Robert E. Pitts. Making the Case for a Business Intelligence Framework. A Master's Paper for the M.S. in I.S. degree. November, 2006. 44 pages. Advisor: Deborah Barreau

This research is intended to develop evidence for whether or not large organizations should spend a large amount of time and resources on building Business Intelligence Frameworks by examining Project Manager's perceptions of complex information systems. Project Managers in a large organization provide a cross functional reporting role that requires them to delve into information technology systems in complex ways when querying for simple metrics related to projects they manage. Using an online survey, this study found that project manager's perceptions changed more positively towards IT systems performing automatic queries, web based queries, IT systems, and business intelligence system dashboards if they did not already have a business intelligence framework in place, and if they were less experienced. More experienced project managers had lower perceptions of current IT systems, automatic queries, web-based queries, and dashboards. There is evidence to suggest that business intelligence frameworks will be positively perceived for project managers with lower experience, and where these systems have not already been introduced.

Headings:

       Information Science -- Field Work

       Business Intelligence -- Frameworks

       Business Information Systems

       Project Management

Making the Case for a Business Intelligence Framework.

by
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Introduction

Business intelligence is the gathering of large amounts of corporate data and using data concentration or information distillation techniques to provide a framework to answer wide ranging queries that cross database systems and delve into a corporate organization's information technology structure in complex ways. The business intelligence framework simplifies the querying process for a variety of data seekers in an organization. A dashboard is an interface into this framework, coalescing data and providing real-time answers to specified pre-formatted queries.

The information retrieval process will be refined to look at metric or key performance indicator (KPI) queries in current business operational systems. In order to narrow down the scope of the KPI queries, this research is concentrated on project managers in a business organization. This will allow the researcher to study a project where a project manager has responsibilities for KPI's and the need to query them on a frequent basis.

The issue is that organization structures and the relatively recent explosion of the corporate information systems that contain overlapping, siloed, or varying aggregate levels of data, complicate the querying process for a single project manager. Trying to define the current status through a particular metric of a particular project has been made unnecessarily difficult when a project manager needs a quick response and an easy display methodology. Difficulties revolve around the number of data sources available, and the technical resources available to the project manager. A project manager's query

may span multiple database systems, multiple aggregate levels of data and then return individual datasets that will have to be combined by hand. A Business Intelligence Framework will allow for an easier interface and less querying for project managers, while still getting the KPI data query sets returned on a per project basis.

The purpose of this research is to answer a few specific questions: Does the number of data-sources alter the perception of the ability of project managers to retrieve the key performance indicators of their project? Does the presence of dashboards or pre-configured queries alter the project manager perceptions of the task of finding key performance indicators? Do perceptions of complex information system querying change in relation to the project manager's experience?

Background

Business intelligence (BI) is the gathering of large amounts of corporate data in order to provide a framework for answering a wide range of queries. These queries can cross multiple data sources and delve into an organization's information technology (IT) infrastructure in complex ways. This type of framework is very much on the minds of the IT industry today (Halevy 778-787) (Sunopsis 2). The BI framework simplifies the querying process for a variety of data seekers in an organization. Data seekers include project managers with responsibility for cross functional reporting and who use multiple data systems to coalesce information on a project that that may involve different functional areas of an organization. This cross functional or matrix operation is becoming increasingly prevalent in the organizational context (Wind 872).

Predefined querying interfaces, such as dashboards, enable the project manager to easily and efficiently navigate the complex IT infrastructure built for something other

than cross matrix management. A dashboard is a real-time interface into a business intelligence framework, and as such, provides the project manager with the necessary efficiencies to gather information related to his or her most frequent queries and reporting dilemmas, the reporting of project metrics also known as "Key Performance Indicators (KPI)" (Combined Standards Glossary 34).

In order to explore these ideas, this study includes a needs analysis that directly answers the questions: Does the number of data-sources alter the ability of project managers to retrieve the key performance indicators for their projects? Does the presence of dashboards or pre-configured queries alter perception of the task of finding key performance indicators by project managers? Do project manager perceptions of how to query complex information systems change as a function of length of experience?

The main thrust of the research questions revolve around Business Intelligence Frameworks, dashboards and real-time decision making systems. The Business Intelligence Framework will need to be fully defined and well documented to ensure that this is not merely a current, popular term, but an area of legitimate academic research. As a real-time data visualization technique for returned query results and an interface into the business intelligence framework, the dashboard will be defined and will be related to previous research. After reviewing the literature in relation to the research questions, this review will describe the methodology of research selection for the works cited, and try to synthesize the current body of knowledge in the areas.

The complexity of a corporate organization's IT system can easily be seen in Bieberstein's case study of IBM's IT infrastructure. The illustration in Figure 1, on page # below, (Bieberstein 695) shows an extensive architecture called the "Enterprise Service

Bus" that is interfaced by the "Business Performance Management" system. Bieberstein

relates these IT systems to the organizational structures inherent in many organizations

(696-697). People in complex IT environments need proactive help to discover useful

resources and a way to easily format and display the results to limit information overload

(Billsus 166). There is evidence that the integration of complex IT infrastructures into a

logical framework will "provide IT users with ease of use, consistency, and uniformity"

(Chung 38). In looking at autonomous agents, Hamdi is simplifying the data source

locating process for users: "…a person is able to state *what* he/she wants (or at least is

able to recognize *what* he/she wants when he/she sees it), and the IC system[1] is

responsible for deciding *which* resources to invoke in response and *how* to do so" (Hamdi

244). The attempt is made in this research to show that complex IT systems and users

need some logical structure defined for them rather than the user performing the logic

themselves. Whether this is Hamdi's "information customization" (232) decentralized

system or Bieberstein's centralized "service oriented architecture" (691) the theme here is

clear. IT architecture has become complex and users need an interface and some

secondary logical framework to help point out where data sources and data reside.

Another complexity for IT concerns the requirement to align to strategic business

objectives (Motjolopane, 147). Kettinger and Sabherwal point out that there is a direct

link between IT strategy and business organization capability, though in Sabherwal's case

it was only for the business strategies of analyzers[2] and prospectors[3], not defenders[4]

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[1] Hamdi defines an IC system system as "software that acts, in accordance with a user's preferences, in an environment" and that has the characteristics: distributed, adaptive, autonomous and robust (232).
[2] An analyzer is a business that "seeks to simultaneously minimize risk while maximizing opportunities for growth" by maintaining a "stable domain of core products while seeking new product/market opportunities" (Sabherwal, 14).
[3] A prospector is a business that "continuously seeks new product/market opportunities and is the creator of market change" (Sabherwal, 14).

(Kettinger, 50; Sabherwal, 11). The literature suggests that there is a need to analyze the

impact of IT projects and measure specific indicators of impact in a framework,

sometimes this analysis view is called a "dashboard" (van der Zee, 60, 78). Van der Zee

describes this dashboard as:

> "…consisting of the appropriate measures to indicate strengths and weaknesses, provides a guide for management and forms the core of planning and control. A dashboard of performance indicators allows management to valuate the contribution of several factors that impact the overall performance of the organization."

This dashboard can be an IT system, a web page, a static report, a software application or

any other methodology that, on a frequently updated basis, displays and simplifies values

for previously identified key performance indicators.

Project management is a methodological approach to managing a temporary

endeavor, and has been developed in several industries over the past few years to become

a formal model that is intrinsic to an organization's success (Brewer 167, Ahituv 99,

Combined Standards Glossary 46). Project managers combine tools, knowledge, skills,

and techniques to meet the needs of an organization when working on managing

particular projects (Combined Standards Glossary 46, 47). One very important

responsibility of project managers is the reporting of "status" on particular projects,

which can include many metrics, and an extensive synthesized data set visualized into a

form that is used for communication to all project stakeholders (Shumate 41-44). Lack of

formality or replication can put projects and therefore business strategies at serious risk

(Mizuno 392). Also, distribution of resources, geographically and functionally can

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[4] A defender is a business that "seals off a stable and predictable but narrow niche in its industry by offering high-quality (but standard) products or services at low prices" (Sabherwal, 14).

impact the ability of project managers to coordinate those resources and put more pressure on the project and project management processes (Qureshi 72-73).

The more mature and formalized a project management process is, the more likely it is to succeed (Grant K 66, Williford 209). The project management methodology is a logical step-by-step process, similar to the Capability Maturity Model (Grant K 59). A framework that allows for the measurement of project metrics integrated within an existing project management methodology, such as the one presented by Paul (256), will provide a project manager with a tool necessary to easily retrieve metrics and answer complex queries (Paul, Table10, 258). Project management is a technique that has been developed over the last two to three decades (Paul, Qureshi, Grant, Mizuno, Fenton 359). This technique involves specific skills, one being the communication and tracking of metrics (Brewer Figure 1 169).

The methodological implementation of metrics programs, though difficult to do (Hall 64, Kautz 14-19, Pfleeger 68), allows for the easy collection of quantified data about a project status. While some synthesis of the measurements for a project is required, and not always viewed as positive (Walsh 38), the process of collecting the metrics and viewing the results helps to manage a project. There are various reasons for a metrics program and they seem to be organization specific (Kautz 19), but overall each of the metrics systems require a framework or program for interaction (Berler 116, Fenstermaker 706, Fenton 361, Fraunholz 194), as the metric retrieval process delves deeply into the organization's multiple functional areas and integrates large amounts of data from the IT infrastructure (Ben-Menachem 99, Herbsleb 272).

One type of visualization technique for these metrics programs is called the "balanced score card" (Berler 116, Debusk 216). This is a dashboard of metrics that are all tied to the same overall subject matter, being the health of a particular organizational unit or the unit itself. In Berler's example, this is a health informatics issue in measuring the quality of healthcare systems.

> "Business Intelligence Tools and Data Warehouses enable the decision maker to have predefined access to specific information of interest regardless of the physical location of the data. Such systems are ideal for performance management and executive reporting and serve as the technological base for supporting the idea of a digital dashboard of indicators" (Berler 120).

Marcus provides another anecdotal example that is descriptive of the issues IT people and managers have in traversing the IT landscape with and without dashboards (48).

The Balanced Score Card is a good example of a commonly used (Gumbus 622) dashboard to interface into the Business Intelligence Framework of a metrics system. The Balanced Score Card takes a series of metrics, combines them into categories, such as "customer service", and then identifies the sources for each metric and any calculation done with the metric. "Customer service" metrics such as customer satisfaction surveys, the time from order entry to delivery of products, and on-time payments could all be identified and reviewed together in one report, along with all other metrics from a product line. This would be the "balanced score card" for a product line's management staff to review on a frequent basis. The metric system has already identified the data sources necessary for each metric, which is hard to do and takes a significant amount of resources (Hall 55-64, Sumner 181-185), but succeeds in applying logic to the querying process in order to make the query efficient for future parties interested in that metric (Mehta 5 Table 1, Pfleeger 73).

The Business Intelligence Framework literature is very sparse and contradictory. Most articles do not define the framework as one related to "business intelligence" but more show examples or reference it in a general sense (Raffo 803-809). Mendonca seems to have the best technical view of what this framework is and does, using the Goal-Question-Metric paradigm (485) to develop a methodological approach of how to define this framework for ongoing measures (496). The industry and trade literature, while not great academic work, does give insight into what a "business intelligence framework" would look like (Doering 9-10, Hannon 56). Figure 1 of Golfarelli's Business Performance Management, or BPM, clearly defines the case for the Business Intelligence Framework (2) and he goes on to show in Figure 2 a complete framework developed to support dashboards and other tools (4).
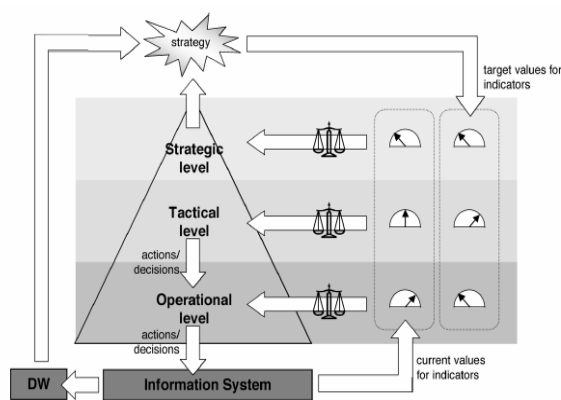
Figure 1. The closed-loop in the BPM approach

Figure 2. A complete architecture for BPM
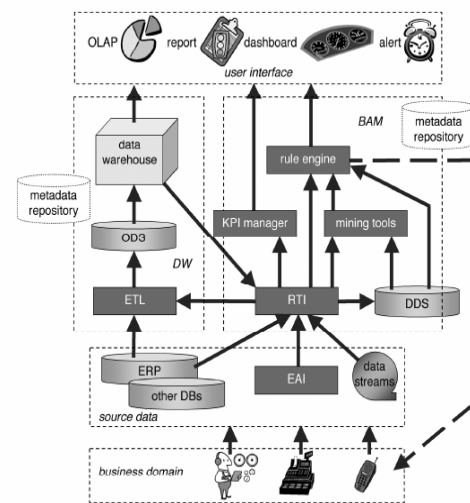
Figure 1 (Golfarelli 2)   Figure 2 (Golfarelli 4)

His conclusions that his "…solution requires a strong system integration at all levels…" (Golfarelli 5) supports the prior research and trade literature (O'Rourke 20) in

metrics systems and IT complexity that define data integration as being something that helps businesses, projects and organizations succeed.

Given that the Business Intelligence Framework seems so ill defined, it is interesting to find that the dashboard, an interface into this system, has been extensively researched and defined, even in direct terms of a "project management dashboard" (Bresnan 33). Design of the dashboard and visualization of the data seems to be more of an issue in the literature (Grant A 235, Nahirny 175) and for trade publications (Few 4, Shen-Hsieh 6) than the querying of the data to present in the dashboard. Weber introduces the idea of "live documents" and states that these documents "require an authoring framework that frees the author from any implementation tasks" (245) which shows a very good parallel to a project manager using a dashboard within a pre-defined framework. Kret seems to have the best list of "reasons" as to why a dashboard would be used as opposed to standardized reports (59) and his research shows how a dashboard would fit into an IT architecture as a support system interface (Kret 61). Mille uses a similar design for an example dashboard in his architecture (Mille S817) and gives a reasonable definition: "We name *dashboard* a window containing *views* where each one represents any kind of information (variables, images, texts, video, ties between dashboards)" (Mille S817).

Frolick presents one of the better examples of real time Business Intelligence and dashboards in use in a corporate environment, in his case study of Continental Airlines "flight management dashboard" (10 – 11). He later goes on to state that "The Flight Management Dashboard is one example of the blurring of the distinction between decision support and operational systems" (17). This is an interesting idea that is

reflected in other real time system literature (Azvine 214-224, Nguyen 79 Figure 1). Many other types of real time systems exhibit many of the same requirements of these dashboards, which is the integration of multiple data sources and systems through a logical framework that contains pre-defined queries (Tesanovic 41, Warren 201 Table 1). The real time systems literature provides a good basis for stating that the dashboard's interface is one of the better interfaces into a complex system of pre-defined operational, decision support and data warehouse IT systems.

It is apparent that there have been few, if any, needs analysis done on dashboards or frameworks. The literature seems to come at this from the opposite direction, where dashboards were written to provide an interface into a business intelligence system that had already been defined. The trade literature is more appropriately focusing on the need of the users. This research is intended to demonstration that that a business intelligence framework is worth the large amount of resources needed to develop and maintain it in the chosen context of the metrics system framework for project management.

The research question stated in the introduction links nicely with the literature in most areas. There is a wide body of research to help support choosing project managers as subjects for the needs analysis. Difficulties in executing queries in the complex IT environment without some pre-defined framework provide rationale to query the subjects on their ability to find data sources and return information on the metrics they are required to report, both with and without the business intelligence framework. It is likely, with the number of resources using the balanced score card as the interface into a metrics framework, that the researcher will likely need to be very careful in describing and identifying the business intelligence framework when questioning subjects. It is also

apparent from the literature the reader has a very hard time concretely visualizing what one of these frameworks looks like from a user's perspective, so the metric system questions will be focused more on the reporting interfaces, such as power point, excel or web pages, when discussing dashboards.

Methods

The research questions laid out in the preceding sections of this paper point to the use of a survey as the prime method for gathering project managers' perceptions on the metrics querying process and the business intelligence framework. This survey will be crafted to examine several key concepts.

The first concept, and a major variable of the project, is the project manager's experience. A demographic section of the survey was used to determine the level of respondent's experience. One way to view experience is years in a particular industry. This variable points to a certain type or set of data sources used to report project status or metrics. Another way to view experience is in a particular position where the respondent will determine themselves to be a project manager. This may point to a tacit information framework that is built by the project manager, that the respondent can transport from job to job and cross industries. Yet another way is to review the time in the current position. This will enable an analysis on whether more or less experience with a particular organizations set of IT infrastructures is a factor in their perception of that infrastructure, regardless of other experiences.

Metrics reporting will also need to be examined in the questionnaire. When asking a respondent to examine this area of responsibility, it will be necessary to look at two facets of the concept—reporting project status and managing project tasks. One will

be querying for status reports to management personnel outside of project, such as direct line managers of the project manager or executives higher in the respondent's organization. Another facet will be internal project metrics that the project manager will use to manage projects. Along both of these facets, related questions examine concepts of metrics reporting frequency, and how the reports are required to be delivered. Information systems should be reviewed as a small part of these delivery systems.

Another concept is the perception of IT complexity and the number of data sources required for metric querying. Questions on these perceptions relate to a respondent's experience with data sources like software applications, and databases. There are a variety of ways to ask these questions to determine respondents' positive or negative perceptions of whether the information infrastructure that is currently available to them is making it more difficult to query for metrics. Thus, we infer that the complexity and number of data sources may be required to either be simplified or left unchanged depending upon the data analysis.

The two final sections of the survey revolve around existing business intelligence frameworks and data visualizations requirements, and then explore "what if" scenarios that use Likert type (Babbie, 169) scales to determine project managers' perceptions of dashboards and other systems in their current environment. Questions on visualization allowed the analysis of data surrounding the project manager's experience and interaction with information technology systems which are required by the organization, and therefore help the researcher to identify current business intelligence frameworks in use. Examples of this would be if the organization requires the project manager to use a power point template to report to managers. This is not a very advanced system, but if the

project manager enters the metrics into a balanced score card type of application on a website, it likely indicates an existing business intelligence framework.

Sample and Population

The total population of project managers within North Carolina is unknown and will be difficult to determine statistically. A simpler population figure is the number of project managers that are registered within an industry trade group. For project management, one such trade group is the Project Management Institute (PMI, 1). Within this large industry trade group, there is a self selected subset of groups, one of which is the North Carolina special interest group (NCPMI, 1). The special interest group is a subset of Project Management Institute members who also register as being in the state of North Carolina. This is the ideal population within which to draw a sample. This sample is a small subset of the population of all North Carolina based project managers, but provided a relatively representative, non-industry specific cross section of those North Carolina based project managers.

Subject Identification and Recruitment

Each member of the NCPMI is required to register with an email address in order to get information related to membership as well as other personalized communications from the chapter. The researcher requested and received permission from the VP of Membership and the VP of Communication the ability to send the study related, voluntary survey to the NCPMI members for recruitment. This request was granted and a series of two emails were used to request participation in the online survey, to be reached by hyperlink through the footer of the email. There were 27 responses in total.

Variables and Measurement Techniques

One major variable to be deduced from the research questions previously described is the one of project manager experience. This is measured as a ratio variable (Babbie, 447) to look at number of years of experience. The survey questions come at this from several directions, including industry experience, current position experience, and project management experience. Several questions revolving around nominal variables were used to determine demographic facts about a subject, particularly certifications achieved that point to a knowledge or experience achievement. This allows for an easy grouping of data if it is found that there is any validity to the certification process as being a differentiator within the data along with experience.

Along with this variable is the metrics and reporting requirements topics that were assessed. Survey questions regarding these topics were also ratio-based, aside from a few yes/no questions that were based on nominal variables. Again, these nominal variables will enable easy grouping and segregation but the ratio variables are of more use to the data analysis. Variables here are frequency of metrics reporting, maximum projects managed at the same time, and total number of metrics, which are all ratio variables.

The existence of a business intelligence framework is another variable that was difficult to query directly. Since the definition of the business intelligence framework is difficult to communicate, it was necessary to ask a series of nominal questions with yes or no answers to try to determine if such a framework exists within the subject's organization. These nominal variables will be combined to give an estimate as to whether the framework existed on a per subject basis.

Further clarification of the responders' perceptions of dashboards and other real-time querying systems was achieved through the use of a series of Likert (Babbie, 169) type scales that develop data for ordinal variables. These include questions and data on what if scenarios such as what if a "dashboard exists" or if "IT systems provided answers to you instead of you looking for the answer". These variables are all related to the need of a project manager to report these metrics frequently and to people other than themselves such as management.

Data Collection Instruments and Materials

SurveyMonkey.com was used to deploy the 64 question survey (Appendix A). The survey was administered online, and available to any respondent with a personal computer, internet connection and browser, which includes the population in question. SurveyMonkey.com allows the data to be collected and exported once the survey has been completed. Emails were used to send communications to the population, of which one hundred percent have email addresses, so that no bias is introduced by the researcher having any other contact with the respondents. This enabled the respondent to use their own equipment, their own emailing and Internet related software systems, and not unduly inconvenience the respondent by making the process more time consuming than necessary. This enabled ease of use of the survey and emailed communications.

Ethical Issues

The survey was anonymous and did not identify a particular respondent by anything other than subject numbers. Subject numbers were assigned on a first come, first serve basis. Information from the browser headers, such as IP address, browser types and other personally identifying information was not collected or stored within the

dataset nor accessed by the researcher. Email addresses are not known by the researcher, but were handled through a third party intermediary (NCPMI) and therefore cannot be used to identify respondents or the sample population. Individual's employment organizations are not queried nor retained. The survey is completely voluntary, and none of the questions within the survey are required to be answered in order to progress through to the end of the survey.

No harm, physically or intellectually will come to any of the respondents or the population, however a series of five emails over the course of two months on the survey may frustrate non-participants and participants who responded to the survey early in the study period. No deceptive questioning or data analysis occurred in the process of this study.

Study Method Advantages and Disadvantages

There are several advantages to using the questionnaire study method laid out above. The most obvious advantage is that it will enable respondents to quickly and easily answer the survey and enable the researcher to collect all data necessary for the study. According to Babbie there are a few general advantages and weaknesses that all surveys have, and this is no exception. Babbie, on page 274, states as weaknesses: "…surveys often appear superficial in their coverage of complex topics". Another weakness is also that "surveys typically require that an initial study design remain unchanged throughout (Babbie, 275)". A final weakness is that a survey is artificial and the answers in response to the survey may not be the same answers a project manager will give when queried in person, or in a practical real world situation (Babbie, 275).

Advantages of the survey revolve around having the flexibility to ask a large number and type of questions to a large number of people. Also, the ability to standardize questions across all project managers, regardless of industry, projects, business or job title will enable the researcher to analyze the data in aggregate on self reported project managers and cuts to the heart of the research questions, which are based on the perception of these project managers (Babbie, 274).

Importance

This topic is important to study because it will provide evidence either for building a case that a business intelligence framework is required to simplify the querying process for project managers in complex organizations, or that the administrative and technical overhead involved is not worth the extensive resources such a system would require. Detailed knowledge of perceptions surrounding metric gathering and the complexity of the data-source landscape will allow knowledge workers who build and customize business intelligence frameworks and dashboards to better tailor their products to the relevant parties such as project managers. Database designers would be interested as the systems will need to interface with a business intelligence framework in order to inform the relevant project managers without having the project manager explicitly query the database. This research informs strategic management, project management, process engineering, and general business studies.

Data Analysis

All variables are nominal, ordinal or ratio and no open ended questions are being asked. The 64 question survey was divided into groups of questions that related to subjects in the research questions posited earlier in this paper. Questions 1 through 5

relate to demographics, questions 6 and 8 through 11 relate to Metrics complexity,

questions 7 and 12 through 14 relate to Standards, questions 15 through 17 relate to IT

Complexity, questions 18 through 27 relate to IT perceptions, questions 28 through 34

relate to the existence of an IT systems framework, questions 35 through 42 relate to

perceptions of web pages automating the querying process, questions 43 through 53

relate to perceptions of a dashboard automating the querying process, and questions 54

through 64 relate to perceptions of a generic IT system automating the querying process.

All logical yes or no responses are assigned a value of 1 for yes and 2 for no. To

calculate ratios on all Likert type (Babbie, 169) scales, values are assigned as follows:

Strongly Agree = 1, Agree = 2, Neutral =3, Disagree = 4 and Strongly Disagree = 5. In

order to analyze the resulting data from the 64 question survey, these groups were used to

define several ratings variables for each respondent (Table 1), which in turn are used in a

paired samples t-test between the ratings, and testing of the three research questions.

Variable	Name	Formula
1	Experience Rating	Sum of questions 1 through 4
2	Industry Certification	Yes = 1, No = 2
3	Metrics Complexity Rating	Product of Question 6, Question 8, and the Median of Question 9, 10 and 11
4	Implied Framework Existence Likelihood	Average of: Question 7 and If Question 12 is Yes then.5, If Question 12 is No then 4 and If Question 13 is Yes then .5, If Question 13 is No then 4 and If Question 14 is Yes then .25, If Question 14 is No then 8
5	Number of Data-sources Rating	Sum of Question 15, 16 and 17
6	Perception of Current IT Systems 1	Average of: Questions 19, 21, 23, and 26
7	Perception of Current IT Systems 2	Average of: Questions 18, 20, 22, 24, 25 and 27
8	Business Intelligence Framework Existence Likelihood	Average of: Questions 28 through 34
9	Perception of a Web Page Performing Automated Queries 1	Average of: Questions 35, 37, 39, and 41
10	Perception of a Web Page Performing Automated Queries 2	Average of: Questions 36, 38, 40 and 42
11	Perception of a Dashboard Performing Automated Queries 1	Average of: Questions 43, 46, 48, 50, 52
12	Perception of a Dashboard Performing Automated Queries 2	Average of: Questions 44, 45, 47, 49, 51, and 53
13	Perception of Generic IT System Performing Automated Queries 1	Average of: Questions 54, 57, 59, 61 and 63
14	Perception of Generic IT System Performing Automated Queries 2	Average of: Questions 55, 56, 58, 60, 62 and 64

Table 1: Variable Set Creation for Data Analysis

For variable 6, questions 19, 21, 23 and 26 all have positive phrasing, and for variable 7,

which is on the same topic of perceptions of IT current systems, questions 18, 20, 22, 24,

25, and 27 have negative phrasing. This should provide a cross check between variable 6

and 7 as to the perceptions of IT systems. This is true of each perception variable pairs;

9, positive phrasing, variable 10, negative phrasing, 11, positive phrasing, 12, negative

phrasing, 13 positive phrasing, and 14, negative phrasing. These positive/negative

grouping should provide an adequate check of a respondents answers. For example a

person that is more positive toward IT systems, would provide a lower average answer to

variable 6 and a higher average answer to variable 7. Question phrasing can be reviewed

in Appendix A.

Results and Analysis

A total of twenty seven responses were returned to the SurveyMonkey.com website. All respondents answered questions 1 through 5, however a variety of questions were skipped per respondent for questions 6 through 64. Five respondents skipped all questions after question 5, an additional two respondents skipped questions from 12 onward and one additional respondent skipped all questions after question 27. Table 2, below, describes the number of responses, range, mean and standard deviation of each of the 64 survey questions.

	N	Min	Max	Mean	Std. Deviation		N	Min	Max	Mean	Std. Deviation
Q1	27	1	36	12.7407	10.01381	Q33	19	1	2	1.5789	.50726
Q2	27	0	13	4.1111	3.06761	Q34	19	1	2	1.5789	.50726
Q3	27	1	19	6.7778	5.93123	Q35	19	1	3	1.8421	.68825
Q4	27	0	30	8.7407	7.48122	Q36	19	2	5	3.4737	1.07333
Q5	27	1	2	1.4815	.50918	Q37	19	1	2	1.6842	.47757
Q6	21	0	45	8.4286	11.62141	Q38	19	1	5	2.0526	1.07877
Q7	22	1	2	1.1818	.39477	Q39	19	1	4	2.2105	1.03166
Q8	22	12	100	29.3636	23.34329	Q40	19	1	5	2.3684	1.30002
Q9	25	0	3500	146.4000	698.80738	Q41	19	1	4	2.1579	1.06787
Q10	23	0	100	8.7391	20.95280	Q42	19	2	5	3.8947	.99413
Q11	24	0	3500	153.5000	712.95716	Q43	19	1	4	1.8947	.93659
Q12	20	1	2	1.8000	.41039	Q44	19	1	5	2.9474	1.26814
Q13	20	1	2	1.7500	.44426	Q45	18	1	5	2.2222	.87820
Q14	20	1	2	1.4500	.51042	Q46	19	1	4	2.1579	.83421
Q15	20	2	12	4.8000	2.44088	Q47	19	1	5	3.2632	1.14708
Q16	20	0	13	2.2500	2.97135	Q48	19	1	4	2.1579	.83421
Q17	20	0	15	2.9500	3.42552	Q49	19	1	5	2.3158	1.05686
Q18	20	1	5	2.3500	1.26803	Q50	19	1	4	2.2105	1.03166
Q19	20	1	5	3.2500	1.20852	Q51	19	1	5	2.2632	1.19453
Q20	20	1	4	2.5000	1.10024	Q52	19	1	4	2.1579	.89834
Q21	20	1	5	3.0500	1.31689	Q53	19	2	5	3.4737	1.26352
Q22	20	2	5	3.2000	1.00525	Q54	19	1	4	1.9474	.84811
Q23	20	1	5	3.8500	1.13671	Q55	19	1	5	3.0526	1.31122
Q24	20	1	5	3.0500	1.50350	Q56	19	1	5	2.0526	.91127
Q25	20	1	5	3.2000	1.36111	Q57	19	1	3	1.6842	.58239
Q26	20	1	5	3.2500	1.37171	Q58	19	2	5	3.1053	1.19697
Q27	20	1	5	3.2500	1.29269	Q59	19	1	3	1.9474	.77986
Q28	19	1	2	1.1579	.37463	Q60	19	1	5	2.2105	.97633
Q29	19	1	2	1.4211	.50726	Q61	19	1	3	1.8947	.73747
Q30	19	1	2	1.7368	.45241	Q62	19	1	5	2.2105	1.13426
Q31	19	1	2	1.4211	.50726	Q63	18	1	4	2.1667	.98518
Q32	18	1	2	1.5556	.51131	Q64	19	1	5	3.1579	1.42451

Table 2: Descriptive Statistics for response set by Question.

Table 3, below, describes the range, mean and standard deviation of the variable set resulting from the initial data analysis.

	N	Min	Max	Mean	Std. Deviation
V1	27	6	71	32.3704	20.0828
V2	27	1	2	1.4815	.5092
V3	25	36	28000	2287.2	6145.7039
V4	27	.25	4.5	2.6051	1.5994
V5	20	3	29	10	6.5373
V6	20	1	5	3.35	.9155
V7	20	1.6667	4.6667	2.925	.8677
V8	20	1.1429	2	1.4962	.1985
V9	19	1	3	1.974	.6661
V10	19	1.5	5	2.9474	.9151
V11	19	1	3.8	2.1158	.7065
V12	19	1.5	5	2.7421	.9129
V13	19	1	3	1.9237	.6268
V14	19	1.3333	5	2.6316	.9155

Table 3: Descriptive statistics for variable set.

A paired samples two tailed t-test was conducted for each of the variables related to the first research question, does the number of data-sources alter the perception of the ability of project managers to query. Data-source number rating was explicitly measured in variable 5 (Table 1), metric complexity was measured in variable 3 and perceptions were measured in variables 6, 7, 9, 10, 11, 12, 13 and 14 (Table 1).

	V5 mean	Std. Dev.	Mean Rating	Std. Dev.	Sig.	Corr. Direction
V6	10	6.54	3.35	.92	p<.025*	negative
V7	10	6.54	2.93	.87	p<.025*	positive
V9	10.37	6.5	1.97	.67	p<.025*	positive
V10	10.37	6.5	2.95	.92	p<.025*	positive
V11	10.37	6.5	2.12	.71	p<.025*	positive
V12	10.37	6.5	2.74	.91	p<.025*	positive
V13	10.37	6.5	1.92	.63	p<.025*	positive
V14	10.37	6.5	2.63	.92	p<.025*	positive

Table 4: Paired samples two tailed t-test for V5

Metric complexity rating was implicitly measured in variable 3 (Table 1) and perceptions were measured in variables 6, 7, 9, 10, 11, 12, 13 and 14 (Table 1).

	V3 mean	Std. Dev.	Mean Rating	Std. Dev.	Sig.	Corr. Direction
V6	2256.60	6156.17	3.35	.92	p>.025	n/a
V7	2256.60	6156.17	2.93	.87	p>.025	n/a
V9	2375.37	6301.28	1.97	.67	p>.025	n/a
V10	2375.37	6301.28	2.95	.92	p>.025	n/a
V11	2375.37	6301.28	2.12	.71	p>.025	n/a
V12	2375.37	6301.28	2.74	.91	p>.025	n/a
V13	2375.37	6301.28	1.92	.63	p>.025	n/a
V14	2375.37	6301.28	2.63	.92	p>.025	n/a

Table 5: Paired samples two tailed t-test for V3

The data suggest that perceptions of IT systems and querying change depending on the number of data-sources, but do not change depending on how complex the metric queries are for those data sources. There is a very large range and standard deviation for metric complexity, implying that this may have been a confusing set of questions or that there are significant data errors from the respondents. The correlations from data-source number variable 5 and perception variables suggest that respondents were positive toward IT systems as the number of data-sources increased.

A paired samples two tailed t-test was conducted for each of the variables related to the second research question does the presence of dashboards or pre-configured queries alter the project manager perceptions of the task of finding key performance indicators. Implicit IT Framework Existence was measured explicitly in variable 4 (Table 1) and Explicit IT Framework Existence in variable 8 (Table 1), and variables 6, 7, 9, 10, 11, 12, 13 and 14 (Table 1) measured perceptions.

	V4 mean	Std. Dev.	Mean Rating	Std. Dev.	Sig.	Corr. Direction
V6	2.84	.33	3.35	.92	p>.025	n/a
V7	2.84	.33	2.93	.87	p>.025	n/a
V9	2.75	1.46	1.97	.67	p>.025	n/a
V10	2.75	1.46	2.95	.92	p>.025	n/a
V11	2.75	1.46	2.12	.71	p>.025	n/a
V12	2.75	1.46	2.74	.91	p>.025	n/a
V13	2.75	1.46	1.92	.63	p>.025	n/a
V14	2.75	1.46	2.63	.92	p>.025	n/a

Table 6: Paired samples two tailed t-test for V4

	V8 mean	Std. Dev.	Mean Rating	Std. Dev.	Sig.	Corr. Direction
V6	1.50	.20	3.30	.90	p<.025*	positive
V7	1.50	.20	2.95	.89	p<.025*	positive
V9	1.50	.20	1.97	.67	p<.025*	negative
V10	1.50	.20	2.95	.92	p<.025*	negative
V11	1.50	.20	2.12	.71	p<.025*	negative
V12	1.50	.20	2.74	.91	p<.025*	negative
V13	1.50	.20	1.92	.63	p<.025*	negative
V14	1.50	.20	2.63	.92	p<.025*	negative

Table 7: Paired samples two tailed t-test for V8

Significant tests in Table 7 suggest that perceptions change when an explicit IT framework has been built for a project manager. We can infer from Table 7, variable 6 and 7 tests, that when an explicit framework is more likely to exist, a respondent is more likely to agree with the stated questions. Tests on variables 9 through 14 imply that if an existing framework is more likely to occur, a project manager is more likely to disagree with the stated questions. This suggests that respondents without existing IT frameworks are more unsatisfied with their IT systems, and are more likely to want an IT framework to perform queries for them. The data also suggests the opposite, that project managers with IT frameworks have lower perceptions of the framework to perform queries for them.

A paired samples two tailed t-test was conducted for each of the variables related to the third research question, do perceptions of complex information systems querying

change as a function of length of experience. Total experience was rated in variable 1, industry certification was measured in variable 2 and perceptions were measured in variables 6, 7, 9, 10, 11, 12, 13 and 14 (Table 1).

	V1 mean	Std. Dev.	Mean Rating	Std. Dev.	Sig.	Corr. Direction
V6	32.90	18.40	3.35	.92	p<.025*	positive
V7	32.90	18.40	2.92	.87	p<.025*	negative
V9	30.95	16.64	1.97	.67	p<.025*	positive
V10	30.95	16.64	2.95	.92	p<.025*	negative
V11	30.95	16.64	2.12	.71	p<.025*	negative
V12	30.95	16.64	2.74	.91	p<.025*	negative
V13	30.95	16.64	1.92	.63	p<.025*	positive
V14	30.95	16.64	2.63	.92	p<.025*	negative

Table 8: Paired samples two tailed t-test for V1

	V2 mean	Std. Dev.	Mean Rating	Std. Dev.	Sig.	Corr. Direction
V6	1.55	.51	3.35	.92	p<.025*	negative
V7	1.55	.51	2.93	.87	p<.025*	negative
V9	1.53	.51	1.97	.67	p>.025	n/a
V10	1.53	.51	2.95	.92	p<.025*	positive
V11	1.53	.51	2.12	.71	p<.025*	negative
V12	1.53	.51	2.74	.91	p<.025*	negative
V13	1.53	.51	1.92	.63	p>.025	n/a
V14	1.53	.51	2.63	.92	p<.025*	negative

Table 9: Paired samples two tailed t-test for V2

Table 8 tests suggest that perceptions change depending upon the experience of a project manager. The evidence also suggests that as a respondent's experience increases, their IT perceptions decrease. The opposite is true as well, that as a respondent's experience decreases, they are more likely to agree with positive statements made regarding IT systems. The same is true for perceptions of web pages performing queries and other generic IT systems querying for the respondent. Dashboard perceptions were mixed for the respondents, with relationships for both related variables 11 and 12 decreasing as experience increases. This indicates an agreement for both positively

worded dashboard perceptions and negatively worded dashboard perceptions. This suggests that possible confusion over the dashboard term could have affected responses.

Conclusions

This research found that there are significant relationships between project manager's perceptions of IT systems, perceptions of automatically generated queries from web, dashboard and generic information systems, and the project manager's experience, explicit existence of a business intelligence framework, and number of reported data sources. Metrics complexity, and the existence of an implicit business intelligence framework do not affect project manager's perceptions. Also, there is inconclusive evidence that an industry certification, assumed to be a mark of experience and training in implicit project management frameworks, has any relationship to a project manager's perceptions of querying or automatically generated queries.

The two most related factors in a project manager's perception of IT systems used for querying, are the project manager's experience, and the total IT complexity ratio they report. The more experienced a project manager is, and the more likely they are to already have an explicit business intelligence framework in place, the lower their perceptions on all measures. This could possibly be a measurement of lack of trust in an IT system as a tool to perform key performance indicator queries. It is possible that if a project manager has more experience in using a set of IT data sources as querying tools for critical reports to management, it is more unlikely that the project manager will delegate the querying process to an IT system in its entirety. Also, the complexity of the query (i.e., Metric Complexity) does not impact perceptions; therefore it is likely that the number of metrics queried does not influence the project manager, just the total amount

of time spent on a querying and the number of data-sources they will have to use to get the required key performance indicators.

It is obvious to this researcher that more thorough research will be needed regarding the link between a project manager's experience in a particular information system, and their ability to delegate querying to an information system framework. The 27 respondents gathered for this research is a very limited sample of the large number of project managers in the population. While this population is not known, it can be assumed that 27 is a very small proportion, and therefore this sample could be biased. It is possible that project managers, especially when highly experienced, would be too busy to respond to a web survey. Also, while this research does provide evidence for having an explicit business intelligence framework, it should also be obvious that this is a very difficult concept to market to project managers in a way that will explain the benefits. It has been noted that this research is based on a small sample set of 27 respondents, some of whom did not fill out the entire survey, creating an additional possible bias to the sample.

The business intelligence framework's existence does affect perceptions, but implicit frameworks do not. Therefore, to market or implement a system of this nature to replace or support an implicit framework, it is required to show a direct relationship between this business intelligence framework's existence, minimization of the number of data sources and increasing the level of experience of a project manager. Also, it is worth noting that more experienced project managers have less positive views of IT systems, indicating that past IT system performance could possibly affect the likelihood and ability of IT systems to fill the needs of these more experienced users.

Based on this research, there is evidence that for inexperienced project managers, or project managers that do not have a business intelligence framework already available to them, an effort to provide these tools would be perceived positively. Also, for experienced project managers, it will be difficult to convince them of the necessity for a new business intelligence framework, based on their past experience with querying for key performance indicators within these types of tools.

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Appendix A: Survey Instrument

Demographics	
Question	**Response Type**
Q1. Please enter the **TOTAL NUMBER OF YEARS** you have worked **WITHIN YOUR CURRENT INDUSTRY**. (Please round to the nearest year)	Numerical Only
Q2. Enter the **TOTAL NUMBER OF YEARS** you have worked **IN YOUR CURRENT POSITION**. (Please round to the nearest year)	Numerical Only
Q3. Enter the **TOTAL NUMBER OF YEARS** you have worked **IN YOUR CURRENT COMPANY**. (Please round to the nearest year)	Numerical Only
Q4. Please enter the **TOTAL NUMBER OF YEARS** you have worked **AS A PROJECT MANAGER** regardless of industry or company. (Please round to the nearest year)	Numerical Only
Q5. Do you have any **PROJECT MANAGEMENT** industry **CERTIFICATION**? (Example: "Project Management Professional" or "PMP")	Logical (Y/N)

Metrics Reporting	
Question	**Response Type**
Instruction: All questions below relate to your current industry and your current position. **In terms of this survey, a "metric" is synonymous with a quantitative Key Performance Indicator which is defined by the Project Management Institute's Combined Standards Glossary (page 38) as:** **"A Key Performance Indicator (KPI) is a criterion by which an organization can determine, quantitatively or qualitatively, whether the Outcome associated with a Capability exists or the degree to which it exists. A Key Performance Indicator can be a direct measurement or an expert assessment.** **When a Key Performance Indicator is quantitative, involving direct measurement, a form of metric is required. A metric is a measurement of something. Something tangible such as an error count, can be measured directly and objectively. Something intangible, such as customer satisfaction, must first be made tangible, -- for example, through a survey resulting in ratings on a scale – before it can be measured. A metric can be binary (something exists or does not exist), it can be more complex (such as scaled rating) or it can be monetary (such as financial returns)."**	
Q6. Enter the **MAXIMUM NUMBER OF PROJECTS** you have managed **AT THE SAME TIME**.	Numerical Only
Q7. Does your current management require you to **REPORT PROJECT STATUS** or **METRICS**?	Logical (Y/N)
Q8. Enter the **NUMBER OF TIMES PER YEAR** you are required to report a project status **TO YOUR MANAGEMENT**. (Example: Weekly = 52 times per year, Monthly = 12 times per year).	Numerical Only
Q9. Enter the **TOTAL NUMBER OF METRICS** you are	Numerical Only

required to report on **PER PROJECT**.	
Q10. Please enter the **MAXIMUM NUMBER OF METRICS** you report to your management **FOR ANY ONE PROJECT**.	Numerical Only
Q11. Please enter the **TOTAL NUMBER OF METRICS** you use to manage a **SINGLE PROJECT FOR YOUR OWN PURPOSES**. (This number can include metrics reported to management).	Numerical Only
Q12. Are metrics calculations standard for all projects you have managed company wide?	Logical (Y/N)
Q13. To your knowledge are metrics calculations standard for all project managers company wide?	Logical (Y/N)
Q14. Do you have a project support office that provides any templates or metrics reporting frameworks to you?	Logical (Y/N)

IT Complexity & Datasources	
Question	**Response Type**
Instruction: All questions below relate to your current industry and your current position	
Q15. Please enter the NUMBER OF SOFTWARE APPLICATIONS that you use to MANAGE YOUR PROJECT. (Please include any software such as Excel, Access, Industry or Company specific applications)	Numerical Only
Q16. Please enter the NUMBER OF DATABASES you access	Numerical Only

| only for PROJECT MANAGEMENT. | |
| Q17. Enter the NUMBER OF INFORMATION SYSTEMS you access for REPORTING. | Numerical Only |

Likert type scale (Babbie, 169)

Anchors: Strongly Agree, Somewhat Agree, Neutral, Somewhat Disagree, Strongly Disagree

My current company's IT systems are:	
Q18. Difficult to query for metrics	1..5
Q19. Logically arranged to report information based on my project	1..5
Q20. Not setup for project managers	1..5
Q21. Helpful to me to report my metrics	1..5
Q22. Too difficult for non-IT personnel to use	1..5
Q23. Providing information to me without me asking for it.	1..5
Q24. Not updated often enough for my projects	1..5
Q25. Often reporting conflicting information	1..5
Q26. Show real-time information about my project	1..5
Q27. Good for what my management wants, but not for what I need	1..5

Display Visualization Requirements & Existing Framework	
Question	**Response Type**
Q28. Does your management require project status reports in	Logical (Y/N)

electronic format (such as Power Point presentations, Web Pages, or pdf documents)?	
Q29. Do you have company standard templates for all projects and project managers to report project status?	Logical (Y/N)
Q30. Do your metrics become part of a "Balanced Score Card" for the business?	Logical (Y/N)
Q31. Are your past metrics reports accessible to you?	Logical (Y/N)
Q32. Do you store your reports in your email system?	Logical (Y/N)
Q33. Do you often have to re-create templates or macros for your project status reports?	Logical (Y/N)
Q34. Can you customize your reports as much as you think you should be able to for your particular project?	Logical (Y/N)

Leading What If Questions	
Question	**Response Type**
Likert type scale (Babbie, 169) Anchors: Strongly Agree, Somewhat Agree, Neutral, Somewhat Disagree, Strongly Disagree	
If you had a WEB PAGE PER PROJECT that DISPLAYED SOME OR ALL of your metrics TO YOU this would:	
Q35. save you time.	1..5
Q36. Cause more problems than it solves.	1..5
Q37. be beneficial to you.	1..5

Q38. depend upon the metric calculation.	1..5
Q39. be more efficient than your current metrics gathering processes.	1..5
Q40. depend upon the project complexity.	1..5
Q41. help you manage your budget.	1..5
Q42. give you less control of your project.	1..5
If you had a DASHBOARD PER PROJECT that DISPLAYED SOME OR ALL of your metrics TO YOUR MANAGEMENT this would:	
Q43. enable better communication with management	1..5
Q44. Cause management confusion over the details of your project	1..5
Q45. depend on the metrics reported	1..5
Q46. save you time.	1..5
Q47. Cause more problems than it solves.	1..5
Q48. be beneficial to you.	1..5
Q49. depend upon the metric calculation.	1..5
Q50. be more efficient than your current metrics gathering processes.	1..5
Q51. depend upon the project complexity.	1..5
Q52. help you manage your budget.	1..5
Q53. give you less control of your project.	1..5
If your project status reports were reported to you by an IT system rather than you querying for each metric to make up the reports, then this would:	

Q54. enable better communication with management	1..5
Q55. Cause management confusion over the details of your project	1..5
Q56. depend on the metrics reported	1..5
Q57. save you time.	1..5
Q58. Cause more problems than it solves.	1..5
Q59. be beneficial to you.	1..5
Q60. depend upon the metric calculation.	1..5
Q61. be more efficient than your current metrics gathering processes.	1..5
Q62. depend upon the project complexity.	1..5
Q63. help you manage your budget.	1..5
Q64. give you less control of your project.	1..5