An Analysis of Cost Overrun

in the Construction Industry

by

Abhinav Goyal

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Graduate Supervisory Committee:

Jacob Kashiwagi, Chair
Dean Kashiwagi
Oswald Chong

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ABSTRACT

This thesis presents a literature research analyzing the cost overrun of the construction industry worldwide, exploring documented causes for cost overrun, and documented parties responsible for the inefficiency. The analysis looks at a comparison between the metrics of construction projects in different continents and regions. Multiple publication databases were used to look into over 300 papers. It is shown that although construction demands are increasing, cost overrun on these projects is not decreasing at the same rate around the world. This thesis also presents a possible solution to improve cost overrun in the construction industry, through the use of the Best Value Performance Information Procurement System (BV PIPS). This is a system that has been utilized in various countries around the world, and has documented evidence that it may be able to alleviate the overrun occurring in the construction industry.

DEDICATION

I would like to dedicate this thesis to everyone who has helped me personally become a better version of myself. First, I would like to thank my parents for allowing me to choose my own paths, and guiding me when I could not find one. Also, I would like to thank my parents for their constant and wonderful support. Second, I would like to thank my brother for teaching me to be humble. You are constantly giving me the opportunity to be a leader, and teaching me when I need to be a follower. I would like to thank my friends for always expanding my horizons and helping me become a better person in society. Lastly, I would like to thank all my personal mentors and teachers who have been patient with me, and helped teach me how to expand my skillset in various facets of life in a professional and expert manner, while always humbling me in my quest to be the best that I can be.

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Lastly, I would like to thank all my friends and colleagues within PBSRG for supporting and letting me practice IMT, in order to better understand it. I would like to specially thank Alfredo Rivera, for being very patient and helpful when teaching me how to better think with logic and IMT. I would also like to thank Nguyen Le for helping me with the literature research data analysis.

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Introduction

More buildings will be built in the next 30 years than in the last 2000 years (CII, 2015). In order to prepare for this it is necessary to understand the state of the current construction industry. Preliminary research on U.S. and U.K. construction identified that almost all construction projects had cost overrun. This leads to the necessity of a study to understand if every country with documented cost information will have similar cost overrun. (Rivera, 2014)

Problem

Only 2.5% of projects are defined as successful (scope, cost, schedule, & business) (Rivera, 2016), after finding out that there is documented cost overrun in the US and UK, and at an average of 27% over the given initial cost in 2006-2016 (refer to Table 6). The author has theorized that this cost overrun may be happening around the world. This is worrying due to the fact that if this is the state of the construction industry around the world, it means that there is massive inefficiency. If this is true it is necessary to find out why this is happening, and what the causes are for it. By doing so, it is possible to find a solution to decrease the cost overrun in the industry, thus making the industry a more efficient process.

Hypothesis

Due to the findings of the preliminary research done in construction in the U.S. and U.K., the construction cost overrun found in the U.S. and U.K is hypothesized that the construction metrics worldwide may show similar results.

Methodology

In order to conduct this research, the author will do follow the following:

1) Literature research on construction cost metrics worldwide.
2) Literature research on major issues causing cost overrun worldwide.
3) Analysis of worldwide construction cost data.
4) Identify potential solutions to overcome cost overrun.
5) Provide recommendations and conclusions

Literature Research

A study done by the Construction Industry Institute (2015) showed the below cost metrics throughout the construction industry worldwide. (Lepatner, 2007; PWC, 2009; Yun, 2013):

- 2.5% of projects defined as successful (scope, cost, schedule, & business).
- 25 to 50% waste in coordinating labor on a project.
- Management inefficiency costs owners between $15.6 and $36 billion per year.
- An estimated $4 billion to $12 billion per year is spent to resolve disputes and claims. (Rivera, 2016)

Based on these metrics it is necessary to identify all the countries around the world, which have documented cost information, that show related cost overrun. In this analysis, the author will look only at cost overrun, which is defined as the amount of money exceeding the original cost.

Due to documented cost information, a total of 38 countries from 7 continents or regions were chosen for this literature research. This study looked at 300+ publications

and documented any relevant cost overrun information. It was found that only about 29 publications met the criteria and had relevant cost overrun information. (Rivera, 2016)

Table 1: List of Countries Researched (PBSRG, 2015)

Regions	**Countries (# of Documented Papers)**	**Total Countries**	**Total Papers**
Africa	Botswana (1). Ethiopia (1), Ghana (3) Kenya (1), Libya (1), Nigeria (11). Rwanda (1), Uganda (1), United Republic of Tanzania (1)	9	21
America	Canada (1), USA (4)	2	5
Asia	Cambodia (1), China (1), Hong Kong (1), India (6), Indonesia (2), Korea (3), Malaysia (6), Thailand (2), Vietnam (2)	9	24
Europe	Finland (1), Ireland (1), Netherlands (1), Norway (1), Portugal (2), Sweden (1), Turkey (3), United Kingdom (4)	8	14
Middle East	Iraq (2), Jordan (2), Kuwait (2), Oman (2), Pakistan (2), Palestine (3), Qatar (1), Saudi Arabia (5), United Arab Emirates (2)	9	21
Oceania	Australia (5)	1	5
Multiple Regions	Multiple Regions (5)	n/a	5

This study discovered that construction industry professionals around the world have not been able to deliver projects on budget, leading to low customer satisfaction. Even though consensus states that first world countries should have an easier time than other countries being on budget, and having high performance metrics as they have more advanced technology and bigger budgets, this study discovered that this is not the case and every country examined has similar cost overrun problems. Even though there have been many efforts to figure out the cause of this inefficiency in the construction industry, it has not been found. (Goff, 2014)

Cost Overrun Worldwide

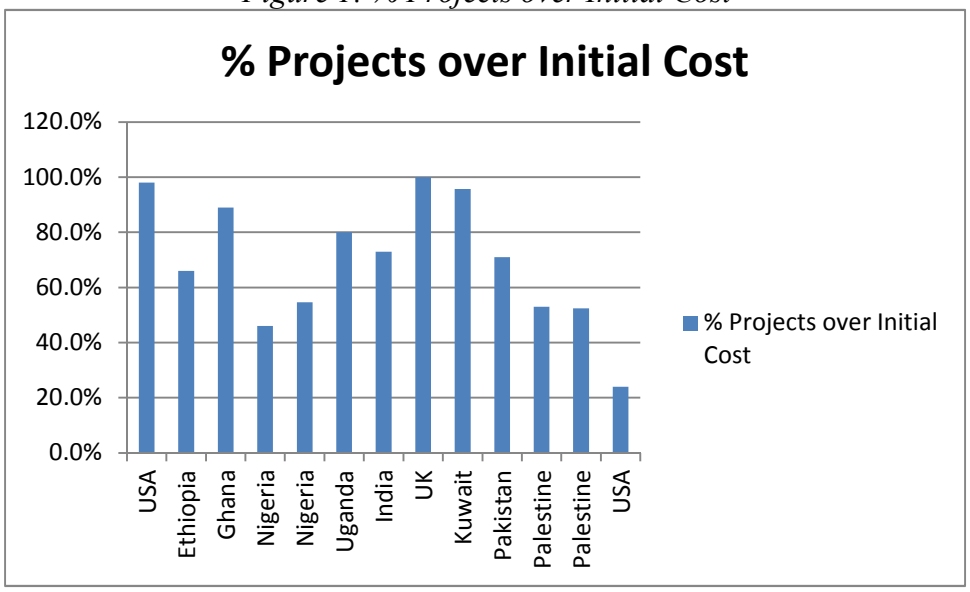
Bent Flyvbjerg, a professor in Oxford's Said Business School, identified that it is not uncommon for major infrastructure projects to overrun by 50%. In fact, after looking at many of the large infrastructure projects around the world, he identified fifteen of the world's largest cost overruns that ranged from 255% to as high 36,000% (CIMA, 2013). These statistics similarly match a study CII conducted on cost overruns on construction projects, which identified only 30% of projects completed within 10% of planned cost. Multiple continents around the world are facing this epidemic (see Table 2). (Rivera, 2016)

Table 2: Cost Overrun (PBSRG, 2015)

Countries	Performance Information
Australia	Over the study period of 1995-2003, on average, a high construction project costs are more than $1M and have a cost overrun of over 10%.
China	In 2014, a study claimed that China, as well as the rest of the world, has an average cost overrun of 28% on all types of infrastructure projects (rail, road, tunnel, bridge, etc.).
Ghana	In 2003, a study suggested that 38% of groundwater drilling projects in Ghana exceeded the original budget.
India	In 2012, a report published by the Ministry of Statistics and Programme Implementation (MOSPI) highlighted that 309 out of 951 projects being monitored have cost overruns.
Korea	According to cost data available on social capital projects, 95 road projects and 100% rail projects have cost overrun up to 50%.
Kuwait	The construction of 33% of residential projects required additional budget to complete.
Malaysia	A study in 2013 indicated that only 46.8% of public sector and 37.2% of private sector projects are completed within budget.
Oman	In 2010, a study of 4 public construction projects indicated that on average there is 28.61% increase in original budget.
Portugal	In 2007, a study of 66 construction projects indicated that the average cost overrun for a project is 12%.
Saudi Arabia	In 2015, more than three hundred project managers from different sectors and disciplines in the construction industry agreed that 80% of the projects were subject to costs overruns.
Vietnam	In 2004, a study with 109 participants in large construction projects (>$1 million) identified that project cost overruns occurred in 60% of these projects.

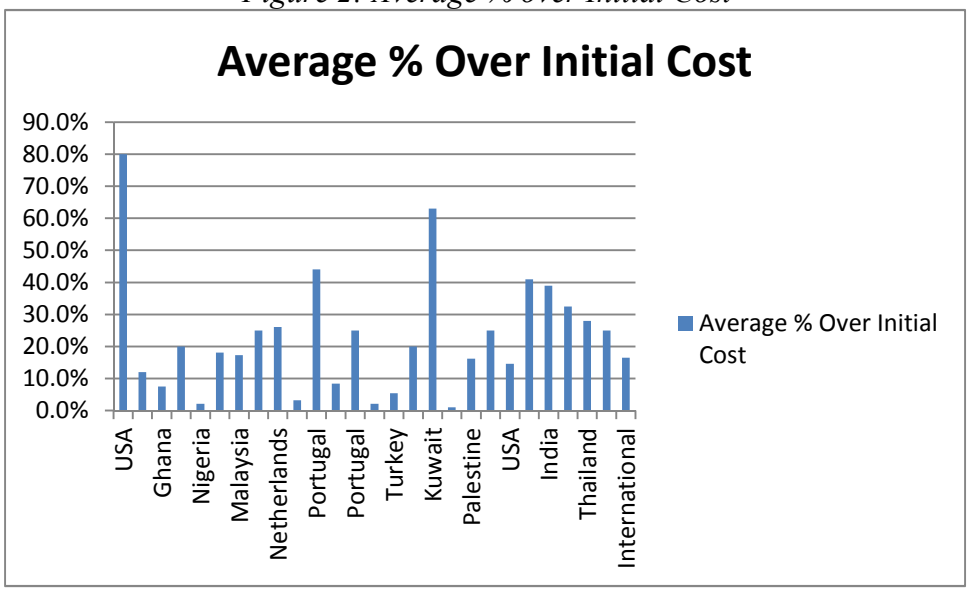
Table 2 displays how common and how prevalent cost overrun is in almost all facets of construction. To expand on these results, the author did a further analysis, which graphically shows the percent of projects that were over budget, from documented publications, in various countries. This can be seen in Figure 1.

Figure 1: % Projects over Initial Cost



As can be seen from Figure 1, every worldwide publication with documented cost metrics displays at least 20% of projects experiencing cost overrun and at most 100% of the projects experiencing cost overrun. In addition, the author also did an analysis to find how much over budget the projects documented in these publications were. The results are shown in Figure 2.

Figure 2: Average % over Initial Cost



As can be seen from Figure 2, although every project documented was over budget, not all the projects were over budget by a large amount. In fact, a few of the third world countries had better metrics than that of the first world countries. This does not allow for a conclusion that the third world countries have better cost metrics than first world countries, since this is only information from documented publications. It is possible that there is a lack of information present, or the information is skewed due to differences in amount of projects reported on.

Cost Overrun Causes and Responsibility

Due to the large number of issues present in projects within the construction industry, it is difficult for projects to be delivered on budget. Since the construction industry is beginning to take on even more projects and with larger scopes, it is becoming ever more difficult for resources and order to be maintained by any one party on a project and between supply chain participants (Lepatner, 2007; PWC, 2009; Yun, 2013). Contractors who are completing work in the projects are now expected to have more experience and knowledge in order to keep up with the demand of the industry due to the size of projects increasing (KMPG, 2015).

Table 3: Top 10 Causes of Non-Performance (PBSRG, 2016)

Top Ranked Issues	**No. of Incidents**	**Rank**	**% Appearance**	
Monthly payment difficulties/ financial problems	47	1	15.3%	Owner
Poor project/contract management	28	2	9.2%	Owner
Shortage of materials/equipment	25	3	8.2%	Owner
Additional work/variation in client's decision/inadequate scope	24	4	7.8%	Owner
Design change	23	5	7.5%	Owner
Poor planning and scheduling	22	6	7.2%	Owner
Poor qualification/shortage of labors	19	7	6.2%	Owner
Delay in construction/other delays	18	8	5.9%	Other
Unforeseen site condition	17	9	5.6%	Unforeseen
Poor/inaccurate estimate	16	10	5.2%	Contractor

Table 3 displays some of the results of the literature research, with the top 10 documented issues that may have to do with scope, cost, and schedule overrun, in order of how often they occurred in the literature, and who is the responsible party for each issue. In order to better understand who may be responsible for the cost overrun that is occurring, first, it is necessary to show the documented responsible parties in the publications that were looked at from the various continents. The following pie chart (Figure 3) is a visual example to show which party is documented as most responsible for the overrun.

Figure 3: Documented Parties Responsible for Overrun

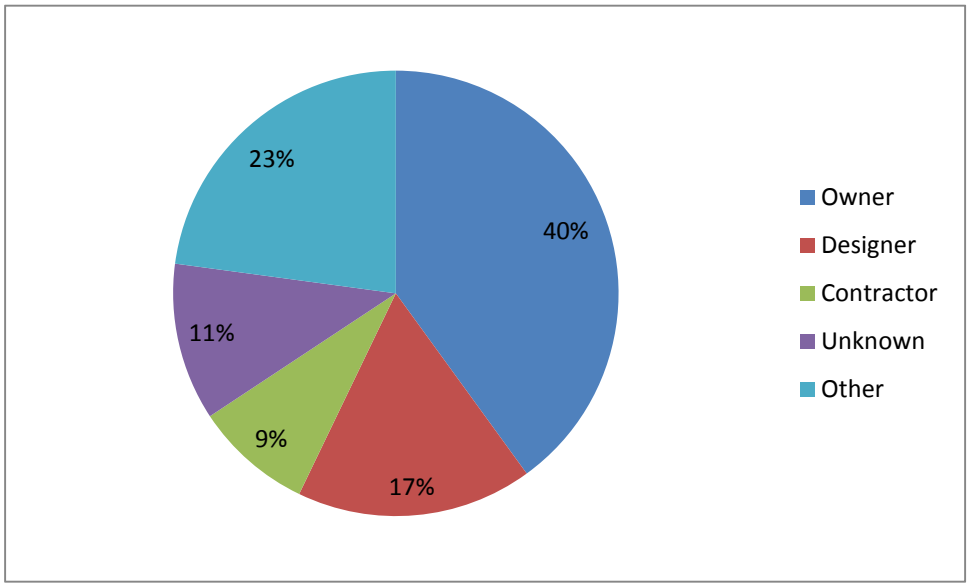
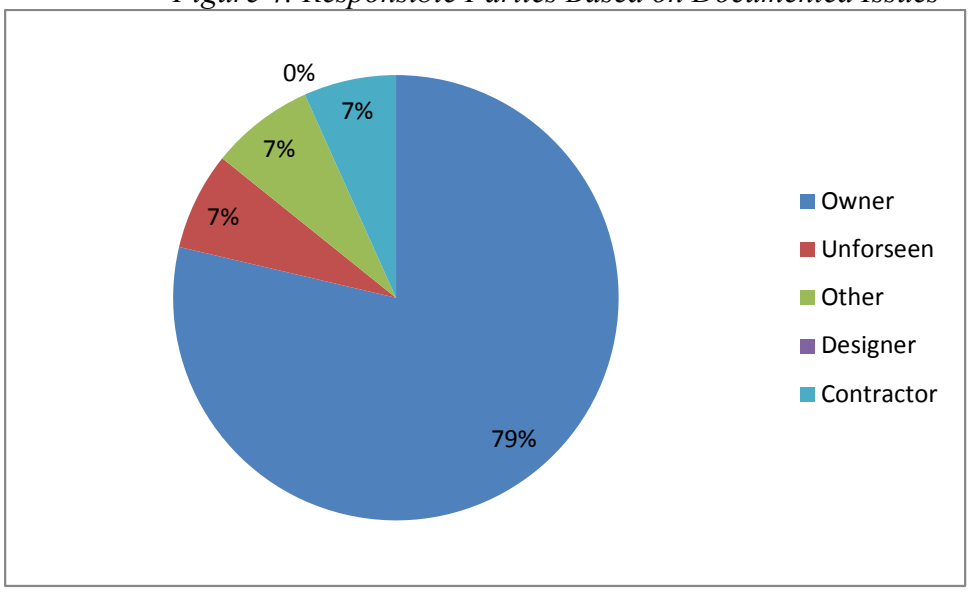


Figure 3 shows that the majority of the documented responsibility of the cost overrun may be due to the owner of the project (40%) and the designer(17%), who is usually also on the owner's side of the project. It is interesting to note that the contractor, who is usually the person actually completing the work has the least number of mentions as a responsible party in all the documented publications.

Second, it is necessary to do a second pie chart (refer to Figure 4) on the data in Table 3 to visually show the difference in frequency between responsible parties from the documented issues.

Figure 4: Responsible Parties Based on Documented Issues



From observing Figure 4 it is discernable that more than half (79%) the documented causes for project overrun are attributed to owner inefficiency. Figure 4 shows a correlation, for who may be the most responsible party for cost overrun, with Figure 3, both having the owner as the most responsible at 40% in Figure 3, and 79% in Figure 4. This suggests that it may be that the owner is the most responsible party on a project when it comes to cost overrun.

Global Cost Analysis

In an analysis of the top 15 countries with documented cost overrun information, it was found that cost metrics around the world, no matter the location, showed cost overrun. The following table displays this information.

Table 4: Cost Overrun Worldwide (Rivera, 2016)

Countries	**Cost Overruns**	**Customer Satisfaction**
Korea	45.5%	Dissatisfied
Vietnam	30.0%	Dissatisfied
Turkey	28.8%	-
Oman	28.6%	-
India	26.1%	-
Thailand	25.0%	-
Nigeria	20.0%	-
Saudi Arabia	20.0%	Dissatisfied
China	20.0%	-
Portugal	12.0%	-
Australia	10.0%	-
Malaysia	10.0%	Dissatisfied
Bangladesh	8.4%	-
Kuwait	1.0%	Dissatisfied
International	*28.0%*	*Dissatisfied*
Average	**20.4%**	**Dissatisfied**

This table shows the cost overrun metrics from the 15 countries, ranging from 45.5% to 1.0% with an average of 20.4%. This information is further supported by the following set of tables (Tables 5-7), the first of which, Table 5, displays metrics for the percent of projects that experienced cost overrun, and what percent they were overrun by, between 3 distinct sets of years.

Table 5: Cost Overrun per Distinct Time Period

Year	% Projects Over Initial Cost	% Over Initial Cost Amount
1985-1995	52	36
1996-2005	75	19
2006-2016	61	22

Table 5 indicates that even though technology and information has increased, cost overrun in the construction industry has maintained steady. This can be shown even

further in Table 6 which shows the percent of projects over budget in different regions and continents between these three distinct time periods.

Table 6: % Project over Initial Cost per Time Period

	1985-1995	1996-2005	2006-2016
Africa	N/A	80	65
Asia	N/A	N/A	59
Europe	52	73	38
Middle East	N/A	71	62
North America	N/A	N/A	98

Table 6 shows that even when separated, different regions of the world have similar documented cost overrun through the three distinct time periods, when referring to the percent of projects that were completed over budget.

The following table, Table 7, displays the percent amount that projects were over budget in these various regions and continents between the three distinct time periods.

Table 7: % Amount over Initial Cost per Time Period

	1985-1995	1996-2005	2006-2016
Africa	N/A	17	33
Asia	N/A	N/A	16
Europe	36	28	12
Middle East	N/A	1	20
North America	N/A	2	42

As shown in Table 7, most of the regions and continents showed similar cost overrun through the different time periods. This supports the information from Table 5, and allows for the statement that cost overrun is occurring around the world. In order to show this in one table, based off the literature research done, Table 8 should be consulted

to show the overall percentage of projects that were over budget, and the percent of the budget amount they were over by region and continent.

Table 8: Summary of Cost Metrics Worldwide

	% Project Over Initial Cost	% Over Initial Cost Amount	Satisfaction
Africa	69	29	Unsatisfied
Asia	59	16	Unsatisfied
Europe	50	29	Unsatisfied
Middle East	65	15	Unsatisfied
North America	98	28	Unsatisfied

Table 8 also includes the overall owner satisfaction per region and continent for projects, which echoes the information given in Table 4. Thus, it can be concluded through an analysis of documented information, that cost overrun is a present within the worldwide construction industry.

Potential Solutions

Through the analysis of the documented information, it has been shown that there are many issues that may be related to cost overrun, and the most responsible party for cost overrun may be the owner. However, there have been no proven solutions found to alleviate the problem. The only possible solution documented was the Best Value method:

"In a literature search for potential solutions to resolve the low performance in the delivery of services, the authors identified, that a CIB Task Group (TG61) performed a worldwide study in 2008 which identified innovative construction methods with documented high performance results. The study filtered through more than 15 million articles and reviewed more than 4,500 articles. In the end, the study found only 16 articles with documented performance results. The Best Value (BV) Performance Information Procurement System (PIPS) was one of three construction methods found in those articles, and it was found in 75% (12 of 16) of the articles (Egbu, et al., 2008, Kashiwagi, 2013). The other two methods were the Performance Assessment Scoring System (PASS) and the City of Fort Worth Equipment Services Department (ESD - FT).

After further investigation, it was found that although the PASS had measured performance information, the system could not show any improvement in performance of their projects. The ESD - FT had measurements to show improvement in their projects, however, this system did not have documented information for how the process worked. It also was a process that was internal to the organization and did not involve projects with suppliers or other organizations. BV PIPS was the only process that had sufficient documentation showing that it could improve customer satisfaction and value on projects in the construction industry that involved suppliers." (Rivera, 2016)

About Best Value

To show how effective BV PIPS has been and the impacts it has made in the industry, a list was compiled of nine instances that BV PIPS showed high performance: "

1. Most licensed university developed technology at Arizona State University with 43 licenses issued by the innovation group AZTech at Arizona State University. PIPS tests have been conducted in 31 states in the U.S. and five different countries besides the U.S. (Finland, Botswana, Netherlands, Canada, and Malaysia).
2. Documented performance of over 1800 projects or $6 billion (1629 projects, $4B construction and 89 projects, $2B non construction), customer satisfaction of 9.8 (out of 10), 93.5% of projects on time and 96.7% on budget.
3. Dominant results include Arizona State University business services and procurement department testing the PIPS system and generating $100M of revenue based on the method in the first three tests, and currently observing $110M a year from using the method.
4. Research tests show that in procuring of services outside of construction, the observed value is 33% or an increase of revenue or decrease in cost of 33% (Kashiwagi, 2013).
5. Minimization of up to 90% of the client's professional representative's risk management efforts and transactions due to reduced risk levels and the transfer of risk management and accountability to the vendors. This is the only documented reduction in management in the construction management industry.
6. In 2008, a CIB Task Group (TG61) performed a worldwide study identifying innovative construction methods with documented high performance results. The study filtered through more than 15 million articles and reviewed more than 4,500 articles. In the end, the study found only 16 articles with documented performance results. PIPS was one of three construction methods found in those articles, and it was found in 75% (12 of 16) of the articles (Egbu, et al., 2008).
7. In 2013, PBSRG sanctioned a follow on worldwide study to the CIB worldwide study in 2008 by Task Group 61 (TG61). The study's objective was to identify all efforts (research or industry) around the world that are similar to its procurement model BV

PIPS, as well as the current construction performance. The study sifted through hundreds of papers, websites, and personal industry contacts, and found similar results to the first study. The BV PIPS was the only method with documented performance results (Rivera, 2014).

8. The results of PIPS testing has won the 2012 Dutch Sourcing Award, the Construction Owners of America Association (COAA) Gold Award, the 2005 CoreNet H. Bruce Russell Global Innovators of the Year Award, the 2001 Tech Pono Award for Innovation in the State of Hawaii, along with numerous other awards.

9. Largest projects: $100M City of Peoria Wastewater Treatment DB project; $53M Olympic Village/University of Utah Housing Project; $1B Infrastructure project in Netherlands." (Rivera, 2016)

To emphasize how effective this method is, there was an audit and two studies done into verifying the effectiveness of BV PIPS. The audit was done by the State of Hawaii, and the two studies were done by two Dutch Researchers, Duren and Doree. All of these studies confirmed that BV PIPS is a very effective method to be implemented in order to increase efficiency as shown below:

"Duren and Doree's study found the following for BV PIPS projects performed in the United States:

- 93.5% of clients who worked with BV PIPS identified that their projects were delivered on time.
- 96.7% of clients who worked with BV PIPS identified that their projects were delivered within budget.
- 91% of the clients stated that there were no charges for extra work.
- 93.9% of the clients awarded the supplier's performance with greater than an 8 rating (on a scale from 1-10, 10 being the highest performance rating).
- 94% of clients would hire the same supplier again." (Rivera, 2016)

Best Value Process

The BV PIPS process has been very effective because it puts an emphasis on project preplanning and constant transparency. In order to prevent unqualified contractors from being hired for a project, there is a selection phase during which contractors compete depending on their level of expertise. Expertise is based on past performance

metrics, the expertise of the workforce, and the ability to identify risk on a project. The contractor that has the highest qualifications in the three areas then is able to move into the clarification phase. During this phase a contractor must simply explain how they plan to complete the project efficiently and with high customer satisfaction. To make it simple for the contractors, BV PIPS requires them to create a plan that includes the project's scope, major milestones, budget, risk management plan (including foreseeable risks and how to prevent them), and performance metrics. Once this is complete, a contractor will set up a meeting with the owner to explain the project simply for approval to start the project. After a contractor receives approval for the project, they will begin working. During the project, contractors are expected to track their progress in an excel spreadsheet called the Weekly Risk Report (WRR). This is a document that tracks their progress weekly according to the categories laid out in the clarification phase. The WRR is submitted to the client weekly, in order to make sure that the owner has an understanding of how the project is progressing. At the end of the project the WRR becomes a document showing the performance of the project. (Rivera, 2016)

Results Comparison

It can be shown how effective BV PIPS has been through metrics taken from a documented 1989 projects completed by them, during which the average vendor and owner cost increase percentage can be shown in Table 9.

Table 9: Best Value Cost Metrics

Vendor Cost Increase %	-0.1%
Owner Cost Increase %	3.0%

These metrics are particularly impressive when compared to the percent of the amount that projects were over the initial cost around the world in the span of 2006-2016. Just comparing the BV PIPS Owner Cost Increase percent with the Percent Amount over Initial Cost in Table 10, it can be seen how BV PIPS has been able to decrease cost overrun within the projects it has been applied to.

Table 10: Comparison of Cost Metrics

Best Value Owner Cost Increase %	3.0%
World % Amount Over Initial Cost (2006-2016)	22%

Utilizing the Best Value Approach, it may be possible to alleviate the cost overrun occurring in the construction industry. While there may be more optimal methods available suited for this problem in today's industry, this is the best documented one the author managed to find.

Conclusion

As the construction industry continues to grow over the next 30 years, more buildings will be built in that time period than in the last 2000 years. Preliminary research done in the U.K. and the U.S. found that there was cost overrun occurring in almost all construction projects. Furthermore, only about 2.5% of projects are defined as successful in the documented worldwide construction industry, in terms of scope, cost, schedule and business. In the U.K. and U.S. it was found that the documented cost overrun averaged to about 27% over the given initial cost in 2006-2016. Due to these findings, it is hypothesized that with the cost overrun shown in the U.K. and U.S., there may be similar results shown worldwide. In order to conduct the research, first, a literature research was

done, then, an analysis of the research. Next, it was necessary to identify the potential solutions and provide a recommendation.

In the literature research, publications from a total of 38 countries from 7 different continents of regions were looked at. About 300+ publications were looked at, and only about 29 publications met the criteria and had relevant cost overrun information. After looking at the metrics shown in the publications it was interesting to note that all the countries had documented cost overrun, and interestingly some third world countries had better metrics than the first world countries. By looking at the publications, a list of at least 10 major documented issues causing cost overrun were identified. Of those, the top 3 were: Monthly payment difficulties/financial problems, with 47 incidents; poor project/contract management, with 28 incidents; shortage of materials/equipment, with 25 incidents. While identifying these issues, it was also necessary to figure out who is responsible for each documented issue, and to compare those results to the documented parties responsible in the publications regardless of what issue they were related to. It was found that in both analyses the owner was most responsible for overrun in the projects and probably the most responsible for cost overrun on the construction projects. After looking at the cost overrun metrics of 15 countries, it was shown that the range of the cost overrun was from 1.0% to 45.5% with an average of 20.4%. In order to better understand this it was necessary to see how the cost overrun changed over 3 distinct periods of time, 1985-1995, 1996-2005, and 2006-2016. First, it was necessary to see if there were projects that were over the initial cost, and how much those projects were over the initial amount by. It was found that in all the time periods, there were at least 52% of projects that were over the initial cost, and those projects were at least 19% over the

initial cost. Next, it was necessary to see if these cost overrun metrics could be applied to the various continents and regions that were looked at. Throughout the 3 times periods it was found that there was cost overrun affecting each of the continents and regions looked at. All of them showed having projects that were over the initial cost, and what percent they were over by during the time periods. In a summary of the cost metrics, it was found that overall, the continents and regions had at least 50% of projects over the initial cost, and those projects were at least an average of 15% over the initial cost of the project.

After researching and finding these various issues and parties that may be responsible for the cost overrun, a potential solution was never identified. The only possible solution documented was the Best Value method. This method was documented as having an audit and two studies done on it. It was found that 96.7% of clients that used this method had projects that were delivered on budget and that 93.5% of projects were delivered on time. This is done in by putting an emphasis on project preplanning and constant transparency. In order to prevent unqualified contractors from being hired, during which contractors compete, based on past performance metrics, and the contractor with the highest qualifications from the past performance metrics is then chosen and moves into the clarification phase. During this phase, the contractor interacts with the client as to how they plan to complete the project efficiently and with high customer satisfaction. In order to ensure transparency during a project, the contractor is required to fill out a plan that includes the project's scope, major milestones, initial cost, risk management plane (including foreseeable risks and how to prevent them), and performance metrics. Once this is complete, the contractor meets with the owner to ensure they understand the plan for the project, and will then give the contractor approval

to carry out the plan. Throughout the completion of the project, the contractor is required to update a form called the Weekly Risk Report (WRR) in which they are able to update their progress in all the categories listed in the previous plan. Once the project is complete, the WRR serves as documented proof of the project and the performance during the project.

Recommendation

Though extensive, the author recognizes that this study's findings can be strengthened through documenting and analyzing more publications per major region. Additionally, there may be undocumented and missing data for each region. Thus, it is recommended that more research be done in this area to possibly identify the cause for cost overrun, and the possible best solution to solve cost overrun.

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APPENDIX A

DATA COLLECTED IN DATABASE FORMAT

The following table shows a list of publications used, in the research for this document, and the corresponding paper code for each publication.

Data Added	Paper Title	APA Citation	Source	Paper Code
06/16/16	CAUSES AND EFFECTS OF COST OVERRUN ON PUBLIC BUILDING CONSTRUCTION PROJECTS IN ETHIOPIA	Nega, F. (2008). Causes and effects of cost overrun on public building construction projects in Ethiopia (Doctoral dissertation, aau).	http://etd.aau.edu.et/bitstream/123456789/4215/3/faq_online_tool_instructions%281%29.pdf	AFET0001
12/30/15	Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study	Frimpong, Y., Oluwoye, J., & Crawford, L. (2003). Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study. International Journal of project management, 21(5), 321-326	http://www.sciencedirect.com.ezproxy1.lib.asu.edu/science/article/pii/S0263786302000558	AFGH0001
06/27/16	DELAY FACTORS IN CONSTRUCTION PROJECT IMPLEMENTATION IN THE PUBLIC SECTOR; A CASE STUDY OF THE KENYA AGRICULTURAL RESEARCH INSTITUTE CONSTRUCTION PROJECTS	Mbaluku, H. N., & Bwisa, H. (2013). Delay factors in construction project implementation in the public sector; a case study of the kenya agricultural research institute construction projects. JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, 585.	http://ir.jkuat.ac.ke/bitstream/handle/123456789/2077/7%20Project%20Mgt%20and%20Human%20Resource%20Development%20-%20A.pdf?sequence=1&isAllowed=y	AFKE0001
12/31/15	Causes of high costs of construction in Nigeria	Okpala, D. and Aniekwu, A. (1988). "Causes of High Costs of Construction in Nigeria." J. Constr. Eng. Manage., 10.1061/(ASCE)0733-9364(1988)114:2(233), 233-244.	http://ascelibrary.org/doi/abs/10.1061/(ASCE)0733-9364(1988)114%3A2(233)	AFNG0001

05/28/16	02/19/16	01/14/16	12/31/15	12/31/15
The effects of construction delays on project delivery in Nigerian construction industry	Time-cost model for building projects in Nigeria	Significant factors causing cost overruns in telecommunication projects in Nigeria	Time-Overrun Factors in Nigerian Construction Industry	Infrastructure delays and cost escalation: causes and effects in Nigeria
Aibinu, A. A., & Jagboro, G. O. (2002). The effects of construction delays on project delivery in Nigerian construction industry. International journal of project management, 20(8), 593-599.	Ogunsemi, D. R., & Jagboro, G. O. (2006). Time-cost model for building projects in Nigeria. Construction Management and Economics, 24(3), 253-258.	Ameh, O., Soyingbe, A., & Odusami, K. (2010). Significant factors causing cost overruns in telecommunication projects in Nigeria. Journal of Construction in Developing Countries, 15(2), 49-67.	Elinwa, A. U., & Joshua, M. (2001). Time-overrun factors in Nigerian construction industry. Journal of construction engineering and management,127(5), 419-425.	Omoregie, A., & Radford, D. (2006, April). Infrastructure delays and cost escalation: causes and effects in Nigeria. Proceeding of sixth international postgraduate research conference, Delft University of Technology and TNO, the Netherlands. 3rd-7th April.
http://www.sciencedirect.com/science/article/pii/S0263786302000285	http://www.tamu.edu/faculty/choudhury/articles/38.pdf	http://web.usm.my/jcdc/vol15_2_2010/JCDC%2015(2)%202010-ART%203_corrected_(49-67)_21.12.2010.pdf	http://ascelibrary.org/doi/abs/10.1061/(ASCE)0733-9364(2001)127:5(419)	http://www.irbnet.de/daten/iconda/CIB_DC26986.pdf
AFNG0008	AFNG0007	AFNG0004	AFNG0003	AFNG0002

06/20/16	01/21/16	02/22/16
Claims for extensions of time in civil engineering projects	Investigation into the Causes of Delays and Cost Overruns in Uganda's Public Sector Construction Projects	Causes and effects of delays and disruptions in construction projects in Tanzania
Yogeswaran, K., Kumaraswamy, M. M., & Miller, D. R. (1998). Claims for extensions of time in civil engineering projects. Construction Management & Economics, 16(3), 283-293.	Apolot, R., Alinaitwe, H., & Tindiwensi, D. (2011). An investigation into the causes of delay and cost overrun in Uganda's public sector construction projects. In Second International Conference on Advances in Engineering and Technology (pp. 305-311).	Kikwasi, G. (2013, February). Causes and effects of delays and disruptions in construction projects in Tanzania. In Australasian Journal of Construction Economics and Building-Conference Series (Vol. 1, No. 2, pp. 52-59).
http://www.tandfonline.com/doi/abs/10.1080/01446199837231 2	http://web.usm.my/jcdc/vol18_2_2013/JCDC%2018(2)%202013-Art.%203%20(33-47).pdf	https://www.dropbox.com/s/7s4cpmtmcpoog53/Causes%20and%20effects%20of%20delays%20and%20disruptions%20in%20construction%20projects%20in%20Tanzania.pdf?dl=0
ASHK0009	AFUG0001	AFTZ0001

02/22/16	02/22/16	01/27/16	01/06/16
Causes of Delays in any Construction Project	Causes of delay in project construction in developing countries	Effect of Construction Delays on Project Time Overrun: Indian Scenario	Analysing factors affecting delays in Indian construction projects
Naikwadi Sumaiyya, R., & Khare Pranay, R. (2014). Causes of Delays in any Construction Project.	Vyas, S. (2013). Causes of delay in project construction in developing countries. Indian journal of Commerce & Management Studies, 4.	Salunkhe, A. A., & Patil, R. S. (2014). effect of construction delays on project time overrun: Indian scenario. Int. J. Res. Eng. Technol, 3, 543-547.	Doloi, H., Sawhney, A., Iyer, K. C., & Rentala, S. (2012). Analysing factors affecting delays in Indian construction projects. International Journal of Project Management, 30(4), 479-489.
http://ijsr.net/archive/v5i1/NOV152573.pdf	https://www.dropbox.com/s/5zxque5tsy9kk8j/Causes%20of%20delay%20in%20project%20construction%20in%20developing%20countries.pdf?dl=0	http://esatjournals.net/ijret/2014v03/i01/IJRET20140301091.pdf	http://pl8cg5fc8w.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info%3Aofi%2Fenc%3AUTF-8&rfr_id=info:sid/summon.serialssolutions.com&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.atitle=Analysing+factors+affecting+delays+in+Indian+construction+projects&rft.jtitle=INTERNATIONAL+JOURNAL+OF+PROJECT+MANAGEMENT&rft.au=Doloi%2C+H&rft.au=Sawhney%2C+A&rft.au=Iyer%2C+KC&rft.au=Rentala%2C+S&rft.date=2012-05-01&rft.pub=ELSEVIER+SCI+LTD&rft.issn=0263-7863&rft.eissn=1873-4634&rft.volume=30&rft.issue=4&rft.spage=479&rft.epage=489&rft_id=info:doi/10.1016%2Fj.ijproman.2011.10.004&rft.externalDBID=n%2Fa&rft.externalDocID=000303783400007&paramdict=en-US
ASIN0005	ASIN0004	ASIN0003	ASIN0001

01/14/16	01/14/16	02/08/16	01/14/16	02/05/16
Cost and time overruns of projects in Malaysia	Time and Cost Performance in Construction Projects in Southern and Central Regions of Peninsular Malaysia	Analyzing Schedule Delay of Mega Project: Lessons Learned From Korea Train Express	Cost overrun and cause in Korean social overhead capital projects: roads, rails, airports, and ports	Examining service quality within construction processes
Endut, I. R., Akintoye, A., & Kelly, J. (2009). Cost and time overruns of projects in Malaysia. retrieved on August, 21, 243-252.	Memon, A., Rahman, I., & Azis, A. (2012). Time and Cost Performance in Construction Projects in Southern and Central Regions of Peninsular Malaysia. International Journal of Advances in Applied Sciences.	Han, S. H., Yun, S., Kim, H., Kwak, Y. H., Park, H. K., & Lee, S. H. (2009). Analyzing schedule delay of mega project: Lessons learned from Korea train express. Engineering Management, IEEE Transactions on, 56(2), 243-256.	Lee, J. (2008). Cost Overrun and Cause in Korean Social Overhead Capital Projects: Roads, Rails, Airports, and Ports. J. Urban Plann. Dev., 134(2), 59–62.	Al-Momani, A. H. (2000). Examining service quality within construction processes. Technovation, 20(11), 643-651.
http://www.irbnet.de/daten/iconda/CIB10633.pdf	http://www.iaesjournal.com/online/index.php/IJAAS/article/view/537/644	http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=4810151	http://dx.doi.org.ezproxy1.lib.asu.edu/10.1061/(ASCE)0733-9488(2008)134:2(59)	http://www.sciencedirect.com/science/article/pii/S0166497200000002X
ASMY0002	ASMY0001	ASKR0002	ASKR0001	MEJO0001

01/14/16	02/26/16	01/21/16
Delay and cost overruns in Vietnam large construction projects: a comparison with other selected countries	Causes and effect of delays in Aceh construction industry	Significant factors causing cost overruns in large construction projects in Malaysia
Le-Hoai, L., Lee, Y., & Nguyen, A. (2008). Delay and Cost Overruns in Vietnam Large Construction Projects: A Comparison with Other Selected Countries. KSCE Journal of Civil Engineering, 12(6), 367-377. doi:10.1007/s12205-008-0367-7	Majid, I. A. (2006). Causes and effect of delays in Aceh construction industry (Doctoral dissertation, Universiti Teknologi Malaysia, Faculty of Civil Engineering).	Abdul Rahman, I., Memon, A. H., Karim, A., & Tarmizi, A. (2013). Significant factors causing cost overruns in large construction projects in Malaysia. Journal of Applied Science, 13(2), 286-293.
http://pl8cg5fc8w.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info%3Aofi%2Fenc%3AUTF-8&rfr_id=info:sid/summon.serialssolutions.com&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.atitle=Delay+and+cost+overruns+in+Vietnam+large+construction+projects%3A+A+comparison+with+other+selected+countries&rft.jtitle=KSCE+Journal+of+Civil+Engineering&rft.au=Le-Hoai%2C+Long&rft.au=Lee%2C+Young+Dai&rft.au=Lee%2C+Jun+Yong&rft.date=2008-11-01&rft.issn=1226-7988&rft.eissn=1976-3808&rft.volume=12&rft.issue=6&rft.spage=367&rft.epage=377&rft_id=info:doi/10.1007%2Fs12205-008-0367-7&rft.externalDBID=n%2Fa&rft.externalDocID=10_1007_s12205_008_0367_7&paramdict=en-US	http://eprints.utm.my/5304/	http://eprints.uthm.edu.my/4306/1/ismail_abdul_rahman_2_U.pdf
ASVN0001	ASMY0008	ASMY0004

01/15/16	06/22/16	06/27/16	02/02/16	01/14/16
Dealing with cost and time in the Portugese construction industry	Cost overruns in road construction—what are their sizes and determinants?	Different cost performance: different determinants?: The case of cost overruns in Dutch transport infrastructure projects	Analysing customer satisfaction and quality in construction–the case of public and private customers	Large construction projects in developing countries: A case study from Vietnam
Moura, H., Teixeira, J., & Pires, B. (2007). Dealing with cost and time in the Portugese construction industry. CIB World Building Congress 2007, 1252-1265.	Odeck, J. (2004). Cost overruns in road construction—what are their sizes and determinants?. Transport policy, 11(1), 43-53.	Cantarelli, C. C., Van Wee, B., Molin, E. J., & Flyvbjerg, B. (2012). Different cost performance: different determinants?: The case of cost overruns in Dutch transport infrastructure projects. Transport Policy, 22, 88-95.	Kärnä, S. (2014). Analysing customer satisfaction and quality in construction–the case of public and private customers. Nordic journal of surveying and real estate research, 2.	Nguyen, D., Ogunlana, S., Truong, Q., & Ka, C. (2004). Large construction projects in developing countries: A case study from Vietnam. International Journal of Project Management, 22(7), 553–561-553–561. doi:doi:10.1016/j.ijproman.2004.03.004
http://repositorium.sdum.uminho.pt/bitstream/1822/8345/3/Cost%20Time%20-MOURA.pdf	http://www.sciencedirect.com/science/article/pii/S0967070X03000179	http://www.sciencedirect.com/science/article/pii/S0967070X12000571	http://lib.tkk.fi/Diss/2009/isbn9789522481337/	http://www.sciencedirect.com.ezproxy1.lib.asu.edu/science/article/pii/S0263786304000298
EUPT0001	EUNO0001	EUNL0001	EUFI0001	ASVN0002

02/19/16	01/04/16	01/22/16	01/04/16	01/15/16
The satisfaction levels of UK construction clients based on the performance of consultants: Results of a case study	The cost of poorly assembled data to the construction industry	Cost overruns in public projects	Illustrative Benchmarking Rework and Rework Costs in Swedish Construction Industry	Claims in railway projects in Portugal
Cheng, J., Proverbs, D. G., & Oduoza, C. F. (2006). The satisfaction levels of UK construction clients based on the performance of consultants: Results of a case study. Engineering, Construction and Architectural Management, 13(6), 567-583.	Hamil, S. (2013, August 13). The cost of poorly assembled data to the construction industry. Retrieved from http://constructioncode.blogspot.com/2013/08/the-cost-of-poorly-assembled-data-to.html	Arditi, D., Akan, G. T., & Gurdamar, S. (1985). Cost overruns in public projects. International Journal of Project Management, 3(4), 218-224.	Josephson, P., Larsson, B., and Li, H. (2002). Illustrative Benchmarking Rework and Rework Costs in Swedish Construction Industry. J. Manage. Eng., 18(2), 76–83.	Moura, H. M. P., & Teixeira, J. M. C. (2005). Claims in railway projects in Portugal.
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EUUK0003	EUUK0001	METR0001	EUSE0001	EUPT0002

01/27/16	01/22/16	02/23/16	02/19/16	02/19/16
Delays and cost increases in the construction of private residential projects in Kuwait	An Empirical Approach for Identifying Critical Time-Ovrerun Risk Factors in Kuwait's Construction Projects	An investigation into the risk of construction project delays in the UAE	PFI: Construction Performance	Cost and time control of construction projects: inhibiting factors and mitigating measures in practice
Koushki, P. A., Al-Rashid, K., & Kartam, N. (2005). Delays and cost increases in the construction of private residential projects in Kuwait. Construction Management and Economics, 23(3), 285-294.	Al Zubaidi, H., & Al Otaibi, S. (2008). An Empirical Approach for Identifying Critical Time-Ovrerun Risk Factors in Kuwait's Construction Projects. Journal of Economic and Administrative Sciences, 24(2), 35-53.	Motaleb, O., & Kishk, M. (2013). An investigation into the risk of construction project delays in the UAE. International Journal of Information Technology Project Management, Volume 4 Number 3.	National Audit Office (2003). PFI: Construction Performance. Victoria: National Audit Office. Retrieved from https://www.nao.org.uk/wp-content/uploads/2003/02/0203371.pdf	Olawale, Y. A., & Sun, M. (2010). Cost and time control of construction projects: inhibiting factors and mitigating measures in practice. Construction Management and Economics, 28(5), 509-526.
http://www.tandfonline.com/doi/abs/10.1080/01446190420003267 10	http://www.emeraldinsight.com/doi/abs/10.1108/10264116200800007	https://openair.rgu.ac.uk/bitstream/handle/10059/1042/Kishk%20IJITPM%202013%20Investigation.pdf?sequence=1&isAllowed=y	https://www.nao.org.uk/wp-content/uploads/2003/02/0203371.pdf	http://eprints.aston.ac.uk/15566/2/Cost_and_time_control_inhibiting_factors_and_mitigating_measures.pdf
MEKW0002	MEKW0001	MEAE0001	EUUK0005	EUUK0004

02/08/16	01/21/16	01/14/16	01/29/16	01/21/16
Risks Leading to Cost Overrun in Building Construction from Consultants' Perspective	Causes of Delay in Road Construction Projects	Cost Overrun Factors In Construction Industry of Pakistan	Causes of Delay in Construction Projects in the Oil and Gas Industry in the Gulf Cooperation Council Countries: A Case Study	Causes, Effects, Benefits, and Remedies of Change Orders on Public Construction Projects in Oman
Mahamid, I., & Dmaidi, N. (2013). Risks Leading to Cost Overrun in Building Construction from Consultants' Perspective. Organization, Technology & Management in Construction: An International Journal, 5(2), 860-873.	Mahamid, I., Bruland, A., & Dmaidi, N. (2011). Causes of delay in road construction projects. Journal of Management in Engineering, 28(3), 300-310.	Azhar, N., Farooqui, R., & Ahmed, S. (2008). Cost Overrun Factors In Construction Industry of Pakistan. First International Conference on Construction In Developing Countries (ICCIDC–I).	Ruqaishi, M., & Bashir, H. A. (2013). Causes of delay in construction projects in the oil and gas industry in the gulf cooperation council countries: a case study. Journal of Management in Engineering, 31(3), 05014017.	Alnuaimi, A. S., Taha, R. A., Al Mohsin, M., & Al-Harthi, A. S. (2009). Causes, effects, benefits, and remedies of change orders on public construction projects in Oman. Journal of Construction Engineering and Management, 136(5), 615-622.
http://www.academia.edu/9613832/o_Risks_Leading_to_Cost_Overrun_in_Building_Construction_from_Consultants_Perspective	http://ascelibrary.org/doi/full/10.1061/%28ASCE%29ME.1943-5479.0000096	http://www.neduet.edu.pk/Civil/ICCIDC-I/Conference%20Proceedings/Papers/051.pdf	http://ascelibrary.org/doi/full/10.1061/%28ASCE%29ME.1943-5479.0000248	http://ascelibrary.org/doi/abs/10.1061/(ASCE)CO.1943-7862.0000154
MEPS0003	MEPS0002	ASPK0001	MEOM0002	MEOM0001

02/19/16	02/02/16	01/22/16	01/21/16	06/27/16
Why do infrastructure projects always go over budget?	Contributors to schedule delays in public construction projects in Saudi Arabia: owners' perspective	Owners' Perspective of Factors Contributing to Project Delay: Case Studies of Road and Bridge Projects in Saudi Arabia	Causes of delay in large construction projects	Cost deviation in road construction projects: The case of Palestine
Siemiatycki, M. (2014, June 09). Why do infrastructure projects always go over budget? Thestar.com. Retrieved February 19, 2016, from http://www.thestar.com/opinion/commentary/2014/06/09/why_do_infrastructure_projects_always_go_over_budget.html	Mahamid, I. (2013). Contributors to schedule delays in public construction projects in Saudi Arabia: owners' perspective. Journal of Construction Project Management and Innovation, 3(2), 608-619.	Elawi, G. S. A. (2015). Owners' Perspective of Factors Contributing to Project Delay: Case Studies of Road and Bridge Projects in Saudi Arabia (Doctoral dissertation, Arizona State University).	Assaf, S. A., & Al-Hejji, S. (2006). Causes of delay in large construction projects. International journal of project management, 24(4), 349-357.	Mahamid, I., & Bruland, A. (2012). Cost deviation in road construction projects: The case of Palestine. Australasian Journal of Construction Economics and Building, The, 12(1), 58.
http://www.thestar.com/opinion/commentary/2014/06/09/why_do_infrastructure_projects_always_go_over_budget.html	http://reference.sabinet.co.za/webx/access/electronic_journals/jcpmi/jcpmi_v3_n2_a1.pdf	http://repository.asu.edu/attachments/157957/content/Elawi_asu_0010N_15169.pdf	http://www.sciencedirect.com/science/article/pii/S0263786305001262	https://search.informit.com.au/documentSummary;dn=119892779280269;res=IELENG
NACA0002	MESA0005	MESA0002	MESA0001	MEPS0005

11/01/16	06/09/16	02/22/16	01/22/16	01/06/16
Bechtel presentation	Construction Delays in Florida: An Empirical Study	The root causes of delays in highway construction	Measuring risk management performance within a capital program	Causes of Quality Deviations in Design and Construction
IHS Markit (2013). Public Annual Reports; press releases. IHS Herold Global Projects Database. Retrieved from: http://www.herold.com/research/industry_research.home	Ahmed, S. M., Azhar, S., Castillo, M., & Kappagantula, P. (2002). Construction delays in Florida: An empirical study. Final report. Department of Community Affairs, Florida, US.	Ellis, R. D., & Thomas, H. R. (2003, January). The root causes of delays in highway construction. In 82nd Annual meeting of the transportation research board. Transportation Research Board Washington, DC.	J. Perrenoud, A., C. Lines, B., & T. Sullivan, K. (2014). Measuring risk management performance within a capital program. Journal of Facilities Management, 12(2), 158-171.	Burati, J., Jr., Farrington, J., and Ledbetter, W. (1992). Causes of Quality Deviations in Design and Construction. J. Constr. Eng. Manage., 118(1), 34–49.
http://www.herold.com/research/industry_research.home	https://ohlsc.fiu.edu/pdfs/research_reports/delays_project.pdf	http://www.ltrc.lsu.edu/TRB_82/TRB2003-000646.pdf	http://www.emeraldinsight.com/doi/full/10.1108/JFM-03-2013-0018	http://ascelibrary.org.ezproxy1.lib.asu.edu/doi/abs/10.1061%2F%28ASCE%290733-9364%281992%2911 8%3A1%2834%29
NAUS0007	NAUS0005	NAUS0004	NAUS0002	NAUS0001

01/22/16	01/04/16	01/04/16	01/04/16	01/04/16
Evaluation of risk factors leading to cost overrun in delivery of highway construction projects	Rework in civil infrastructure projects: Determination of cost predictors	Quantifying the causes and costs of rework in construction	A project management quality cost information system for the construction industry	Influence of project type and procurement method on rework costs in building construction projects
Creedy, G. D., Skitmore, M., & Wong, J. K. (2010). Evaluation of risk factors leading to cost overrun in delivery of highway construction projects. Journal of construction engineering and management.	Love, P. E., Edwards, D. J., Watson, H., & Davis, P. (2010). Rework in civil infrastructure projects: Determination of cost predictors. Journal of construction engineering and management, 136(3), 275-282.	Love, P. E., & Li, H. (2000). Quantifying the causes and costs of rework in construction. Construction Management & Economics, 18(4), 479-490.	Love, P. E., & Irani, Z. (2003). A project management quality cost information system for the construction industry. Information & Management, 40(7), 649-661.	Love, P. E. D. (2002). Influence of project type and procurement method on rework costs in building construction projects. Journal of Construction Engineering and Management, 128(1), 18-29. doi:10.1061/(ASCE)0733-9364(2002)128:1(18)
http://ascelibrary.org/doi/10.1061/(ASCE)CO.1943-7862.0000160	http://ascelibrary.org.ezproxy1.lib.asu.edu/doi/abs/10.1061%2F%28ASCE%29CO.1943-7862.0000136	http://www.tandfonline.com.ezproxy1.lib.asu.edu/doi/abs/10.1080/01446190050024897	http://www.sciencedirect.com.ezproxy1.lib.asu.edu/science/article/pii/S0378720602000940	http://ascelibrary.org.ezproxy1.lib.asu.edu/doi/abs/10.1061%2F%28ASCE%290733-9364%282002%29128%3A1%2818%29
OCAU0006	OCAU0004	OCAU0003	OCAU0002	OCAU0001

05/28/16	01/22/16	01/06/16	01/04/16
Establishing project risk assessment teams	Underestimating costs in public works projects: Error or lie?	Analysis of cost and schedule performance of international development projects	Measuring the Impact of Rework on Construction Cost Performance
Frame, J. D. (1997). Establishing project risk assessment teams. Kähkönen K. and Artto KA (eds.) Managing Risks in Projects, St. Edmunsbury Press Ltd., Suffolk, UK, 22-27.	Flyvbjerg, B., Holm, M. S., & Buhl, S. (2002). Underestimating costs in public works projects: Error or lie?. Journal of the American planning association, 68(3), 279-295.	Ahsan, K., & Gunawan, I. (2010). Analysis of cost and schedule performance of international development projects. International Journal of Project Management, 28(1), 68-78.	Hwang, B., Thomas, S., Haas, C., and Caldas, C. (2009). Measuring the Impact of Rework on Construction Cost Performance. J. Constr. Eng. Manage., 135(3), 187–198.
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OTHR0007	OTHR0003	OTHR0002	OTHR0001

The following table lays out the metrics found from each publication, identified by the paper code, and tells what country and the type of work that was being analyzed for each entry.

Date Added	Paper Code	Region	Country	**Type of work**	**Year**	**Rework**	**% project delay**	**Average % delay duration**	**% project overbudget**	**Average % overbudget amount**	**Customer Satisfaction**
2/2/2016	EUFI0001	Europe	Finland	Survey	2004						Dissatisfied
1/15/2016	EUPT0001	Europe	Portugal	Overall 66 construction projects	2007						Dissatisfied
12/31/2015	AFNG0001	Africa	Nigeria	Survey	1988						Dissatisfied
2/22/2016	AFTZ0001	Africa	Tanzania	Survey	2012						Dissatisfied
2/19/2016	NACA0002	North America	Canada	Public projects	2014						Dissatisfied
2/22/2016	ASIN0004	Asia	India	Overall	2013						Dissatisfied
2/8/2016	ASKR0002	Asia	Korea	Survey	2009						Dissatisfied

5/17/2016	1/21/2016	1/28/2016	2/5/2016	2/19/2016	2/19/2016	1/15/2016	1/14/2016	2/5/2016
MEAE0001	MESA0001	MEKW0002	MEJO0001	EUUK0003	EUUK0003	EUPT0002	ASVN0001	ASMY0004
Middle East	Middle East	Middle East	Middle East	Europe	Europe	Europe	Asia	Asia
United Arab Emirates	Saudi Arabia	Kuwait	Jordan	UK	UK	Portugal	Vietnam	Malaysia
Survey	Overall 76 projects	450 private housing projects	Survey	Survey	Survey	Survey	Overall	Survey
2013	2006	2004	2000	2006	2006	2004	2008	2013
Dissatisfied	Dissatisfied	Dissatisfied	Dissatisfied	Dissatisfied	Dissatisfied	Dissatisfied	Dissatisfied	Dissatisfied

1/14/2016	2/19/2016	1/14/2016	1/15/2016	10/19/2016	1/28/2016	1/22/2016	1/22/2016
ASKR0001	AFNG0007	ASMY0001	EUPT0001	NAUS0007	MEKW0002	MESA0002	OCAU0006
Asia	Africa	Asia	Europe	North America	Middle East	Middle East	Oceania
Korea	Nigeria	Malaysia	Portugal	USA	Kuwait	Saudi Arabia	Australia
154 rail and road projects	Overall 85 projects	Overall 140 projects	Overall 66 construction projects	General	450 private housing projects	49 roads and bridges projects	Highway projects
2001	2006	2012	2007	2016	2004	2015	2010
88.2%	89.0%	92.0%	94.0%	98.0%	100.0%	100.0%	
27.5%	20.0%	7.5%	40.0%		6.4%	38.9%	
	46.0%	89.0%	66.0%	98.0%			
	20.0%	7.5%	12.0%	80.0%			
							Dissatisfied

12/30/2015	1/21/2016	6/20/2016	1/14/2016	6/9/2016	1/22/2016	12/31/2015
AFGH0001	MESA0001	ASHK0009	ASMY0002	MEJO0001	MEKW0001	AFNG0003
Africa	Middle East	Asia	Asia	Middle East	Middle East	Africa
Ghana	Saudi Arabia	Hong Kong	Malaysia	Jordan	Kuwait	Nigeria
47 groundwater projects	Overall 76 projects	67 projects	Overall 359 projects	Overall 130 projects	28 infrastructure and building projects	Overall as suggested by 72 construction professional
1999	2006	2010	2012	2000	2008	2001
70.0%	70.0%	76.0%	77.7%	81.5%	82.0%	85.0%
	20.0%	85.0%	49.7%	55.8%	38.0%	
80.0%			54.6%			
			2.1%			

2/19/2016	1/28/2016	6/14/2016	2/22/2016	1/6/2016	2/22/2016	1/27/2016	5/17/2016	2/19/2016
EUUK0004	MEOM0002	METR0001	ASIN0005	ASIN0001	AFTZ0001	ASIN0003	ASMY0008	EUUK0005
Europe	Middle East	Europe	Asia	Asia	Africa	Asia	Asia	Europe
UK	Oman	Turkey	India	India	Tanzania	India	Malaysia	UK
Survey	40 public projects	126 public projects	646 central sector projects	Overall 951 projects	Survey	Overall 205 projects	30 state projects	Survey
2010	2015	2006	2004	2012	2012	2012	2011	1999
10.0%	38.0%	39.10%	40.0%	49.8%	56.0%	57.0%	60.0%	70.0%
			40.2%				23.7%	
10.0%				32.5%				73.0%
						18.1%		

2/22/2016	1/6/2016	1/6/2016	1/22/2016	1/21/2016	1/22/2016	1/6/2016	1/15/2016	5/28/2016
NAUS0004	OTHR0002	OTHR0002	EUTR0001	AFUG0001	NAUS0002	OTHR0002	EUPT0002	AFNG0008
North America	Asia	Asia	Europe	Africa	North America	Asia	Europe	Africa
USA	Thailand	Bangladesh	Turkey	Uganda	USA	India	Portugal	Nigeria
150 highway projects	19 public projects	31 public projects	Overall 384 projects	Overall 30 projects	266 university construction projects	20 public projects	25 railway projects	Overall 61 projects
2002	2007	2007	1985	2007	2014	2007	2002	1999
25.0%	32.7%	34.4%	40.0%	46.5%	48.9%	55.7%	85.0%	92.6%
2.1%	25.0%	8.4%	44.0%		3.2%	26.1%	25.0%	17.3%

1/15/2016	1/15/2016	6/27/2016	6/22/2016	1/21/2016	1/28/2016	6/17/2016	2/11/2016	1/6/2016	1/21/2016
EUPT0001	EUPT0001	MEPS0005	EUNO0001	AFUG0001	MEKW0002	AFET0001	MEPS0003	OTHR0002	MEPS0002
Europe	Europe	Middle East	Europe	Africa	Middle East	Africa	Middle East	Asia	Middle East
Portugal	Portugal	Palestine	Norway	Uganda	Kuwait	Ethiopia	Palestine	China	Palestine
26 major motorway projects	Expo 98 projects	169 road construction	620 projects	Overall 30 projects	450 private housing projects	70 public building construction projects	Survey	30 public projects	Survey
1995	1998	2008	1995	2007	2004	2008	2013	2007	2012
								13.6%	20.0%
		24.0%	52.4%	53.0%	71.0%	95.7%	100.0%		
39.0%	41.0%	14.6%	25.0%	16.2%	1.0%	63.0%	20.0%	5.4%	

12/31/2015	6/9/2016	2/8/2016	1/21/2016	6/27/2016	1/14/2016	1/22/2016	2/8/2016
AFNG0002	NAUS0005	ASKR0002	MEOM0001	EUNL0001	MEPK0001	OTHR0003	ASKR0002
Africa	North America	Asia	Middle East	Europe	Middle East	Other	Asia
Nigeria	USA	Korea	Oman	Netherlands	Pakistan	International	Korea
9 highway projects	4 projects of environmental and engineering design services for roadway construction	7 mega projects over 1b budget	Overall 4 public projects	76 projects	Survey	258 transportation infrastructure projects	29 medium-sized ($50m) projects
1994	2002	2009	2010	2002	2008	2003	2009
				16.5%	25.0%	28.0%	32.5%

1/4/2016	1/4/2016	1/4/2016	1/4/2016	1/4/2016	1/4/2016	1/4/2016	1/6/2016	6/27/2016
OCAU0002	OCAU0003	OCAU0001	OCAU0004	EUUK0001	EUSE0001	OTHR0001	NAUS0001	AFKE0001
Oceania	Oceania	Oceania	Oceania	Europe	Europe	North America	North America	Africa
Australia	Australia	Australia	Australia	UK	Sweden	USA	USA	Kenya
1 residential and 1 warehouse projects	2 projects, 16.8m budget	Overall 161 construction projects	115 civil infrastructure projects	Overall	Overall	Overall	9 projects, 1.2b budget	9 construction projects
2003	2000	2002	2010	2013	2002	2005	1992	2013
2.30%	2.80%	6.40%	10%	5%	4.40%	5%	12.40%	

2/2/2016	1/14/2016	1/14/2016	1/21/2016	1/14/2016	1/14/2016	12/31/2015	1/4/2016
MESA0005	ASVN0002	ASVN0001	ASMY0004	ASMY0001	AFNG0004	AFNG0001	OTHR0001
Middle East	Asia	Asia	Asia	Asia	Africa	Africa	Other
Saudi Arabia	Vietnam	Vietnam	Malaysia	Malaysia	Nigeria	Nigeria	International
	Overall	Overall		Overall 140 projects	53 telecommunication projects	Overall	Survey
2013	2004	2008	2013	2012	2010	1988	2005
							5%

5/28/2016	OTHR0007	Other	International	Overall 8000 projects	1994						
2/2/2016	MESA0005	Middle East	Saudi Arabia		2013						

The following table lays out the performance metrics found in each publication, as identified by paper code, and who the paper states is the responsible party for the overrun experienced by a project.

Paper Code	Party Responsible [O]wner, [C]ontractor, [D]esigner, [U]nforeseen, O[T]her	Performance metrics
EUFI0001	-	- In 2004, a survey on 200 private and 154 public owners found out that their overall customer satisfaction rates were 66.4% (3.32 out of 5) and 70.8% (3.54 out of 5) respectively
EUPT0001	-	- In 2007, a study about the causes of non-performance issues on 66 projects in Portugal indicated that clients were awarded that they were the causes of non-performance issues.
AFNG0001	-	- In 1988, a survey indicated that clients and contractors did not seem to agree very much on delay and cost overrun factors (60% agreement rate). As the result, there were always accusations and counter-accusations between the two as to who was responsible for delays and cost escalations.
AFTZ0001	-	- In 2012, a study suggested that a current issue with delays had caused increase in disputes, arbitration, litigation, delaying in return loans and earns profits for clients.
NACA0002	-	- In 2014, Governments across the Greater Toronto Area were currently undertaking a period of sustained infrastructure development, to make up for a lost generation of investment due to over-budget issues in past projects.
ASIN0004	-	- In 2013, a study in India indicated that delay issues have been adding stress to project participants and decreasing customers' faith and trust.
ASKR000	-	- In 2009, schedule delays had been a source of great distress to both owner and contractor.

- In 2013, the growing rate of delays in project delivery is considered a major criticism of the construction companies	- In 2006, a study on 57 construction participants and 76 projects suggested owners and contractors were disagreeing with each other when it came to identification the major source of delay on projects. Agreement degree between owners and contractors were 56.8%.	- In 2004, a study on 450 private housing projects pointed out that the owners' dissatisfaction with the construction may be influenced by the psychological and irritation ('headache') factors associated with the implementation of various design, procurement and implementation phases of the project, and not solely a function of time-delay and/or cost increases.	- In 2000, a survey on 48 private,37 public owners, and 53 contractors indicated that the entire service offered by the contractors is not satisfactory to most project owners. Additionally, the public officials have a very poor satisfaction regarding the contractors' performance and have the most complaints.	- In 2006, a survey on 61 construction clients found out that they had a negative satisfaction mean which means the clients perceived that the performance they received was not up to their expectations.	- In 2006, a study on customer satisfaction in construction industry indicated that public clients are less satisfied than private ones.	- In 2004, Portuguese construction stakeholders have widely recognized a sensitive increase in disputes and contractual claims.	- In 2008, Vietnam's Ministry of Planning and Investment acknowledge project delays and cost overruns problems as a big headache, especially with government-related funded projects	- In 2013, the issue of cost overrun in construction has become a serious concern to investors.
O	-	-	-	-	-	-	-	-
MEAE0001	MESA0001	MEKW0002	MEJO0001	EUUK0003	EUUK0003	EUPT0002	ASVN0001	ASMY000

- In 2001, a survey from 72 construction professionals suggested that delays occurred on average 85% of projects in Nigeria.	- In 2008, a study on 154 rail and road projects completed between 1985-2001 found out that more than 88.2% of them were delayed with average delay rate of 27.5%	- In 2006, a study on 85 completed projects found out that 89% of them experienced delays and the delay rate was more than 20%. On the other hand, 46% of them experienced cost overrun and the cost overrun rate was more than 20%.	- In 2012, a study on 140 construction projects in Malaysia found out that 92% of them experienced delay with average delay rate of 7.5%, and 89% of them faced cost overrun issues with average cost overrun rate of 7.5% contract price	- In 2007, a study on 66 construction projects varying in nature suggested that 94% of these projects experienced delays with average delay rate of 40%. Also, about 66% of these projects experienced cost overruns and the average cost overrun rate was 12%	- In 2016, during a CII Annual Conference, the President and COO of Bechtel Group estimated the industry has been experiencing 98% cost overruns or delays, and 80% average cost increase. Average 20 months project duration delay	- In 2004, a study on 450 private housing projects found out that 100% of them experience d delay and the average delay rate was 6.4%	- In 2015, a study on 49 roads and bridges projects revealed that 100% of them had time overrun issues and the average delay rate was 38.88%	- In 2010, a study on highway projects indicated that cost overruns of highway projects have a serious impact on program budgeting from the view of the owner
O,C	O,U	-	D,O,C	O,D		C,O,T	O	-
AFNG0003	ASKR000	AFNG0007	ASMY0001	EUPT0001	NAUS0007	MEKW00	MESA000	OCAU000

- In 2012, a survey on 60 construction participants found out that more than 56% of their projects experienced delays	- In 2012, a study conducted by Infrastructure and Project Monitoring Division of Ministry of Statistics and Programme Implementation reported that out of 205 ongoing projects, 57% of them experienced time overrun. The average cost overrun was 18.1%	- In 2011, a study on 30 state projects had identified that 60% of these projects experienced delay more than 10% of original duration. Average delay rate was 23.7%.	- In 1999 Government survey, public projects experienced delays in 70% of them and cost overrun in 73% of them.	- During 1970-1999, out of 47 groundwater projects, 33 (70%) were delayed and 38 (80%) were overruns in budget	- in 2006, a study on 57 construction participants and 76 projects suggested that 70% of these projects experienced delays and the average delay rate was 20%	- In 2012, a study on 359 projects completed between 1994 - 2005 varying in size, procurement methods, and the nature of works. The findings were that 54.6% of projects experienced cost overrun and average cost overrun rate in these projects was 2.08%; 77.7% of projects experienced time delay and average delay was 49.71%	- In 2000 a study of 130 projects were conducted and it is found that The overall delays were in 106 out of 130 (81.5%) projects.	- In 2008, a case study on 28 infrastructure and building projects revealed that 82% of these projects had time overrun issues with an average delay rate of 38%
D,O,T,C	-	O,C,T	-	O, C, U	O,C,D,O	-	O,C,D	O,T,D
AFTZ0001	ASIN0003	ASMY0008	EUUK000	AFGH0001	MESA0001	ASMY0002	MEJO0001	MEKW0001

- In 2007, a study from 20 public projects from India reported that their average delay and cost overrun rates were 55.7% and 26.1% respectively	- In 2005, a study on 25 railway projects completed during 1998-2002 suggested that these projects had an average delay rate of 85% and cost overrun rate of 25% of the initial contract duration and value respectively	- In 2002, a study on 61 projects completed between 1990 and 1999 estimated that average delay rate for these projects was 92.6% and average budget overrun rate was 17.3%.	- In 2010, a survey on 110 construction professionals suggested that a majority of them experienced time and cost overrun in more than 10% of their projects	- In 2015, a study on 40 public projects in the last 3 years reported that 38% of them weren't completed within the planned time.	Contractors' data related to the 126 public projects they had undertaken indicated that these were completed with an average delay of 34.60% over the average estimated project duration. The data obtained from public agencies resulted in an average delay of 43.65% in the 258 projects they had contracted out.	- In 2004, Ministry of Statistics and Program Implementation (MOSPI) suggested that out of 646 central sector projects that they are tracking, 40% of them were delayed and the average delay rate was 40.23%.	- in 2012, the Ministry of Statistics and Programme Implementation in India reported that out of 951 projects that they had been looking at, 32.5% of them had cost overruns, and 49.8% of them were behind schedule
O,T	-	-	D,U,O,T	C,T		-	O,C,D
OTHR0002	EUPT0002	AFNG000	EUUK0004	MEOM0002	METR0001	ASIN0005	ASIN0001

- In 2013, a survey on 25 consultants found out that they experienced cost overrun in 100% of their projects and the average overrun rate was 20%.	- In 2007, a study from 30 public projects from China reported that their average delay and cost overrun rates were 13.6% and 5.4% respectively	- In 2012, a survey with 80 contractors and consultants indicated that 70% of them experienced an average delay rate of 20% in their projects	- In 2002, an investigation on 150 highway projects in Florida suggested that the average delay rate was 25% and the average cost overrun rate was 2.1%.	- In 2007, a study from 19 public projects from Thailand reported that their average delay and cost overrun rates were 32.7% and 25% respectively	- In 2007, a study from 31 public projects from Bangladesh reported that their average delay and cost overrun rates were 34.4% and 8.4% respectively	- In 1985, a study on 384 projects with different natures found out that these projects had an average delay rate of 40% and cost overrun rate of 44%	- In 2013, a study on 30 projects since 2007 indicated that they have an average delay rate of 46.5%	- In 2014, a study on 266 construction projects of University of Minnesota reported that these projects had an average delay rate of 48.9% and cost overrun rate of 3.2%
U,T	O,T	T,O,U	U,D,O	O,T	O,T	U,T	O	O
MEPS0003	OTHR0002	MEPS0002	NAUS000	OTHR0002	OTHR0002	EUTR0001	AFUG000	NAUS0002

- In 2008, a survey with 25 construction professionals suggested that almost every project in the local industry faced cost overrun issue with average rate at about 25%	- In 2003, a study on 258 transportation infrastructure projects suggested that the average cost overrun rate for these projects was 28%	- In 2009, an analysis on 29 medium-sized projects ($50M-$1B) found out that the average cost overrun rate was 32.5%.	- During 1985-1995, 26 major motorway projects in the country reached 39% average cost overrun rate	- In 1998, the closing of EXPO 98 projects revealed that cost overruns averaged as much as 41%	During 2004-2008, 169 road construction projects were analyzed and it was found out that 24% of them experienced cost overrun issues and the average cost overrun rate was 14.6%	- In 2004, a study on 620 road projects from 1992-1995 found out that 52.42% of these projects experienced cost overrun issues and the average cost overrun rate was 25%	- In 2013, a study on 30 projects since 2007 indicated that 53% of them experienced cost overruns, with average cost overrun rate of 16.2%	- In 2004, a study on 450 private housing projects found out that more than 71% of them experienced cost overrun and the average cost overrun rate was 1%	67 out of 70, (95.7%), public building projects investigated in the research suffered cost overrun in their execution. For these public building construction projects, the average actual cost overrun was 63%.
U,O,D,T	-	-	O,D	D,O			O	C,O,T	
MEPK0001	OTHR0003	ASKR000	EUPT0001	EUPT0001	MEPS0005	EUNO000	AFUG000	MEKW00	AFET0001

- In 2005, research conducted by Construction Industry Institute reported that average direct costs caused by rework are 5% of construction costs	- In 1992, a study on 9 projects with total budget of $1.2B indicated that rework could take up to 12.4% of project costs	- In 2013, a study on 9 construction projects found out that only 78% of them were delayed and 22% of them had cost overrun issues.	- In 1994, a study on 9 highway projects in Nigeria in order to forecast the effect of project delay and cost escalation suggested these projects have an average delay rate of 188% and average budget overrun rate of 14%.	- In 2002, a study on 4 environmental and engineering services for roadway construction has found out that these projects had an average delay rate of 69% and average budget overrun rate of 24.8%	- In 2009, an analysis on 7 mega projects (over $1B) completed in 2000s found out that 100% of them experienced cost overrun and the average overrun rate was 122.4%. Also, 100% of them experienced schedule delays and the average time delays was 3.6 years	- In 2010, a study on 4 different public projects indicated that 100% of these projects experienced delays and the average delay rate was 21% (excluding 1 outlier). Also, 75% of them experienced cost overrun issues with an average cost overrun rate of 16.5% (excluding 1 outlier)	- In 2002, a study on 78 infrastructure projects in Netherlands indicated that those projects had an average cost overrun rate of 16.5%
O,D	D		U,D,O,C		O,C,U,T	O,T	
OTHR0001	NAUS000	AFKE0001	AFNG0002	NAUS0005	ASKR0002	MEOM0001	EUNL0001

- In 2010, a study on 53 telecommunication projects in Nigeria attempted to identify the causes of cost overrun issues in these projects (no metrics)	- In 1988, this paper assumed poor performance in terms of costs in construction industry in Nigeria with no metrics and attempted to identify the causes	- In 2005, research conducted by Construction Industry Institute reported that average direct costs caused by rework are 5% of construction costs	- In 2003, a research on a residential and a warehouse project with total budget of $15M found out that rework costs were about 2.3% of the budget	- in 2000, a research on 2 project, 12M and 4.8M budget, found out that they had direct rework costs of 3.15% and 2.4% of total budget respectively	- In 2002, a research on 161 construction projects found out that rework contributed to 52% of a project's cost growth. Direct and indirect rework costs found were 6.4% and 5.6% of original contract value respectively	- In 2010, a research on 115 civil infrastructure projects found out that average rework cost is 10% of project's contract value	- In 2013, a construction expert estimated the direct cost of rework in UK was 5% of construction value (around £2B)	- In 2002, a study on 7 projects in Sweden found out that average direct cost of rework was 4.4% of construction values
O,D,T,U	U,D,O,C	D	O,D	O	O	-	D	D,C
AFNG0004	AFNG0001	OTHR0001	OCAU000	OCAU0003	OCAU0001	OCAU0004	EUUK0001	EUSE0001

- In 1994, a study of more than 8000 projects conducted by the Standish Group found that only 16 percent were able to satisfy the famous triple constraints of project management: to get the job done on time, within budget, and according to specifications	- In 2013, a survey on 25 public owners found out that rework was one of the top contributors in project delays.	- In 2013, used metrics from MESA0001	- In 2004, a study assumed cost and delay issues in construction projects in Vietnam (no metrics) and attempted to find the causes by surveying construction professional	- In 2008, a study assumed cost and delay issues in construction projects in Vietnam (no metrics) and attempted to find the causes by surveying construction professional	no metrics	- In 2012, a study on 140 construction projects in Malaysia pointed out that scope changes and poor planning stage were the second major factor that caused poor performance in time and cost and this factor consequently led to major changes and rework in construction projects.
-	-	O,C,T,D	O,C,D,U	O,C,D,U	C	O,C
OTHR0007	MESA0005	MESA0005	ASVN0002	ASVN0001	ASMY0004	ASMY0001

The following table displays the documented issues reported in each publication, as identified by paper code, and the empirical evidence supporting a responsible party for the issue.

Paper Code	Construction Issues Raw	Empirical Evidence to Support Party Responsible
EUFI0001		"According to this survey, a common feature of the low satisfaction items is that they come out in later phases of the construction project. This result could indicate that the contractor and customer have not planned the completion stage, or that it has been poorly designed"
MEAE0001		Table 4: Top 5 delay factors: Change orders, Lack of capability of client representative, Slow decision making by client, Lack of experience of client in construction, Poor site management. Top 4 causes are associated with Client.
MESA0002	Owner's risk factors: 1. land acquisition 2. Re-designing 3. Line services (utilities and underground services) 4. variations in estimating quantities between designer and GC	Table 6: Responsibility percentage of the causes of each party: 1. Owner (53%) 2. Contractor (27%) 3. Consultant (1%) 4. Other stakeholders (19%)
MEKW0002		3 most frequently observed factors: Contractor-related (25%), owners' financial difficulties (22%), labor-related (13%)
EUPT0001		Figure 422.6: Major causes of delays: Client and design responsibility. Figure 422.13: Major causes of cost overruns: Design errors, direct change orders, different site conditions

Table 7: 5 major sources of delays: 1. Owner 2. Contractor 3. Design team 4. Labor 5. Consultant	Table 1: The major causes identified were: poor design, change orders, weather, site conditions, late delivery, economic conditions and increase in quantity.	Table 7: Most occurred risk factors: 1. Client induced additional work beyond the original scope (87% of projects) 2. Delays in government approvals/ permits related to projects (78%) 3. Delay in preparation and approval in variation orders (74%) 4. Changed engineering conditions from the contract document (65%)	Fig. 2 Clients were responsible for 62% of delays, Contractors were responsible for 32%, and other factors were responsible for 6%.	Table 3: 1. Changes in project scope 2. Delay in construction 3. Poor estimation and adjustment of cost (low bid) 4. No practical use of earned value management system	Table 3: Major causes: 1. Design and documentation issues 2. Delay in payment for completed works 3. Scope change and poor planning
			Client: refusal to pay for materials fluctuations, wrongful and abrupt termination of the contract because of selfishness/greed, government policies and instability in the system, not honoring payment certificates for completed works as and when due. Contractor: incompetence, delays in carrying out instructions on sites, poor project supervision, strikes by workers for improved conditions of service.		
MESA0001	MEJO0001	MEKW0001	AFNG0003	ASKR0001	ASMY0001

Seven major factors are responsible for project delay: (1) poor site management and supervision by contractors, (2) problems with subcontractors, (3) inadequate planning and scheduling of projects by contractors, (4) poor management of contractors' schedules, (5) delay in delivery of materials, (6) lack of effective communication among project stakeholders, and (7) poor interaction with vendors in the engineering and procurement stages.	Table 4: Top 5 factors of non-performance: 1. lack of commitment from owners and contractors 2. Inefficient site management 3. Poor site condition 4. Improper planning 5. lack of clarity in project scope	Table 2: Top 5 delay causes: 1. design changes 2. Delay in payments to contractors 3. Information delays 4. Funding problems 5. poor project management	Table 4: Top 5 delay cause: Practice of assigning contract to lowest bidder, Contractor's poor site management, Cash flow and financial difficulties faced by contractors, Ineffective planning and scheduling by contractors, Problems with subcontractors	Survey rankings of major factors responsible for project delays and cost overruns according to contractors, consultants, and owners: 1. Monthly payment difficulties 2. Poor contract management 3. Material procurement 4. Inflation 5. Contractor's financial difficulties (not agreed by all 3 groups) 6. Escalation of material prices
MEOM0002	ASIN0001	AFTZ0001	ASMY0008	AFGH0001

Table 2: Top 3 reasons that accounted for delay: 1. Lengthy procedure for contract evaluation and award 2. Procurement delay 3. Civil works and land acquisition delay	Table 3: Top 4 factors that made up of 71.34% relative weights for cost overruns: 1. Increase in material prices (23.08%) 2. inflation (21.84%) 3. Difficulties in obtaining construction materials at official current prices (13.63%) 4. Reasons that yield construction delays (12.79%)	Page 44: delays were most frequently caused by changes in the work scope (46%). The second most frequent cause was delayed payments (21%).	Table II: Cost impacts during 2005-2011: Impact by client was 56.57% of total cost overrun while the next biggest impact was Unforeseen (18.7%). Table III: Schedule impacts during 2005-2011: 2 largest impacts were Client (37.79%) and Other (23.77%), the 3rd largest impact was Design which was only 10.86%	Table 2: Top 3 reasons that accounted for delay: 1. Lengthy procedure for contract evaluation and award 2. Procurement delay 3. Civil works and land acquisition delay	Conclusions: Top 5 factors inhibiting time and cost control practice in UK was revealed as 1. Design changes 2. Risks and uncertainties 3. Inaccurate evaluation of project time / duration 4. Complexity of works 5. Non-performance of subcontractors
OTHR0002	EUTR0001	AFUG0001	NAUS0002	OTHR0002	EUUK0004

3 main reasons: Contractor-related (25%), owners' inexperience in construction (22%), material-related (13%)	Table 10: Red zone factors and their related groups: 1. Political situation 2. Fluctuation of prices of materials 3. Economic instability 4. Currency exchange 5. Level of competitors 6. Number of competitors 7. Previous experience of contract 8. Project financing 9. Inflationary pressure 10. Contract management	Table 2: Top 3 reasons that accounted for delay: 1. Lengthy procedure for contract evaluation and award 2. Procurement delay 3. Civil works and land acquisition delay	Table 14: Top 5 delay causes and related groups: 1. Political situation (External) 2. Segmentation of the West Bank and limited movement between areas (External) 3. Award project to lowest bid price (Project) 4. Progress payment delay by owner (Owner) 5. Shortage of equipment (Materials)	Table 3: Top 4 reasons that resulting the most additional time: 1. Subsurface conditions 2. Architectural feature related issue 3. Design Standard/ Spec change 4. Local government agreement modification	Table 2: Top 3 reasons that accounted for delay: 1. Lengthy procedure for contract evaluation and award 2. Procurement delay 3. Civil works and land acquisition delay
MEKW0002	MEPS0003	OTHR0002	MEPS0002	NAUS0004	OTHR0002

Table 8: 5 major sources of delay and cost overrun in Oman: 1. Owner instructs additional works 2. Owner instructs modification to design 3. No availability of construction manuals and procedures for project construction in Oman 4. No availability of engineering licensing for engineers in Oman to maintain the quality of consultancy services 5. Poor communication between relevant governmental units and the owner	Table 1: Top 10 cost overrun factors: 1. Fluctuation in prices of raw materials 2. Unstable cost of manufactured materials 3. High cost of machineries 4. Lowest bidding procurement method 5. Poor project (site) management/ Poor cost control 6. Long period between design and time of bidding/tendering 7. Wrong method of cost estimation 8. Additional work 9. Improper planning 10. Inappropriate government policies	Page 1253: [cost overrun] due to incomplete design at the procurement phase, deficient contract documents, cardinal changes due to the change of scope, direct changes, different site conditions and delayed site disposal	Page 1253: [cost overrun] due to design errors, omissions and inappropriate options, inadequate contract systems (unit price and direct awarding), premium clauses, late site disposal and direct and cardinal changes	Page 43: Eighty-four per cent of the cost overruns were caused by change in work scopes.
MEOM0001	MEPK0001	EUPT0001	EUPT0001	AFUG0001

Design errors and production management mistakes (from contractors) accounted for over 50% of rework costs (26% and 25% respectively)	Table 11: In 296 domestic (USA) projects, Design errors and Owner changes are the two greatest sources that cause rework ranked by costs, both agreed by data from owners and contractors	Table 5: Design changes were responsible for 79% of rework costs. The same issue happened in other research in later years which means this issue has been unaware of or difficult to fix		Table 6 - Major factors accountable for non-performance: 1. price fluctuations 2. Financing and payment of completed works 3. Poor contract management 4. Delays 5. Change in site conditions 6. Shortage of materials 7. Inaccurate estimates 8. Design changes 9. Additional work 10. Imported materials and plant items 11. Subcontractors and nominated sub suppliers 12. Weather 13. Fraudulent practices and kick backs	Table IV Delay by factors by responsibility: Owner group has 18 factors, Contractor group has 5 factors, and join-responsibility group has 3 factors.
			Delay in honoring payment certificates, Poor cash flow in project ,Poor contractor supervision, Insufficient communication between parties, DeLay in instruction ,Underestimation of contract time, Poor professional management, Client initiated variations/change orders, Inadequate skill and experience of contractor staff, Poor site management		
EUSE0001	OTHR0001	NAUS0001	AFKE0001	AFNG0002	ASKR0002

Three most important factors as agreed by architects, engineers, and quantity surveyors: 1. Shortage of materials (caused by fluctuation in availability and unawareness of designer on availability of materials) 2. Finance and payments for completed works 3. Poor contract management (by contractors)	Table 11: In 64 international projects, Design errors are the greatest sources that cause rework ranked by costs, both agreed by data from owners and contractors	Table 4: 73% of rework costs occurred during Design phase	- Project: design changes, construction changes, and design errors accounted for 92% of rework cost, most of them were caused by changes required by end-users - Project B: construction changes and errors accounted for 50% of rework costs. These changes were initiated by client representative to improve the project functionality	Page 25: Documentation due to design changes and omissions initiated by clients and end users appears to be a regular occurrence in Australian projects.	Conflict between specifications and drawings remained a major issue, accounted for 19% of change orders
				Client demands may influence the quality of contract documentation produced, as errors and omissions may emerge that can result in rework and thus cause cost and schedule overruns.	
AFNG0001	OTHR0001	OCAU0002	OCAU0003	OCAU0001	EUUK0001

Table 7: 1. Incompetent designer / contractor 2. Poor estimation and change management 3. Social and technological issues 4. Site related issues 5. Improper technique tools	6.1 Ranking of Causes in Terms of Occurrence and Severity: 12 major factors: 1. Poor site management and supervision 2. Poor project management assistance 3. Financial difficulties of owners 4. Financial difficulties of contractors 5. Design changes 6. Unforeseen site conditions 7. Slow payment of completed works 8. Inaccurate estimates 9. Shortages of materials 10. Mistakes in design 11. Poor contract management 12. Price fluctuations	In 2013, a survey on 262 construction participants who worked on different types of projects ranging from $6M to over $50M suggested that top 3 major causes of cost overruns were: 1. Fluctuation of prices of materials 2. Cash flow and financial difficulties faced by contractors 3. poor site management and supervision	Table 3 discussion: "Respondents believe that changes in scope and inadequate site investigation at the planning stage leads to major changes and rework in construction projects."	Table 3: Construction-related items being the most dominating factor that caused cost overruns. This factor includes following items: 1. Frequent design changes 2. Fraudulent practices and kickbacks 3. Additional works 4. Contract management 5. Inadequate labor availability 6. Duration of contract period 7. Contractual procedure
ASVN0002	ASVN0001	ASMY0004	ASMY0001	AFNG0004

Table 3: Top delay contributors from owners' perspective: 1. bid award to lowest price 2. Poor communication and condition between construction parties 3. Poor site management 4. Payments delay 5. Poor labor productivity 6. rework		MESA0005