development Indicators	http://databank.worldbank.org/Data/
WGI	World Bank – Worldwide Governance Indicators	http://info.worldbank.org/governance/wgi/
FSI	The Fund for Peace – Failed States Index	http://www.fundforpeace.org/global/?q=fsi
UNDP	UN Development Program – International Human Development Indicators	http://hdr.undp.org/en/statistics/hdi/
Frac	Alesina et al. – Fractionalization [14]	http://www.nsd.uib.no/macrodataguide/set.html?id=16&sub=1

APPENDIX B – Predictive Model Inputs

Scaling (vector of means and diagonal matrix of reciprocal standard deviations):

$$q_\mu = \begin{bmatrix} -0.427 \\ -0.264 \\ -0.458 \\ -0.147 \\ 1.252 \\ 1288 \\ 1.72 \\ 2.270 \\ 2.463 \\ 11.24 \\ 40.83 \\ 35.62 \\ 4.714 \\ 13.99 \\ 120.6 \\ 44.25 \\ 6.469 \\ 0 \end{bmatrix} \qquad Q_{1/\sigma} = \operatorname{diag}\left(1.993,\ 2.405,\ 2.310,\ 2.061,\ 0.940,\ 8.19\text{E-}4,\ 0.592,\ 0.564,\ 0.400,\ 0.067,\ 0.105,\ 7.44\text{E-}3,\ 0.129,\ 0.048,\ 6.13\text{E-}3,\ 0.057,\ 0.113,\ 1\right)$$

Principal Component Analysis (matrix of principal component loadings):

$$Q_{PCA} = \begin{bmatrix} .499 & & & & & \\ .486 & & & & & \\ .484 & & & & & \\ .429 & & & & & \\ & -.466 & & & & \\ & .433 & & & & \\ & .424 & & & & \\ & -.419 & & & & \\ & .413 & & & & \\ & & -.615 & & & \\ & & -.505 & & & \\ & & -.374 & & & \\ & & & .652 & & \\ & & & .624 & & \\ & & & & -.533 & \\ & & & & -.520 & \\ & & & & .459 & \\ & & & & & 1 \end{bmatrix}$$

Logistic Regression (matrix of regression coefficients and vector of intercepts, for 10 sectors)

$$C_1 = \begin{bmatrix} 0.287 & & & & & 1.383 \\ 0.253 & 0.129 & & & & 1.823 \\ 0.218 & & & -0.444 & -0.349 & 1.097 \\ 0.129 & & & & & 1.007 \\ 0.174 & 0.103 & -0.453 & & & 1.262 \\ 0.405 & & 0.339 & -0.376 & & 0.965 \\ & & & & & 1.281 \\ & & & & & 2.673 \\ 0.194 & & 0.217 & -0.280 & & 1.111 \\ & 1.003 & & & 1.720 & 2.122 \end{bmatrix} \qquad c_2 = \begin{bmatrix} -6.414 \\ -8.695 \\ -4.670 \\ -4.515 \\ -6.010 \\ -4.219 \\ -6.013 \\ -12.92 \\ -5.178 \\ -8.524 \end{bmatrix}$$

APPENDIX C – R Commands

Table 16: R Commands Used

Command	Package	Purpose
princomp	stats	Performs Principal Component Analysis
varimax	stats	Performs Varimax rotation on loadings matrix
omega	psych	Calculates McDonald's omega estimates
glm	stats	Fits Generalized Linear Models (used for logistic regression)
multinom	nnet	Fits multinomial regression models
paf	rela	Performs principal axis factoring (used to compute Kaiser-Meyer-Olkin score)