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Toward improving performance measurement in public sector organizations

Matthew Thomas Kutz

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MATTHEW T. KUTZ

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Approved by

Dr. Bih-Ru Lea, Advisor	Dr. Wen-Bin Yu

Dr. Gregory Gelles

ABSTRACT

The objective of this research is to investigate various means of improving the performance measurement methods for public sector organizations. A case study is conducted using data from the Missouri Department of Transportation (MoDOT). As a government organization, MoDOT must publish measurements of its performance for the general public and for the legislators who provide funding. Currently, MoDOT produces a quarterly publication, called the Tracker, for performance measurement reporting. This research hypothesizes that the Tracker is not an effective performance measurement system and stakeholders of MoDOT would benefit from a more concise and pointed report of MoDOT performance. A software prototype utilizing the Balanced Scorecard approach is developed to test proposed hypotheses. A survey comparing the Balanced Scorecard with MoDOT's current practices indicates a strong preference for the Balanced Scorecard among the general public. Areas of particularly high agreement in favor of the Balanced Scorecard were finding and interpreting the data, as well as monitoring performance of the organization.

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1. INTRODUCTION

The objective of this research is to investigate various means of improving the performance measurement methods for public sector organizations. Performance measurement has helped profit-seeking organizations improve immensely over the last fifty years. More recently, public sector organizations have adopted methods of performance measurement (Kaplan and Norton, 1996; Kaplan, 2002).

First, a literature review focuses on two specific methods of improving performance that have helped profit-seeking organizations over the last two decades. The first is the Balanced Scorecard introduced by Robert Kaplan and David Norton in 1990. The second is Enterprise Resource Planning (ERP), a type of large computer application that unites various business units of an organization. An ERP application allows an organization to display real-time data in one place, which makes performance measurement more effective.

Then a case study is conducted using data from the Missouri Department of Transportation (MoDOT). As a government organization, MoDOT must publish measurements of its performance for the general public and for the legislators who provide funding. Currently, MoDOT produces a quarterly publication, called the Tracker, for performance measurement reporting. The Tracker contains over 300 measurements that are difficult to comprehend at one time. The Tracker also contains very little evaluation of its data.

This research hypothesizes that the Tracker is not an effective performance measurement system and stakeholders of MoDOT would benefit from a more concise and pointed report of MoDOT performance. A software prototype utilizing the Balanced Scorecard approach is developed to test the proposed hypothesis. A survey comparing the Balanced Scorecard with MoDOT's current practices indicates a strong preference for the Balanced Scorecard approach among the general public. Three areas, including finding needed data, interpreting the data, and monitoring performance of the organization, each showed particularly high agreement in favor of the Balanced Scorecard. The level of agreement varied dramatically, however, between those with experience with the software used in the prototype and those without experience.

2. LITERATURE REVIEW

2.1. BALANCED SCORECARD

2.1.1. Introduction Business Performance Measurement (BPM) has been a very active area of research in the last two decades and researchers across many disciplines have produced a large body of new knowledge (Marr and Schiuma, 2003). Although the traditional financial performance measures worked well for the industrial era, they posed problems with the skills and competencies companies are trying to master today (Kaplan and Norton, 1992). The business environment of the 1990s through today is very different from the business environment prior to the 1960s. This new environment is quicker and more turbulent, which means companies must be more aggressive (Dinesh and Palmer, 1998).

Robert Kaplan of the Harvard Business School and David Norton, a business executive, first introduced the Balanced Scorecard (BSC) in 1990 after a one-year study of twelve companies. Their study (Kaplan and Norton, 1992) led to the conclusion that financial measures alone were no longer sufficient to measure performance. To meet the need for continuous improvement and innovation, Robert Kaplan introduced the BSC to complement financial measures of past performance with indicators of future performance (Dinesh and Palmer, 1998; Gumbus and Lussier, 2006; Kaplan and Norton, 1992; Niven, 2005). Overemphasizing short-term financial results can cause companies to overemphasize the immediate future and under-invest in long-term value creation, which is less tangible and harder to measure (Kaplan and Norton, 1996).

The Balanced Scorecard has received increased attention in the past fifteen years. A study conducted by Marr and Schiuma (2003) showed that the Balanced Scorecard (BSC) developed by Kaplan and Norton was the most popular methodology in business performance measurement (BPM) and has become synonymous with BPM. Various studies have suggested that up to 60 percent of companies in the USA have experimented with the BSC (Marr, 2005).

A Balanced Scorecard is unique because it adds three perspectives to the traditional financial perspective. A typical Balanced Scorecard uses four perspectives: financial, customer, internal business process, and learning and growth derived from an organization's vision and strategy (Kaplan and Norton, 1996). Gumbus and Lussier

(2006) suggest that these additional measures are essential to giving stakeholders an accurate picture of an organization. This study will briefly describe each of these perspectives. One unique feature is that the four perspectives Kaplan suggests attempt to balance the financial measures with other, more difficult to measure company characteristics.

Additionally, the BSC considers the mission and strategies of the company and advocates that the measurements for the four perspectives be coordinated with the mission and strategies. This coordination leads to a much stronger connection between the desired outcomes and the indicators of those outcomes. Furthermore, Kaplan also insists on tangible objectives and measures for reporting.

In addition to being a performance measurement system, the Balanced Scorecard is a management tool, referred to by Kaplan and Norton as a "strategic management system" (Kaplan and Norton, 1996). The word "strategic" refers to long-term planning, as opposed to "tactical", which refers to short-term maneuvering or operational decisions. The word "management" calls to mind day-to-day operations. Then a "strategic management system" is a long-term-planning, daily-operations system. We can assume the apparent oxymoron is intended. Kaplan and Norton's BSC ranges from long-term executive vision planning to the day-to-day operations of the employees.

Kaplan and Norton claim to accomplish this shift through a four part implementation of the BSC. Knowing these four processes of implementation helps in understanding the overall picture of the BSC. The first is "clarify and translate vision and strategy." The senior executives must work to translate strategy into objectives with associated measures for each of the four BSC perspectives mentioned above. Creating these objectives can be difficult, but it helps with aligning the organization in a common purpose.

The second process is to communicate the strategic objectives throughout the organization. Everyone in the organization must know what the strategic objectives are and how to accomplish them in their particular area. This process is important to prevent the BSC from being a tool for executives only with no impact on other members of the organization.

The third process is to "plan, set targets, and align strategic initiatives." These targets should be aggressive and require improving business processes "that will be critical to the organization's success." Short-term milestones must also be included.

The fourth and most important process to the BSC is the enhancement of strategic feedback and learning. A company cannot begin the BSC and then let it ride for five years before reassessing. Today's business environment requires quick changes based on advice from all levels of an organization. Strategic feedback is critical to executives' ability to improve their knowledge and leadership of an organization (Kaplan and Norton, 1996).

In summary, the BSC starts with an organization's vision and strategy for success. Translating this vision and strategy into objectives separates the BSC from traditional performance measurements (Dinesh and Palmer, 1998; Niven, 2005). Communicating the objectives throughout the organization causes a chain reaction of planning throughout the organization (Gumbus and Lussier, 2006). The ability to report on the measurable objectives, as well as linking effects with their causes throughout the organization, leads to quicker and more effective maneuvering of a company (Atkinson et al., 1997; Gumbus and Lussier, 2006). As an added bonus, the emphasis on reporting and communicating makes it easy to use BSC as a method of communication with external stakeholders, as well (Gumbus and Lussier, 2006; Marr and Schiuma, 2003).

2.1.2. Specific Description of Balanced Scorecard Concepts The four perspectives of the Balanced Scorecard each have a very specific purpose. As mentioned above, the financial perspective is the traditional measure of a company, giving performance history and an indication of the immediate future. The other three perspectives give an indication of the more distant future of a company, which is necessary in today's extremely competitive market. Gumbus and Lussier (2006) list the other three perspectives as competence and knowledge, customer focus, and operational efficiency and innovation. The perspectives are essentially the same as Kaplan and Norton's, but they gave them different names. Operational efficiency and innovation is the Internal Business Process perspective from Kaplan and Norton's book (2006). Competence and knowledge is the Learning and Growth perspective.

2.1.2.1. Financial The financial perspective is the keystone of the Balanced Scorecard because most companies have the ultimate goal of making money. The

measures chosen "focus on profits, revenue growth, productivity, and asset utilization" (Niven 2005). The financial measures themselves are very similar to the traditional financial objectives of a profit oriented company (Kaplan and Norton 1996).

The unique contribution of the BSC is that financial goals are met by meeting the other, less tangible goals of the other three perspectives. Rather than focusing on the financial goals directly, which leads to short-sightedness, an organization focuses on the goals of the other three perspectives. Improvements in the other three perspectives lead to improvements in the financial objectives. The financial objectives become the targets for the objectives of the other scorecard perspectives (Kaplan and Norton 1996). Using the traditional financial measures by themselves is the problem. Niven (2005) compares it to driving a car using the rear-view mirror.

2.1.2.2. Customer The customer perspective is essential for success in the information age when competitors can very quickly improve on meeting customer desires if there is an opportunity (Kaplan and Norton 1996). The BSC customer perspective can be divided into two parts, easily measurable, lagging attributes, and harder to measure, leading attributes. Examples of easily measurable attributes are customer retention and satisfaction. These attributes are lagging indicators like indicators of the financial perspective. The need for more future-oriented indicators is the reason for the second set of attributes.

The second part gives the organization a leading indicator of its potential for success. The three categories of this second part are product and service attributes, customer relationship, and image and reputation. The product and service bundle is what the organization provides to customers. It gives value to the organization. The customer relationship is important for the future of the business. Repeat customers cost less in advertising and are more profitable to serve. The number of repeat customers is dependent upon customer relationships. The public's attitude toward the organization characterizes its image and reputation. If a company has a great product-service bundle and a great customer relationship, but it has a bad image, it will not succeed. Current customers might or might not continue with a company that has a bad image despite a good relationship with the company. New customers will be very difficult to attract. If a company has specific measures in all three of these areas, managers can be sure they are focusing their organization on higher value (Kaplan and Norton 1996).

2.1.2.3. Internal Business Process The internal business process perspective focuses on value chain measurements of innovation, operations, and post-sale service. Many organizations use business process measurements. For example, business units monitor the quality of a product or the time it takes to make it. A profound distinction between the BSC and traditional performance measurement systems is that the BSC includes the innovation process in the internal-business-process perspective. The innovation process is the future value of the organization. This process is necessary to maintain an organization's value with time and to help increase its value (Kaplan and Norton 1996).

Kaplan and Norton (1996) suggest that the measures and objectives for the internal business processes come directly from the objectives of the customer perspective, which are linked, in turn, to the financial perspective. This makes the measurements more purposeful because they are linked to the overall objectives of the company. If customers want low prices, for example, measurements of operations would focus on ways to keep costs low (Niven 2005).

2.1.2.4. Learning and Growth After finding the measures for immediate success, the BSC requires a company to include measures for purely future success. If a company does not succeed in this area, it will eventually collapse in the first three areas. Managers evaluated only on short-term performance find it difficult to make the investments needed for long-term success. It is very easy to sacrifice long-term investments to make the short-term bottom-line more successful (Kaplan and Norton 1996).

Traditional areas of investment for the future are in equipment and in research and development. The BSC stresses investment and upkeep in three other areas. The first is employee capabilities. The information age requires employees to think and contribute knowledge in their jobs. The second is technology systems. In today's competitive environment, employees also need excellent information to best utilize their skills and knowledge. The third is motivation and employee initiative. Employees are unlikely to contribute to the organizations goals if they are not motivated and given freedom to make decisions (Kaplan and Norton 1996). Today's workforce is more mobile than that of the past. Retaining an employee requires keeping them happy. This perspective enables everything else appearing on an organization's balanced scorecard (Niven 2005).

2.1.3. Advantages The literature supports several advantages of the Balanced Scorecard. First, linking measurements and objectives to the organization's strategy helps managers improve the organization according to the goals. The measurements have a purpose, which is fundamentally connected to the welfare of the organization. If measurements are chosen in such a purposeful way, managers can focus on a few measures that are most critical to company goals, and they can avoid data sifting to find significant points (Euan, 2007; Gumbus and Lussier, 2006; Lipe and Saltero, 2000; Kaplan and Norton, 2007; Palandino, 2007).

Second, the BSC encourages communication throughout the organization. It is not just an exercise for executives. The BSC must be communicated back and forth between executives, managers, and workers (Euan, 2007; Marr, 2005; Lipe and Saltero, 2000).

The biggest advantage of the BSC is that it is used as a management tool. As mentioned, it encourages communication between managers and employees. They must discuss what is being measured and why. The measurements have a strong cause-effect relationship with organizational objectives. Managers will watch the measurements knowing they will improve the organization. Employees watch the measurements knowing management depends on them for determining the good of the organization (Atkinson et al., 1997; Marr, 2005).

Another advantage of the BSC over conventional methods of performance measurement is flexibility. Today's business environment changes very quickly. The BSC allows companies to quickly align and mobilize around the company strategies. It allows management to monitor and respond proactively to the needs of a fluctuating market (Moretti, 2007; Paladino, 2007).

With the advancing communications and technology, companies are focusing on not only improving management within their organization, but also managing their supply chain. Supply Chain Management is a new business process improvement. The BSC has been shown to work with Supply Chain Management, as well as organizational management (Bhagwat, 2007; Palmatier et al., 2007).

Finally, the particular perspectives that Kaplan suggests should lead to more balance between immediate goals and long-term goals. The learning and growth perspective, for example, is a leading indicator relating to long-term goals. The financial

perspective shows the current state of the company, which relates to short-term goals (Kaplan and Norton, 1996).

2.1.4. Challenges After initial success in the early and mid-nineties, authors in the scholarly literature have raised questions about some aspects of the BSC. They point out that the evidence for the BSC is almost solely based on case studies, rather than on scientific studies of various implementations (Maiga and Jacobs, 2003; Marr and Schiuma, 2003). The BSC does have convincing case studies supporting it. However, without rigorous scientific studies, the support is not solid.

A major problem in recent years has been incomplete understanding of the BSC and its key measurements (Ittner et al., 2003; Marr, 2005; Parmenter, 2007). Misunderstanding the BSC is one thing. A more common and defensible difficulty is having trouble finding metrics that will help improve performance and achieve goals. Finding these key metrics is a problem for many companies (Hammer, 2007).

Another reason for incomplete understanding of the BSC is its complexity. The BSC is complex because the organization must implement many scorecards with accompanying objectives and measurements. Every organizational unit must make a scorecard in support of the organizational scorecard. Therefore, each unit must have its own objectives and measurements (Dinesh, 1998). Because of this complexity, the BSC takes a lot of time to implement (Dinesh, 1998; Jyothi and Vittaldas, 2007).

Finally, some studies have shown that multiple performance measures can have undesirable effects. For example, without clear priorities, it can lead to subjective management decisions. If the company has made the effort to create a BSC, managers must use the objective data from the measurements. Otherwise, the companies are no better than before they implemented the BSC (Cheng, 2007; Rich 2007).

2.1.5. Balanced Scorecard for Non-Profit Organizations While the BSC was developed for profit seeking companies, it can be just as useful for non-profit seeking organizations (non-PSOs) with minor adjustments. Adjustments are required because the financial measures inherited from pre-BSC performance measurement are still a cornerstone of the BSC. Because profit is not the goal of non-PSOs, the financial cornerstone must be replaced with a combination of more appropriate perspectives. The

following section will describe this necessary change and give examples of non-PSOs, as well as DOTs, that are using the BSC successfully.

The non-PSO must adjust the financial and customer perspectives in the BSC because the non-PSO has a different relationship with these perspectives than do profit-seeking organizations. Kaplan suggests using three themes to combine financial and customer objectives in the BSC: cost incurred, value created, and legitimizing support. After creating this top level, the BSC approach works much the same in the PSO as in privately held companies. The BSC approach must be deployed down to its individual departments, and further to its individuals (Kaplan 1999).

In the fifteen years since it was introduced, many non-PSOs have adopted the BSC with great success. For example, New Profit Inc.'s mission is to launch the careers of young people who want to make a difference in their communities. They used the BSC to monitor their own business, as well as that of the organizations they funded (Kaplan 2001). The American Association of Retired Persons, AARP, is the second largest organization in the United States. While AARP does not use the BSC by name, in 2002 it introduced a dashboard with four perspectives that relate to the four used in the BSC. Previously, it had measured up to 217 metrics. The new dashboard was "a one-page document that captured, categorized, and measured outcomes within four priority areas: members ("member growth"), social impact, financial, and human resources ("people")" (Datar, 2007). Finally, a few school districts provide great examples of using the BSC in non-PSOs. Districts such as the Texas Education Agency have used the BSC to connect their mission with their performance measurement. The Texas Education Agency is the nation's second largest public school system, with $15 billion in appropriations at its disposal. The organization proudly displays their BSC to show how they have used all of that money to fulfill their mission (Johnson, 2003).

Many DOTs have also begun using the BSC or similar ideas similar to improve their performance and efficient use of tax dollars. States that have been successful with the implementation of a BSC or similar performance measurement have had the support of all the various stakeholders. One champion of the BSC will not work. States that have been successful in implementing the BSC include North Carolina, Texas, Utah, Illinois, Virginia, Montana, Pennsylvania, Tennessee, Michigan, Minnesota, and Ohio (Baird and

Stammer 2000 B Transportation Research Board 2005; Management Consultants, L.L.C., 2004; Poister, 2004).

2.2. ENTERPRISE RESOURCE PLANNING

2.2.1. Introduction The concepts leading to Enterprise Resource Planning (ERP) have been evolving for more than thirty years. As networks have become more prevalent, ERP has become more important. ERP implementation has peaked with large organizations (Ranganathan and Brown, 2006), but the value of ERP for these large organizations is expected to rise. ERP budgets for maintenance and further implementation are growing as companies anticipate the increasing value (Mahato et al., 2006; Sweeney and Jacobson, 2007). ERP has its roots in computer systems called Material Resource Planning (MRP), which were designed for manufacturing companies (Velmuri and Palvia, 2006). As its name implies, ERP encompasses every business unit of an organization. Additionally, ERP has moved into many areas of business, including health care, retail, and public sector companies, as well as smaller companies most recently (Sweeney and Jacobson, 2007).

Enterprise Resource Planning might be more accurately named Enterprise Information Systems because planning is a minimal part of ERP (Edwards, 2001). The primary goal of ERP is to connect all departments and functions. When connected, each department can know what every other department knows. Every department, including finance, manufacturing, warehousing, project management, product development, and others, will have one version of the company's information (Sweeney and Jacobson, 2007; Gunasekaran and Ngai, 2007; Sutherland, 2003).

2.2.2. ERP Features ERP eliminates delays and potential errors associated with paperwork being moved from department to department. An order will be entered only once and it will appear in every department's system instantly. Avoiding paper shuffling and re-keying data are two big ways ERP saves resources and eliminates mistakes. The data does not wait to be entered into every system individually, so there are fewer delays. Finally, the instantaneous nature of updates allows every department to see the exact status of every order (Sutherland, 2003).

Until very recently, ERP has been completely focused on a company's internal information. ERP now tends to include both customer relationship management software and supply chain management (Sutherland, 2003). Both of these pieces extend beyond the organization itself, allowing suppliers or customers to see relevant company information, further streamlining the business process.

2.2.3. Advantages ERP offers a lot of advantages if implemented correctly. A major selling point for executives is the consolidation of information. If an organization has an ERP package, everyone in the organization, including executives, will have access to the same information. This single version of the truth is a major advantage over each business unit providing their own data in their own format, trying to promote their own best interests. Consolidation of data also allows the global view of an organization that is so important to today's fast and extremely competitive marketplace (Sweeney and Jacobson, 2007; Chand et al., 2005; Sutherland 2003; Edwards, 2001).

Often, companies use an ERP implementation to standardize business processes. ERP packages include best practices as their default implementation. Though companies are not forced to accept the best practices in implementation, not doing so can introduce other challenges. The challenges of changing business processes or changing the software to meet current business processes will be discussed later. Suffice it to say that changing business processes may be difficult in the beginning. However, it often results in faster manufacturing processes, more accurate human relations information, and helpful results in all areas of an organization. Often, the internal obstacles to the running of an organization are the biggest hurdles to competitive success. Eliminating these roadblocks can be a big improvement (Sweeney and Jacobson, 2007; Chand et al., 2005; Fang and Lin, 2006; Sutherland 2003).

A powerful and well implemented ERP package can facilitate supply chain management. Information like production plans, for example, can be shared across the internet to better inform suppliers (Gunasekaran and Ngai, 2007). ERP also allows companies to reduce inventory because the order process is more visible and the knowledge of inventory needed is more exact (Sweeney and Jacobson, 2007; Chand et al., 2005; Fang and Lin, 2006; Sutherland 2003).

ERP standardization goes beyond the business practices of individual units. Manufacturing, inventory, distribution, and sales can coordinate with each other from many different places simultaneously. Additionally, human resources and accounting also have the same information with which to make decisions and perform their work (Sweeney and Jacobson, 2007; Chand et al., 2005; Sutherland 2003).

Finally, after the initial implementation, IT costs may be lowered. Many companies have hundreds of legacy applications that can be replaced by a single ERP application. Both maintenance and training are less expensive when an employee can go from one department to another and use the same application.

These are the current benefits that companies have seen with ERP. The future also looks bright for company-wide IT systems that are producing more data than anything before ERP. The software companies are finding ways to take better advantage of this data. Additionally, SAP, Oracle, and Microsoft will make use of web services and service-oriented architecture (SOA). This allows the software to communicate more easily with different kinds of software. This makes deployment and integration with other vendors' software much easier. It will give companies greater choices and flexibility with changes in individual business areas (Whiting 2006).

ERP vendors offer lots of flexibility for installing only partial ERP packages and some customization for particular business needs (Sutherland, 2003). This flexibility can also be a drawback because partial implementation can lead to a failed ERP implementation.

2.2.4. Drawbacks ERP has several drawbacks, but the main obstacle is the cost. ERP is expensive from any angle. The proprietary software is expensive (Serrano and Sarriegi, 2006), but consultants, implementation, and training might run more than four times the cost of the software (Whiting 2006). Every type of company faces a high price for ERP (Sutherland 2003). Despite the costs, most large companies have decided the price is worth the expected return.

One reason ERP is so costly is that the systems are necessarily complex. Bringing together many different departments and the people in them, in addition to combining many legacy computer systems, is a difficult task. Companies often do not

have enough resources and skills to complete the task on their own (Serrano and Sarriegi, 2006). Most authors believe these integration difficulties will remain in the near future (Whiting 2006).

Companies must know before deciding to implement ERP that it will not be a quick and easy company improvement. It is probably the most challenging project any company can undertake (Gargeya and Brady, 2005; Sutherland, 2003). Besides the monetary cost, ERP implementation also requires huge resources and considerable time.

Even if companies swallow huge expenses, the risk of ERP failure is real (Velmuri and Palvia, 2006). In 1998, The Garner Group reported that 70 percent of all ERP projects fail to be fully implemented after three years (Gargeya and Brady, 2005). The horror stories of huge ERP disasters such as those in FoxMeyer in 1996, the Whirlpool Corporation in 1999, and Hershey Food Corporation in 1999, should be a warning to CEO's considering ERP (Velmuri and Palvia, 2006). Some authors claim that more than one in four companies experience a drop in their performance when their ERP system goes live (Sutherland 2003). This might be misleading because ERP systems are too complex and require too many changes to show their benefits immediately. The vast majority of ERP companies are ultimately very satisfied with their system. Nevertheless, almost all of the literature reviewed stressed that ERP implementation failure is possible.

One major challenge that leaders can manage before and during the implementation is participation of everyone in the organization in the new system (Mahato, et al. 2006). People do not like to change, so this obstacle is especially difficult. It is crucial that the people in an organization become familiar with the software and alter their habits to make use of it (Velmuri and Palvia, 2006). Some authors claim this is the most important factor in an ERP success (Sutherland 2003). The users must not only change the basic methods of doing their work, but also become proficient at creating and sharing knowledge throughout the organization with the ERP system (Gunasekaran and Ngai, 2007).

A drawback closely related to getting people involved is actually changing the company's business processes. It is the organization's members that will be doing this changing, but the leaders and ERP implementers must decide what the changes are and

how many changes there will be. ERP software complexity often requires significant business process changes (Serrano and Sarriegi, 2006; Whiting, 2006). Companies can re-write ERP software to avoid dramatic business changes. However, re-writing code will "slow down the project, introduce dangerous bugs into the system and make upgrading the software to the ERP vendors next release excruciatingly difficult because the customizations will need to be torn apart and rewritten to fit with the new version" (Sutherland, 2003). Sutherland (2003) goes on to claim that an organization not willing to change will likely have a failed ERP system.

2.3. BALANCED SCORECARD AND ERP

In recent years, the Balanced Scorecard has been used in conjunction with ERP packages to help show the benefits of ERP. Several studies have shown how ERP systems impact the four perspectives of the Balanced Scorecard (Lin et al., 2006; Chand et al., 2005). The Balanced Scorecard shows how ERP can help meet company goals.

Several ways stand out in which the Balanced Scorecard can help make ERP more valuable. In the last two decades, ERP packages have provided more and more data. Raw data has a lot of potential, but it must be transformed into usable knowledge in order to be helpful to a company. Knowledge is the competitive edge companies now need to succeed. The Balanced Scorecard provides a format to organize the data, make it comprehensible, and connect to company goals (Edwards, 2001; Tiazkun, 1999; Business Wire, 1999; Holt, 1998). Another way the Balanced Scorecard can improve an ERP package is by making the ERP focus on leading indicators. ERP systems are designed to focus on financial indicators. The Balanced Scorecard supplements financial indicators, which tell about past performance, with leading indicators (Fang, 2006; Lin et al, 2006; Edwards, 2001). Finally, companies have a difficult time deciding if the huge expense of ERP will be justified. The Balanced Scorecard can help to articulate the goals of an ERP implementation. Then the BSC can make it clear that the goals will be helpful to the company's strategy (Chand et al, 2005).

Researchers also see reasons that ERP systems could help with the Balanced Scorecard. One challenge of the Balanced Scorecard is communicating the strategy throughout an organization. ERP packages specialize in disseminating information that is

uniform and current. This gives managers and employees alike a way to stay informed of progress toward goals (Fang, 2006; Edwards, 2001).

2.4. CURRENT PRACTICES OF DEPARTMENTS OF TRANSPORTATION

This section will discuss current issues facing Departments of Transportation (DOTs) in the United States. While each DOT has its own problems and challenges, some challenges are shared by many DOTs. This section will address some of those common challenges.

2.4.1 DOTs Reporting Needs All DOTs in the US are subject to a democratic government. This means they must report publicly on their projects and on-going work. It also means they must respond to needs and requests of the citizens they serve. Public reports might seem simple, but many challenges arise in the process. For example, a new requirement to report the value of DOT infrastructure can lead to a project in itself. A DOT might have to assign values to assets that have not been previously given values. DOTs have many types of assets in constant motion to meet the needs of their citizens (Thompson 2002). In today's information age, people have less and less tolerance for inadequate service, whether it is lack of speed, poor quality, or not meeting peoples' needs. For example, television and internet media make it clear where a state stands in comparison to road conditions in other states, or how long it takes to fix a damaged road. DOTs do not have the luxury of saying they are trying their best today. If satisfaction standards are not met, governments will respond with legislation or by removing the people who are responsible.

Furthermore, the information age requires government agencies to be more accountable. Corruption and waste have led to calls for more visibility. Increased reporting requirements are difficult to fulfill without good information management. The volume of data potentially created by a DOT is a challenge in itself. Organizing and presenting the data can be extremely resource consuming if the information is managed poorly. A study mandated by the Tennessee DOT suggested that this new era of accountability and visibility should lead agencies to "structure themselves and develop a framework for performance measurement" (Management Consultants, 2004).

2.4.2 DOT Size and Growth Requires Articulated Goals and Strategies DOTs are huge organizations and are continuingly growing. The Transportation Research Board reported in 2005 that highway transportation is not only growing, but is growing at a continuingly increasing rate of exponential growth instead of just geometric growth (Transportation Research Board, 2005). Missouri Department of Transportation (MoDOT) expects 700 thousand more trucks to use I-70 each year (KOMU News, August 1, 2007). This is significant because DOTs are already enormous. They have responsibility for wide ranges of assets, from highways and associated infrastructure to corporate data, and from real estate and financial assets to equipment (Thompson 2002). DOTs also have an increasingly wide range of strategic goals. Of course, they all have goals for safe and effective transportation. They also focus on productive relationships with their "customers", the general public, and government oversight. Many DOTs are focusing on employee development and organizational effectiveness with increased technology and the more mobile workforce. Finally, DOTs are increasingly focusing on economic, as well as environmental, goals (Poister 2004). The Transportation Research Board mentions that, amid all these varied goals, it would be helpful for DOTs to focus their goals more. Any agency can be more effective with more selective goals and clearer priorities (Poister 2004).

Having clearer goals and objectives helps in the short-term, as well as the long-term. Effective transportation will always be an important need for people. Therefore, DOTs are required to have long-term plans. Almost all have at least a twenty year plan. The long-term nature of DOTs requires especially effective planning for the future. These plans are often changed with changing political tides. This makes long-term planning an even greater challenge that cannot be marginalized in a DOT.

Government agencies, and especially DOTs, have a difficult task in reporting their wide range of activities and responsibilities. Additionally, huge changes due to information shifts and increased concerns, such as the environment, in recent years have shown weaknesses in effectively managing the activities. Both reporting challenges and management challenges have led many DOTs to focus on performance measurement and performance based management (Transportation Research Board 2005). DOTs have the

ability to make strategic plans, but they lack strategic management. DOTs have to learn to implement their strategic plans and use them to make decisions (Poister, 2004).

Along with the wide range of responsibilities in DOTs comes the challenge of effective communication between organizational units. In the past, responsibilities have been divided into functional areas that focus on their own particular area of responsibility. With the increased need for reporting and visibility, this "silo" mentality will not be adequate. Many DOTs are using performance measurement, along with other mechanisms, to help establish communication between functional units, as well as "broad- view" capabilities (Thompson 2002).

While many DOTs use some kind of performance measurement, most still use traditional measures. For example, many DOTs allow each functional area to choose its own measurements without consulting other areas. Traditional measurements are also rarely linked to specific organizational goals. Without this link, it is difficult to know whether an improved measure will result an improved the organization. A DOT might be able to report that it smoothed and resurfaced 10,000 miles of highway. If the governor had ordered the DOT to focus on safety, this measurement might be meaningless with reference to the goal. Furthermore, the idea of integrating measurement with management, common in the private sector, is not widespread in DOTs. (Transportation Research Board, 2005)

2.4.4. Methods to Meet DOTs' Challenges In order to address many of these challenges, some DOTs are using new methods of performance measurement, such as connecting functional areas. Another idea is to involve performance measurement in asset management and strategic management. One simple way DOTs are connecting performance measurement with management is by setting numeric targets for specific strategic goals (Poister, 2004). DOTs in New York, Florida, Colorado, Ohio, and Virginia are integrating performance measurement with strategic goals and business management at various levels of the organization (Transportation Research Board, 2005). Some states are even linking decisions about allocation of resources to measures linked to strategic goals (Transportation Research Board, 2005). The state of Washington is a great example of how integrating functional areas in measurement and linking measurement to strategic goals can transform a DOT (Turnbull, 2004).

Several DOTs are finding ways to use measurements to improve individual employee responsibility for meeting strategic goals. PennDOT has found success tying employee work to strategic goals and distributing "abbreviated or simplified versions of their strategic plans to all employees to help achieve buy-in from the work force" (Poister, 2004). Similarly, Kansas DOT distributed a pamphlet showing how its work fit into the overall plan of the agency (Poister, 2004). New Mexico DOT's *Compass* sets the standard for using performance measurement systems as management tools (Poister, 2004). PennDOT uses a dashboard to summarize how it is doing with core functions, which is reviewed every month to be sure it is not losing track of core functions while implementing its strategic agenda (Poister 2004). North Carolina DOT recently implemented an interfaced maintenance management system and financial management system. Connecting these systems to condition survey results, NCDOT can predict highway conditions for any level of spending, which helps optimize spending and planning decisions. All this information is then available to other management systems in NCDOT (Pilson et al., 2006).

The BSC ideas described earlier in this paper have guided many of the measurement approaches in DOTs. North Carolina, Texas, Utah, Illinois, Virginia, Montana, Pennsylvania, Tennessee, Michigan, Minnesota, and Ohio all use the BSC (Baird and Stammer 2000 B Transportation Research Board 2005; Management Consultants, L.L.C., 2004; Poister, 2004). Several other DOTs, such as Washington and Missouri, have used the ideas in part. The state of Washington has implemented something very similar to the Balanced Scorecard. They have measurements linked to clearly defined strategic goals, and the limited number of goals makes it readable (Gray Notebook, 2006). Missouri DOT's "Strategic Plan of 2003-2008" included three strategic priorities and thirteen goals, with strategies and actions to achieve these goals. MoDOT had required field offices and functional divisions to develop more operational plans based on this overall strategy (Poister 2004).

3. METHODOLOGIES

3.1. EXAMINING MISSOURI DEPARTMENT OF TRANSPORTATION

The Missouri Department of Transportation (MoDOT) web site was used in examining their current practices of performance measurement. Various publications found through the web site provided most of the needed information. The web site listed MoDOT's mission, values, and objectives listed on one page, which helped illustrate what MoDOT has done for performance measurement. The most useful publication on the website was MoDOT's Tracker, which is a compilation of performance measurements. The Tracker provided the best picture of current performance measurement in MoDOT. The Tracker is discussed in detail in the Results section of this work.

3.2. SUGGESTIONS BASED ON THE LITERATURE REVIEW

The literature review provided strong motivation to further consider improving the Missouri Department of Transportation's methods of performance measurement. As discussed in the Literature review section, using the Balanced Scorecard (BSC) is widely accepted as a way to improve performance measurement. The literature review gave evidence, from the City of Charlotte, North Carolina, for example, that indicates the Missouri Department of Transportation could be improved using the BSC.

The literature review also indicated that MoDOT, like any other public organizations, could benefit from some kind of Enterprise Resource Planning (ERP) implementation. MoDOT's public nature requires frequent publication of the details of its performance. Each publication of the Tracker is an individual task of compiling and reporting recent and past data. Compiling and reporting over 300 measures is not a simple task. Based on the success of other organizations, both public and private, it is reasonable to assume MoDOT would also be helped by an ERP package.

3.3. APPLYING BALANCED SCORECARD AND ERP TO MISSOURI DEPARTMENT OF TRANSPORTATION

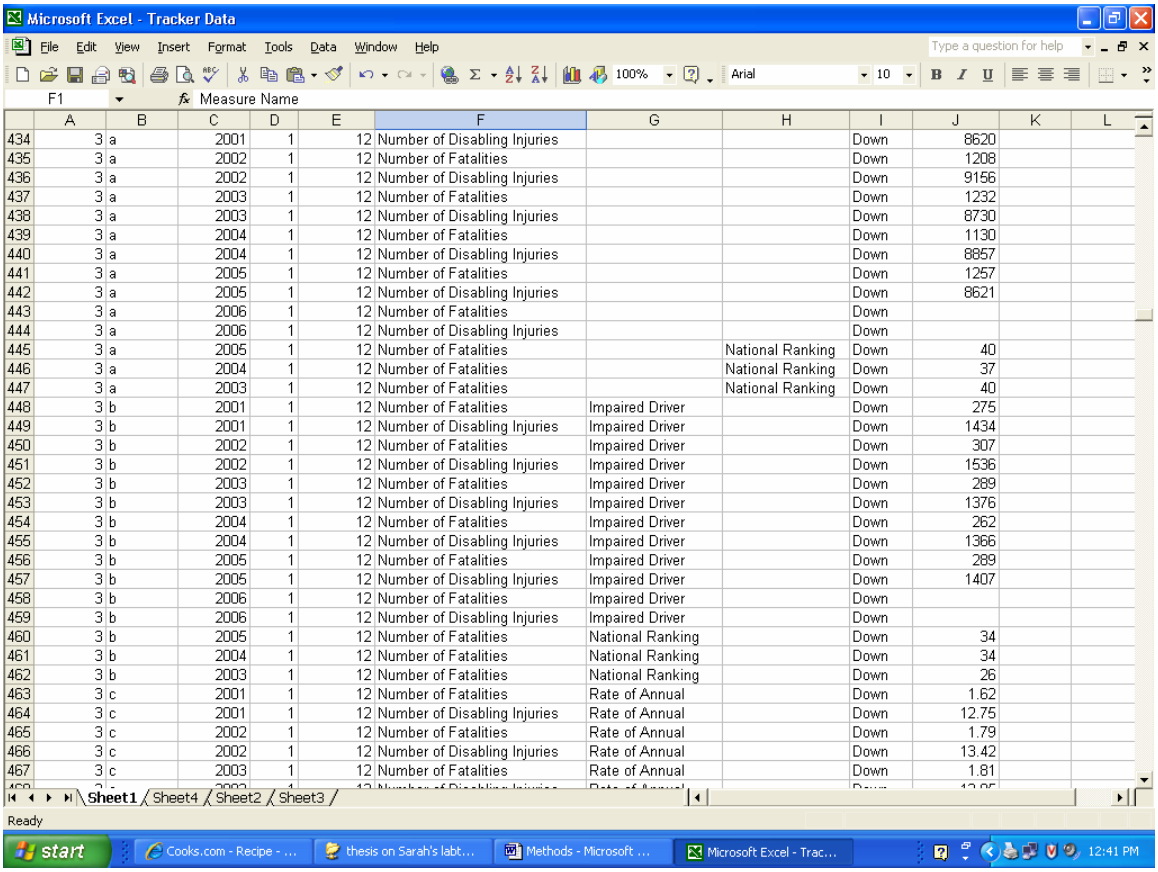
After gaining an understanding of how the BSC and ERP software have helped organizations and could potentially help MoDOT, the next step was to apply these tools

to MoDOT's mission and objectives. This task was more difficult than anticipated because a digital form of the data could not be obtained from MoDOT. The Tracker is published quarterly in hard copy and in Adobe Acrobat format, but not in a format that can be manipulated or used in a database. Attempts were made to obtain the data in this format from MoDOT, but they were unsuccessful. While the reasons are not altogether clear, it is likely MoDOT does not have the data readily available in such a format. MoDOT's computer system is not linked like an ERP package, so each objective is from a different department with different computer applications.

The first task was to create a digital format of MoDOT's data using a spreadsheet. The January 2007 Tracker was used as the basis for setting up the data. As the process went on, other editions of the Tracker were used to supplement the original data. Figure 3.1 shows a screen shot of the original data.

The measure names often had similar titles. To enable easy searching, the full titles were broken into four pieces. For example, someone could easily filter this data by any measure that included "Number of Fatalities" in the title. This filter would result in measures for fatalities in general, fatalities due to an impaired driver, or fatalities involving motorcycles, for example. Each data point also included a date broken down by year, starting month, and ending month. This method allowed similar entry of all data, whether it was in years, quarters, months, or groups of months other than quarters. Each data point also included an objective number and a measure letter. Unfortunately, these references were not consistent between Tracker publications. The January 2007 publication was used as the basis for all the data used in this study.

After entering the data into Excel, some evaluation and manipulation of the data was performed to determine how best to use it. The data was converted into an Access data base. The measures, data points, page references, and dates were all split into relational tables to allow the creation of various forms and reports for the data. A form was developed that allowed easy entry of data points for future use. Several reports from the database provided different pictures of the data.



	A	B	C	D	E	F	G	H	I	J	K	L
434	3	a	2001	1	12	Number of Disabling Injuries			Down	8620		
435	3	a	2002	1	12	Number of Fatalities			Down	1208		
436	3	a	2002	1	12	Number of Disabling Injuries			Down	9156		
437	3	a	2003	1	12	Number of Fatalities			Down	1232		
438	3	a	2003	1	12	Number of Disabling Injuries			Down	8730		
439	3	a	2004	1	12	Number of Fatalities			Down	1130		
440	3	a	2004	1	12	Number of Disabling Injuries			Down	8857		
441	3	a	2005	1	12	Number of Fatalities			Down	1257		
442	3	a	2005	1	12	Number of Disabling Injuries			Down	8621		
443	3	a	2006	1	12	Number of Fatalities			Down			
444	3	a	2006	1	12	Number of Disabling Injuries			Down			
445	3	a	2005	1	12	Number of Fatalities		National Ranking	Down	40		
446	3	a	2004	1	12	Number of Fatalities		National Ranking	Down	37		
447	3	a	2003	1	12	Number of Fatalities		National Ranking	Down	40		
448	3	b	2001	1	12	Number of Fatalities	Impaired Driver		Down	275		
449	3	b	2001	1	12	Number of Disabling Injuries	Impaired Driver		Down	1434		
450	3	b	2002	1	12	Number of Fatalities	Impaired Driver		Down	307		
451	3	b	2002	1	12	Number of Disabling Injuries	Impaired Driver		Down	1536		
452	3	b	2003	1	12	Number of Fatalities	Impaired Driver		Down	289		
453	3	b	2003	1	12	Number of Disabling Injuries	Impaired Driver		Down	1376		
454	3	b	2004	1	12	Number of Fatalities	Impaired Driver		Down	262		
455	3	b	2004	1	12	Number of Disabling Injuries	Impaired Driver		Down	1366		
456	3	b	2005	1	12	Number of Fatalities	Impaired Driver		Down	289		
457	3	b	2005	1	12	Number of Disabling Injuries	Impaired Driver		Down	1407		
458	3	b	2006	1	12	Number of Fatalities	Impaired Driver		Down			
459	3	b	2006	1	12	Number of Disabling Injuries	Impaired Driver		Down			
460	3	b	2005	1	12	Number of Fatalities	National Ranking		Down	34		
461	3	b	2004	1	12	Number of Fatalities	National Ranking		Down	34		
462	3	b	2003	1	12	Number of Fatalities	National Ranking		Down	26		
463	3	c	2001	1	12	Number of Fatalities	Rate of Annual		Down	1.62		
464	3	c	2001	1	12	Number of Disabling Injuries	Rate of Annual		Down	12.75		
465	3	c	2002	1	12	Number of Fatalities	Rate of Annual		Down	1.79		
466	3	c	2002	1	12	Number of Disabling Injuries	Rate of Annual		Down	13.42		
467	3	c	2003	1	12	Number of Fatalities	Rate of Annual		Down	1.81		

Figure 3.1. Sample of Tracker Data in Excel

Once the data was in a digital format, it needed to be made more useful. This could only be accomplished by first limiting the number of measures. A person cannot simultaneously comprehend the meaning of several hundred measures. For this reason, a significant number of measures needed to be eliminated.

The first stage of measure elimination used variable correlation. Matching all the data points of one measure against the data points of another measure, Excel provided a simple correlation for the numbers. This method was limited slightly by the amount of data points available for any one measure. Most measures had fewer than six points. The small number of data points let to high coincidental correlation. Two methods were used to avoid eliminating measures based on coincidence. First, the correlation factor was set quite high. Only correlation factors above 0.86 were considered. This somewhat arbitrary number worked well to identify possible variables for elimination, but not too many unrelated variables.

Of the variables selected above the 0.86 threshold, each correlation was considered individually. If the correlation was intuitive, a correlation above 0.86 was deemed sufficient to eliminate the correlated variables. If the correlation was counter-intuitive, a higher correlation was required for elimination. For example, average speeds on two comparable roads would be intuitively correlated, so one was eliminated if they showed a correlation above 0.86. An average speed on a certain country road is not at all intuitively correlated with the number of females hired by MoDOT. In such a case, neither variable was eliminated, no matter how high the correlation was. The correlation was not a strong enough test with only a few data points. Variable correlation eliminated about sixty measures.

The second stage of measure elimination was based on the literature review and the practices of other states' departments of transportation. The articles from the literature review indicated that performance measurement works much better when it is focused on a few key measurements. MoDOT included every measurement in its Tracker for a reason. However, presenting over 300 measurements at the same time inhibits the usefulness of any individual measure. Rather than inhibiting all of the measures by including too many, MoDOT should choose a few key measurements that can indicate progress toward an objective. This method is confirmed by other non-profit organizations and departments of transportation, in which common practice is to have two or three measures for each objective.

3.4. CREATING A PROTOTYPE TO COMPARE WITH CURRENT PRACTICES

3.4.1. Use of SAP The final stage of research was to simulate a combined package of ERP and Balanced Scorecard (BSC) to examine how the combined package would help MoDOT's performance evaluation. A leading supplier of ERP packages is a German company called SAP. SAP's ERP has a business intelligence package that includes a Balanced Scorecard application. This model is highly consistent with what the literature review suggests would drastically help MoDOT. Using SAP allows a simulation of how a combination of ERP and BSC would help MoDOT.

3.4.2. Creating the Prototype Creating the framework for MoDOT's Balanced Scorecard was a major step in the simulation. MoDOT needs to go through various

exercises to create its BSC. An organization must decide on an overall strategy and then consider that strategy from several perspectives, as described in the literature review of this study. The simulation did not require additional input from MoDOT because it focused on the usability and presentation of MoDOT's data. Therefore, to begin the simulation creation, a strategy and four perspectives were selected based on the literature review and the practices of other DOTs. Using the Tracker, objectives were selected to support the four perspectives. The variable reduction exercise was used to select variables to support the objectives. Of particular help in this process was the Illinois Department of Transportation, which implemented a BSC several years ago and has continually updated it. In addition to the framework proposed by the literature, the IDOT framework was referenced during the prototype development process.

3.4.3. Creating an SAP Info Cube In order to create the simulation, the data from the Tracker had to be inserted into an Info Cube, which is a storage system for SAP. An Info Cube consists of dimensions (characteristics of the data), at least one time dimension, and key figures (data points). The key figures can be queried using the dimensions. The Info Cube for this study did not need characteristics beyond one time characteristic. For the simulation purposes, it was not necessary to include all of the data from the BSC framework described in Section 3.4.2. One objective, along with its measurements, was selected from each perspective. Documentation of this process can be found in Appendix A. After the Info Cube was created, queries were created for use in the Balanced Scorecard. Finally, the BSC was implemented, as described in Section 4.3.

3.4.4. Creating the Survey for Evaluation Finally, the BSC simulation and the published Tracker were compared in a survey. The subjects of the survey were two groups of citizens. The first group consisted of SAP experts who needed no instruction on the SAP interface. The second group had no experience with SAP. Both groups were given a few exercises to demonstrate the differences between the BSC simulation and the published Tracker. Then each subject was asked to answer questions based on their experience. Additional survey materials can be found in Appendix C.

4. RESULTS AND EVALUATION

4.1. TRACKER DESCRIPTION

The Tracker projects a positive first impression. MoDOT's mission is well stated, and its objectives are clear. Each objective has a color picture and an introduction stating the purpose of the objective and how it is measured. In turn, each measure also has an introduction giving a little background on the measure and some explanation of the data. Different MoDOT employees are responsible for each measure, and each person has done a good job on his or her area.

However, given the purpose of the Tracker, it leaves a lot to be desired. The purpose of performance measurement is to improve the organization by measuring key areas linked to a strategy. The Tracker does not have an overall strategy. Its list of objectives lacks a hierarchy or prioritization. Each of the eighteen objectives includes a number of measurements, but the lists of measurements also lack prioritization.

The published Tracker has eighteen sections that could be considered objectives. The number of measurements in each section varied greatly. Altogether, the January, 2007 Tracker included 369 measurements. Each measurement averaged between four and five data points, one for the current measurement and several more of previous time periods. While MoDOT provides some evaluation for each measurement, the evaluation is excluded from the graphs. The graphs usually exclude benchmarks or target values. Some measurements indicate a desired trend with an arrow next to the graph. The arrow does not tell if MoDOT is doing as well as expected or much worse than expected.

Given the eighteen objectives, the average number of measurements per objective was about twenty-one. To get a good idea of how MoDOT is doing toward an objective, a person would have to personally evaluate more than twenty measurements and about a hundred points of data among those measurements. While showing the data in graphs is helpful, the Tracker still includes hundreds of graphs spread over many pages.

The Tracker is produced every quarter. Some of the measurements are broken down by month in each quarter. Other measurements are reported each year, so they are not updated in each Tracker, just reprinted each time.

Some measurements needed changes before they could be used in a Balanced Scorecard system. The most significant example of this is the Average Speed

measurements in the first section of the Tracker. The tracker measures 39 different average speeds. While many of these measurements correlate with each other, measuring speeds on only a few roads at certain times would not work. MoDOT employees might tend to focus more on the measured roads. The correlation between measured and non-measured roads would disappear. A solution to measure a lot of roads, but not overwhelm readers of the BSC with measurements, would be to report one combined measurement of average road speeds. With an ERP system like SAP, MoDOT could then drilldown into that overall measurement to see what specific roads may need attention. Another improvement to this average speeds measurement would be to report scores based on the MoDOT's evaluation of the average speeds. This would show meaningful information instead of raw data that can be interpreted in conflicting ways. For example, commuters might want the average speeds to go as high as possible, despite the posted limits. Highway patrolmen would want the speeds slightly under the posted limit. The goal of the Tracker is MoDOT performance measurement, not raw data distribution.

If a person wanted to know how MoDOT was doing toward their objective of Unrestricted Data Flow, the person would have to interpret each of the twelve graphs in the objective and try to unify the information to get an overall idea of MoDOT's progress in that area. While the presentation of the Tracker is good, it lacks substance between the measurements. Each measurement is its own compartment, and each objective is also a compartment. At the very least, one would expect an overall view of MoDOT's progress in each objective.

4.2. BALANCED SCORECARD FRAMEWORK

Developing a Balanced Scorecard begins with the mission or goal of an organization. MoDOT has a clearly stated mission.

> Our mission is to provide a world-class transportation experience that delights our customers and promotes a prosperous Missouri.

This is a good mission from which to begin MoDOT's Balanced Scorecard. The next step is to develop a strategy or strategies to fulfill this mission, which is something only

MoDOT can do for itself. For the purpose of this study, we used a single generic strategy of "Improve MoDOT's performance when compared to neighboring state DOTs".

Next the strategy and mission must be considered from various perspectives. The simulated Balanced Scorecard will have four perspectives, based very closely on the suggestions of Robert Kaplan (Kaplan, 2002). The top perspective is "Value Creation for the State of Missouri through the transportation system". This is the perspective to which the other perspectives point. The perspective below Value Creation is the Customer Perspective. Missouri's customers are both the general public and the legislators who provide funding. The third perspective is the Internal Process perspective, which includes best practices in the industry. Finally, the fourth perspective is the Learning and Growth Perspective, which focuses on creating the climate in which the other perspectives can thrive.

Each of the perspectives is broken down into objectives. Progress toward the objectives, and therefore toward the perspectives, is indicated by performance measures grouped under the objectives. As mentioned, MoDOT has no shortage of measurements. The simulated Balanced Scorecard for this study used selected existing objectives and measurements. For an actual Balanced Scorecard, MoDOT might have to develop additional measures or adjust current measures to better focus on certain areas. Overall, though, the current measures are so comprehensive that appropriate measures exist for every perspective.

The simulated Balanced Scorecard used most of the section headings in the Tracker as the objectives in the BSC. Two sections were not used as objectives. The first was the Tracker section heading "Efficient Movement of Goods." This section had measurements showing how much freight was moved by various modes, and how fast trucks moved on the interstates. These measurements overlapped with the first section of the Tracker that tracked traffic speeds on various roadways. The other section not used from the Tracker was the last section called "Accurate, Timely, Understandable, and Proactive Transportation Information." This section dealt with MoDOT's interaction with the media.

Several of the Tracker sections were divided or combined to create the objectives of the Balanced Scorecard. The first two sections were combined to form the first objective under value creation. Only selected measurements were used from the Tracker

sections. The measurements were selected based on the criteria discussed in the Methods section of this work. Whenever a measurement was selected, it was placed under the objective corresponding to that measure's Tracker section.

Below is a table of an example MoDOT Balanced Scorecard framework. The four perspectives are in bold. The objectives are indented once. The measures are indented twice.

Table 4.1. Balanced Scorecard Framework

Value Creation for the State of Missouri through the transportation system
Provide Unrestricted Traffic Flow on smooth and unrestricted roads
Average Speeds on various roads
Average Time to Clear Accident
Percent of Major Highways that are in good condition
Percent of Deficient Major Bridges
Provide a Safe Transportation System
Number of Fatalities
Rate of Nighttime Crashes Head on and Sideswipe
Promote a prosperous Missouri
Number of Miles of New Four-Lane Corridors Completed
Easily Accessible Modal Choices
Number of Passengers Rail All Missouri
Number of Daily Scheduled Airline Flights Missouri
Number of Vehicles Transported by Ferryboat Mississippi County
Provide safe and attractive roadsides and roadside accommodations
Number of Users of Rest Areas

Customer Perspective – delighting customers

- Personal, Fast, Courteous & Understandable Response to Customer Requests
  - Percent of Customers Who Contacted MoDOT who felt they were Responded to in a personal courteous manner
  - Percent of Overall Customer Satisfaction total
- Provide Unrestricted Traffic Flow on smooth and unrestricted roads
  - Percent of Customers Who Feel MoDOT is Providing a Quality Transportation System Satisfied
- Provide a Safe Transportation System
  - Percent of Work Zones Meeting Expectations for Visibility
- Easily Accessible Modal Choices
  - Percent of Customers Satisfied with Transportation Options
- Promote environment responsibility
  - Percent of Projects Completed Without Environmental Violation Total
  - Number of Historic Resources Avoided or Protected as Compared to those Mitigated Protected
  - Number of Tons of Waste/Recycled Used in Construction Projects Hot Mix Asphalt
- Customer involvement in transportation decision-making
  - Percent of Customers Somewhat or Very Satisfied With Feedback from MoDOT after Offering Comments
  - Percent of Customers Strongly or Somewhat Agree Who Feel MoDOT Includes them in transportation decision making process
- Provide safe and attractive roadsides and roadside accommodations
- Percent of Customers Satisfied with Rest Area's Cleanliness

Internal Processes – efficiency and best practices

- Partner With Others to Deliver Transportation Services
  - Number of Dollars Discretionary Funds Allocated to Missouri-Highways
  - Number of Dollars Discretionary Funds Allocated to Missouri-Multimodal
- Innovative Transportation Solutions
  - Percent of Innovative Transportation Solution
  - Number of External Rewards Received
- Fast Projects That Are Of Great Value
  - Annual Dollar Amount Saved by Implementing Value Engineering Construction Phase
  - Percent of Estimated Project Cost Compared to Final Project Cost
- Best Value for Every Dollar Spent
  - Number of Lost Workdays per Year
  - Percent of Vendor Invoices Paid On Time
- Advocate for Transportation Issues
  - Percent of Transportation-Related Pieces of Legislation Directly Impacted By MoDOT in the Senate

Learning

- Retain and Train a Diverse Workforce
  - Rate of Employee Turnover Voluntary
  - Percent of Females Employed
  - Percent of Minorities Employed
- Develop an atmosphere of innovation
  - Percent of Innovative Transportation Solutions
- Number of External Rewards Received

4.3. PARTIAL IMPLEMENTATION OF THE BALANCED SCORECARD

This study concludes with a survey of citizens comparing the usefulness of a proposed Balanced Scorecard prototype with the MoDOT's current practice. SAP was chosen to host the Balanced Scorecard prototype, as described in the Methods section of this work. The technical details of creating the prototype are also discussed in the Methods section, as well as in Appendix B.

A partial, preliminary implementation of the Scorecard was deemed satisfactory for the purposes of the survey. One objective was chosen from each perspective. The four perspectives and the four chosen objectives were all implemented. All the measurements relating to the chosen objectives were also fully implemented with actual data from MoDOT's Tracker. Note that existing perspectives in the SAP system were utilized to reduce implementation time to create the perspective names used in the prototype. Therefore, they do not match exactly the BSC framework outlined in Section 4.2.

As the main target users of TRACKER are public, the respondents in this survey were sampled from student population at the University of Missouri Rolla instead of MoDOT employee. It was intended to present an initial idea of how general public who are not affiliated with MoDOT would respond to the two formats of data presentation.

One of the main advantages of a Balanced Scorecard implementation is the ability to present high volume data/information on the performance of an organization to users in a quick glance. This requires clear evaluation of raw data. MoDOT lacks evaluation of most of the raw data that they publish. For implementation purposes, evaluation of the data was created based on indications in the Tracker. However, it will require MoDOT to define its actual data evaluation if the proposed prototype is to be implemented in the future.

One of important features of the proposed Balanced Scorecard based performance measurement prototype is to present information/data at different aggregation levels, an *Overall Balanced Scorecard View*, as shown in Figure 4.1, is presented to the survey participants to provide information at the most aggregate level. Note that a gray X next to an objective indicates that objective was not implemented in this prototype.

Notice that each of the four perspectives has an evaluation symbol next to it. These symbols represent an average of the objective evaluations for that perspective. The objective evaluations might also come from an average of the evaluations of its measurements. However, the weights can be customized to meet an organization's own situation and needs. For example, MoDOT could decide to place more emphasis on some objectives by changing these averaging formulas in the weighting schema design.

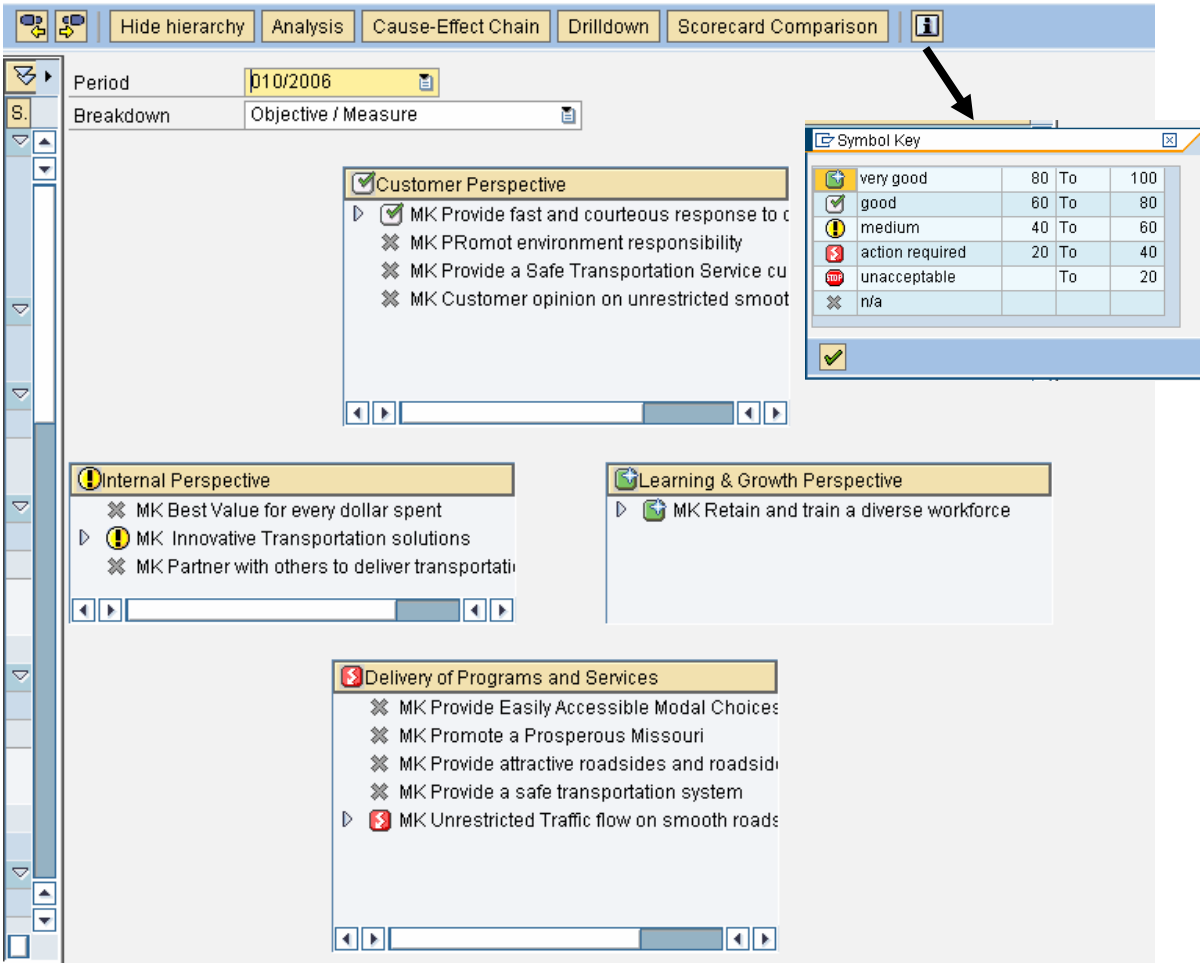


Figure 4.1. Initial Balanced Scorecard Screenshot

Participants taking the survey were fist shown the above BSC overview screen. They were given questions about the evaluation of various perspectives and periods. They were shown the detailed views of the measurements, as the example screen shot shows in Figure 4.2. The graphs on the measurement details imitated the graphs shown in the Tracker. The descriptions of the measurements and the objectives were taken from

the Tracker. However, the prototype also provides additional information including period of evaluation, owner or responsible person of a measure, trends and score of a measure, and actual, plan, and target performance value. That is, the proposed prototype provides features to support documentation (e.g., definition and actual data of a measure as shown in Figure 4.2) and to improve data visibility (relevant graphical representation as shown in Figure 4.2), relational clarity, and communicability. Furthermore, the proposed prototype provides features to support accountability (e.g., owner of a measure as shown in Figure 4.2) and traceability overtime as well as the ability to comment on external factors that may significantly affect performance (e.g., the ***Assessment*** feature as shown in Figure 4.2).

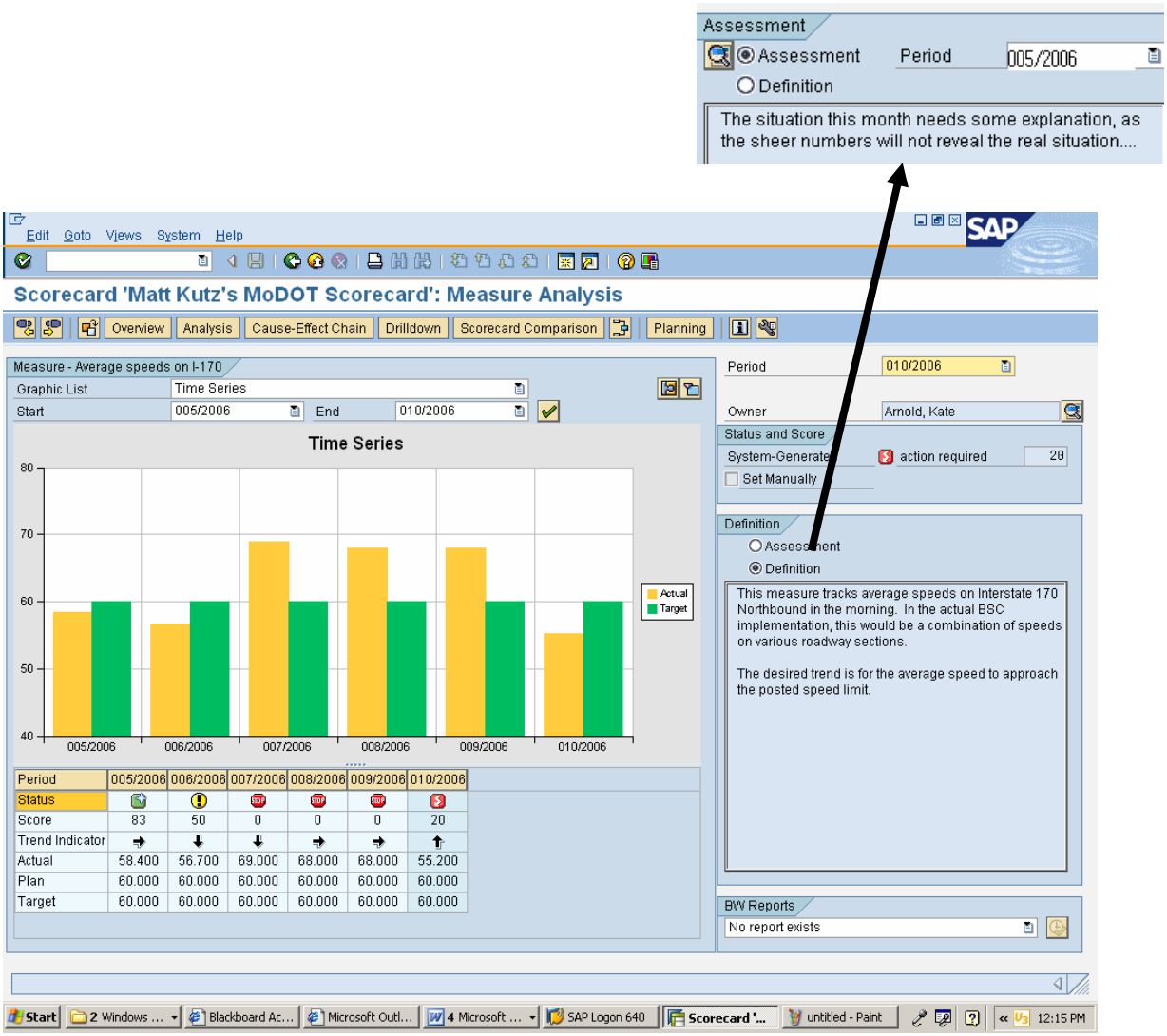


Figure 4.2 Measurement Detailed View

The Overview feature shown in Figure 4.1 provides the highest level of data aggregation while Measure Analysis feature shown in Figure 4.2 provides additional information available at different aggregation levels. The proposed prototype can also provide various levels of information detail based on selected criteria to meet different purposes for different users at different time through a ***Drilldown*** feature. Survey takers also saw an example of drilling down from a perspective to measurements supporting that perspective, as shown in Figure 4.3. The ***Drilldown*** feature provides data for trend and comparison data among actual performance, planned, and the target values as well as assigns a score to facilitate performance assessment.

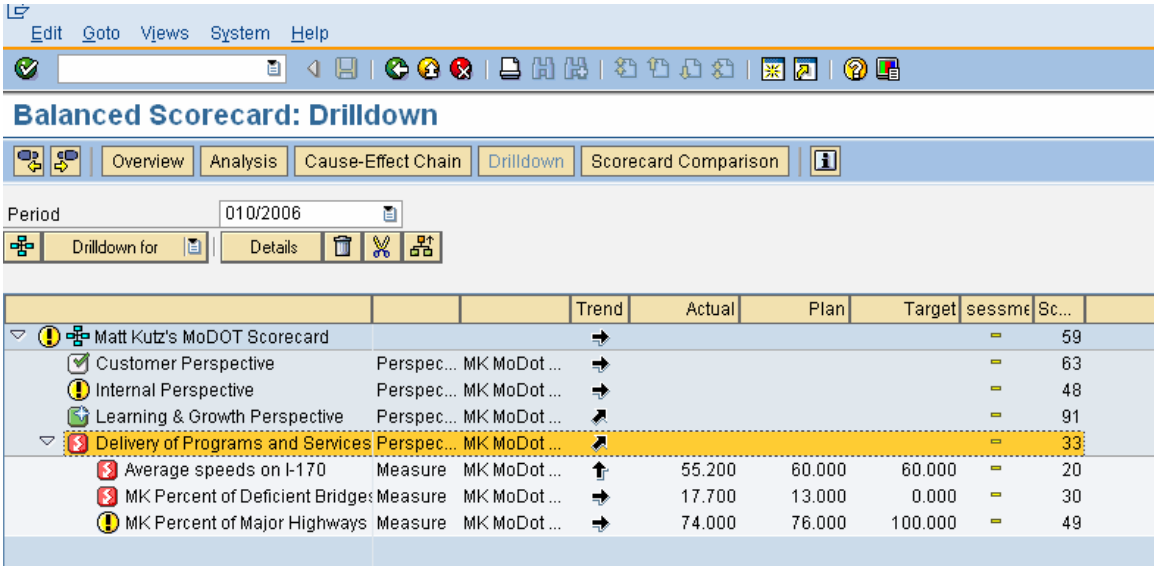


Figure 4.3. Drilldown from Scorecard to Perspective to Measurements

4.4. SURVEY RESULTS

The survey asked 36 people eleven questions asking their opinion of two ways to present MoDOT's performance evaluation. The first way was the proposed software prototype, and the second was MoDOT's published Tracker. The actual survey and supporting documents are found in Appendix C. We collected demographic information from each of the respondents. The demographic breakdown is shown in Figure 4.4.

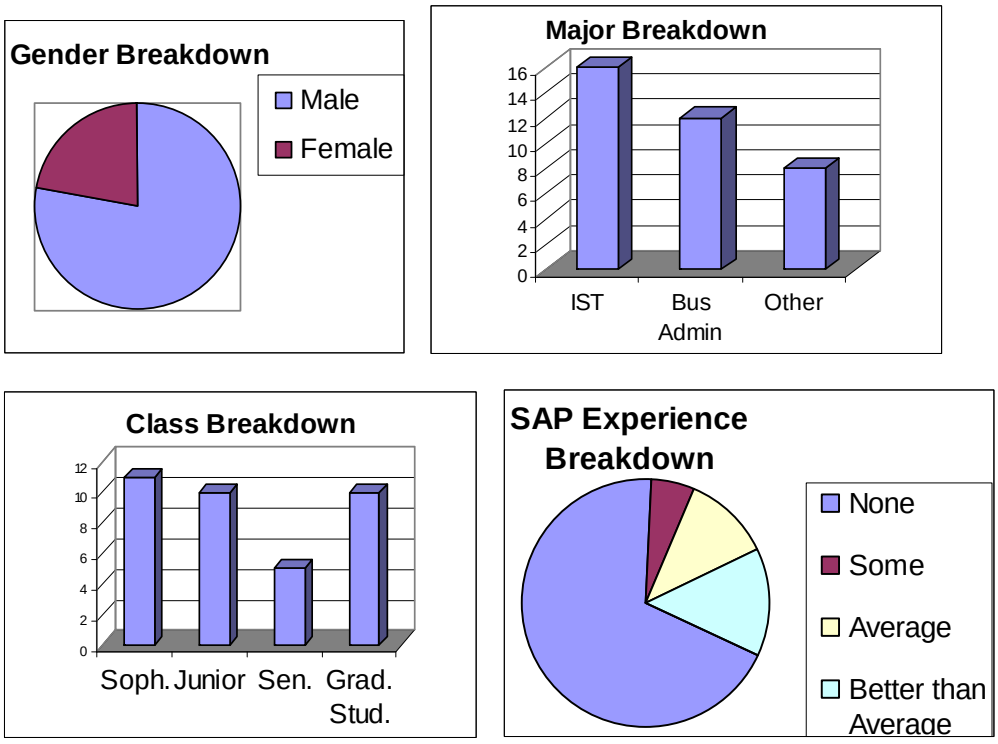


Figure 4.4. Demographic Breakdown of Survey Respondents

The eleven questions all had five answers from which to choose: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree. For simplicity in reporting, the Strongly Agree and Agree answers were combined, as were the Strongly Disagree and Disagree answers. The following is a list of the questions.

The proposed software prototype is better than the published format at the following:

1. Finding performance measures of interest. (Locating Data)
2. Understanding the meaning of the performance measures. (Meaning is clear)
3. Providing a better means to track accountability (i.e. who is in charge of the measure) (Accountability)
4. Providing timeliness of information (the published format is published four times a year). (Timeliness)
5. Providing overall data and results *interpretation*. (Data Interpretation)
6. Providing a better means to monitor performance. (Monitor Performance)
7. Presenting different information details for different interested parties for different purposes. (Drilldown feature)
8. Providing a better connection between performance measures and organizational strategies and goals. (Measures and goals connected)
9. Ease of use.
10. Providing a more user friendly user-interface. (Interface)
11. Providing an easier means to identify a causally linked relationship between performance. (Causally linked measure)

The following is the overall results of the survey.

Table 4.2 Overall Results of the Survey

Overall Results

Breakdown

	Total:	36		
Question:	Percent Agree	Agree	Neutral	Disagree
1	86.1	31	3	2
2	72.2	26	7	3
3	69.4	25	7	4
4	77.8	28	7	1
5	83.3	30	2	4
6	80.6	29	4	3
7	66.7	24	11	1
8	63.9	23	11	2
9	58.3	21	6	9
10	58.3	21	9	6
11	72.2	26	9	1
	71.7			

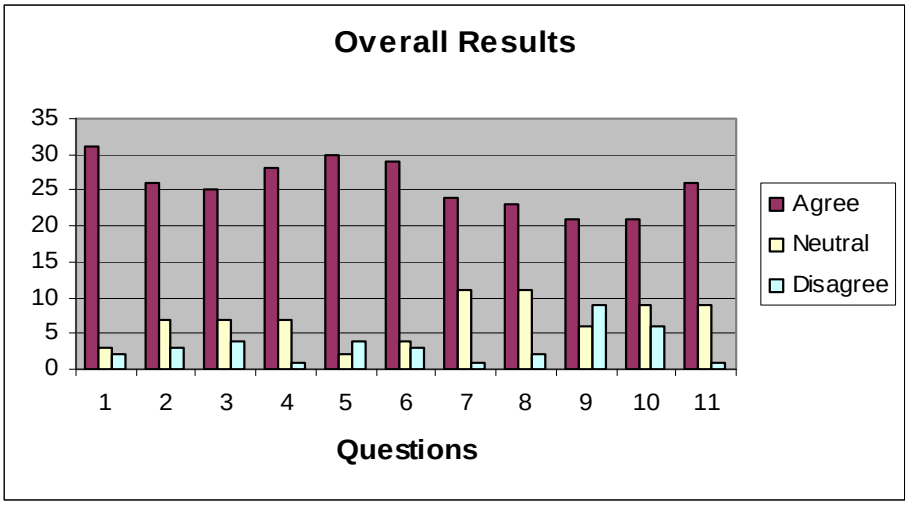
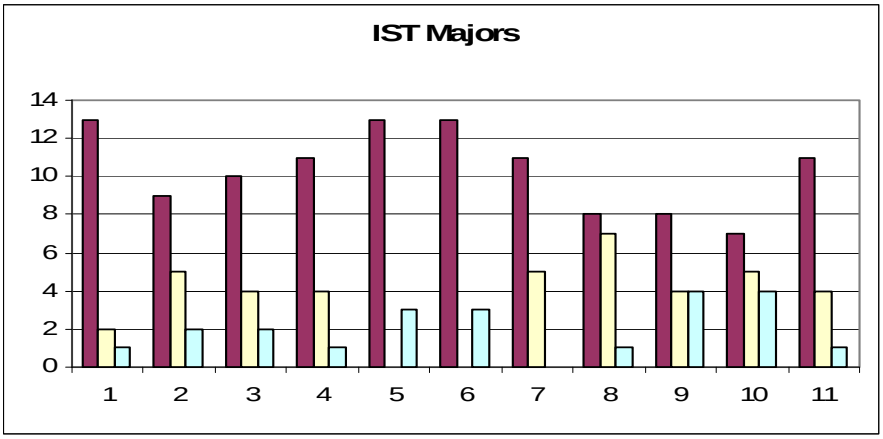


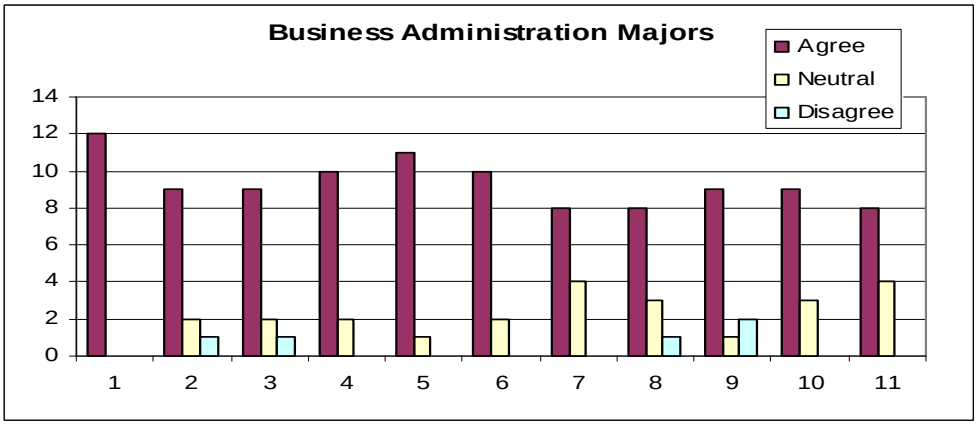
Figure 4.6. Graph of Overall Results by Question.

The results clearly show the advantages of the Balanced Scorecard method. For every question, respondents who thought the prototype was better far outweighed those who did not think it was better. The breakdown by major is shown in Table 4.2.

Table 4.3 Results of survey by Major

Major	**IST**		**Total:**		16
Question:	Percent Agree	Agree	Neutral	Disagree	
1	81.3	13	2		1
2	56.3	9	5		2
3	62.5	10	4		2
4	68.8	11	4		1
5	81.3	13	0		3
6	81.3	13	0		3
7	68.8	11	5		0
8	50.0	8	7		1
9	50.0	8	4		4
10	43.8	7	5		4
11	68.8	11	4		1
Average Agreement:	64.8				
Business Administration			**Total:**		12
Question:	Percent Agree		Agree	Neutral	Disagree
1	100.0		12	0	0
2	75.0		9	2	1
3	75.0		9	2	1
4	83.3		10	2	0
5	91.7		11	1	0
6	83.3		10	2	0
7	66.7		8	4	0
8	66.7		8	3	1
9	75.0		9	1	2
10	75.0		9	3	0
11	66.7		8	4	0
Average Agreement:	78.0				
Other Majors					
	Total:		8		
Question:	Percent Agree		Agree	Neutral	Disagree
1	75.0		6	1	1
2	100.0		8	0	0
3	75.0		6	1	1
4	87.5		7	1	0
5	75.0		6	1	1
6	75.0		6	2	0
7	62.5		5	2	1
8	87.5		7	1	0
9	62.5		5	1	2
10	62.5		5	1	2
11	87.5		7	1	0
Average Agreement:	77.3				





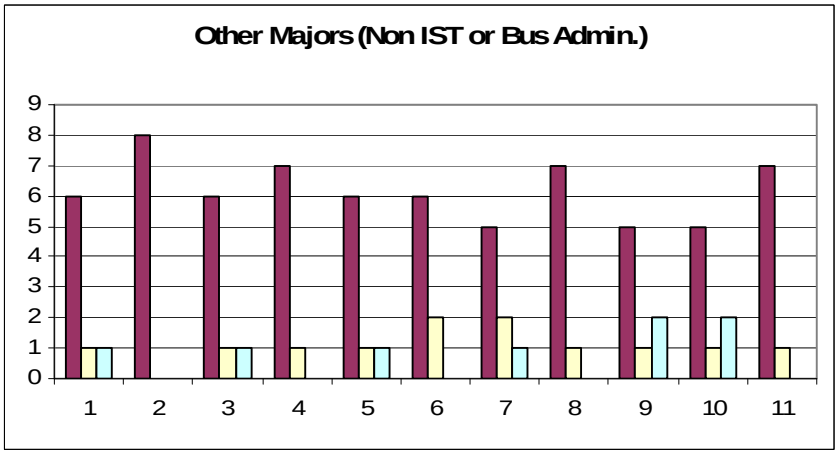


Figure 4.7 Graphs of Survey Results by Major

The results for the female breakdown are shown in Table 4.3. The responses are very similar to the overall results. The similarity indicates correctly that the male responses are also very similar. Because of the similarity, the male results table and chart have been omitted.

Table 4.4 Results of survey for Female Respondents

Gender: Female		**Total:**	**8**	
Question:	Percent Agree	Agree	Neutral	Disagree
1	87.5	7	1	0
2	87.5	7	1	0
3	62.5	5	2	1
4	87.5	7	1	0
5	75.0	6	1	1
6	75.0	6	2	0
7	75.0	6	2	0
8	50.0	4	3	1
9	50.0	4	2	2
10	50.0	4	2	2
11	62.5	5	2	1
Average Agreement:	69.3			

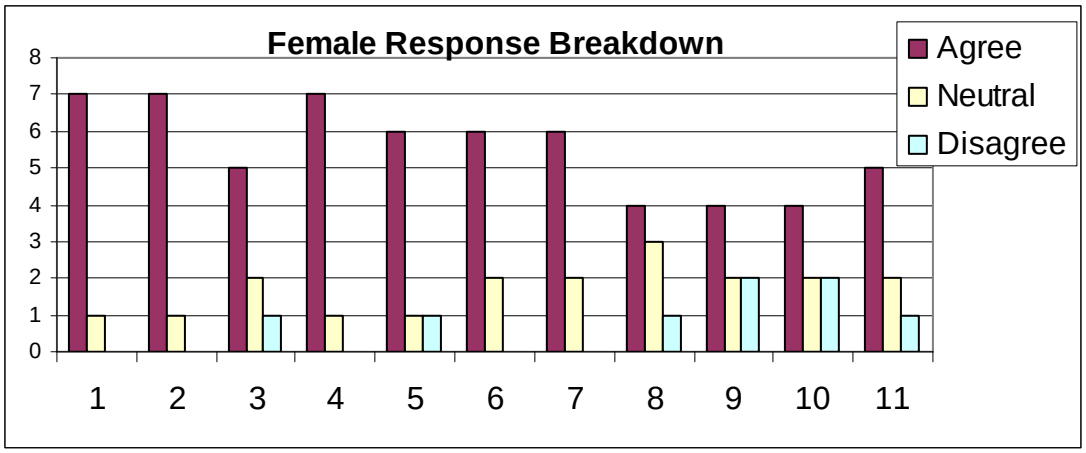


Figure 4.8 Graphs of Survey Results for Females

Table 4.4 shows the results broken down based on the users' SAP experience. The first group of respondents has no experience with SAP. If the respondents had any experience, they are part of the second group.

This breakdown shows a significant difference between those with SAP experience and those without experience. The percentage of agreement for the prototype was almost twenty percent higher for the group with SAP experience. This shows that the SAP interface was a significant stumbling block for many inexperienced respondents.

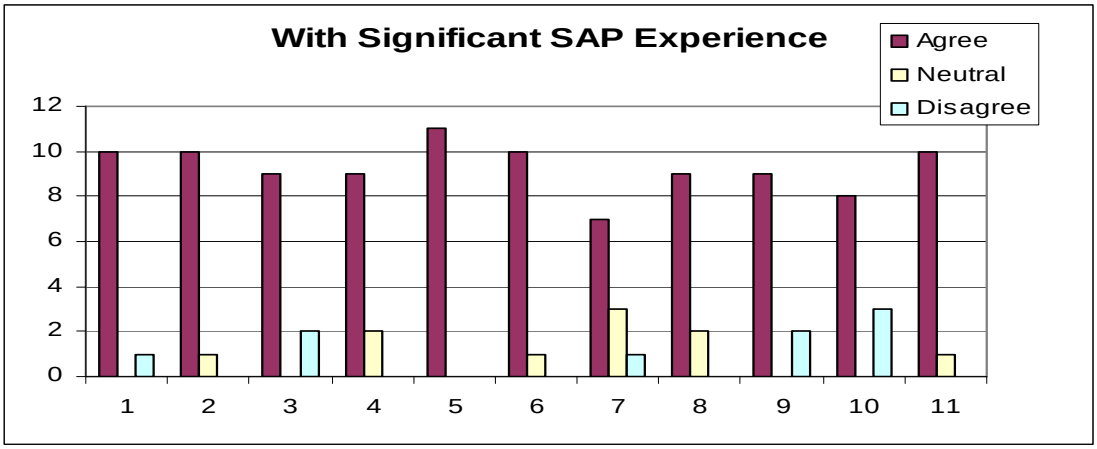
Table 4.5 Results of survey Divided by SAP Experience

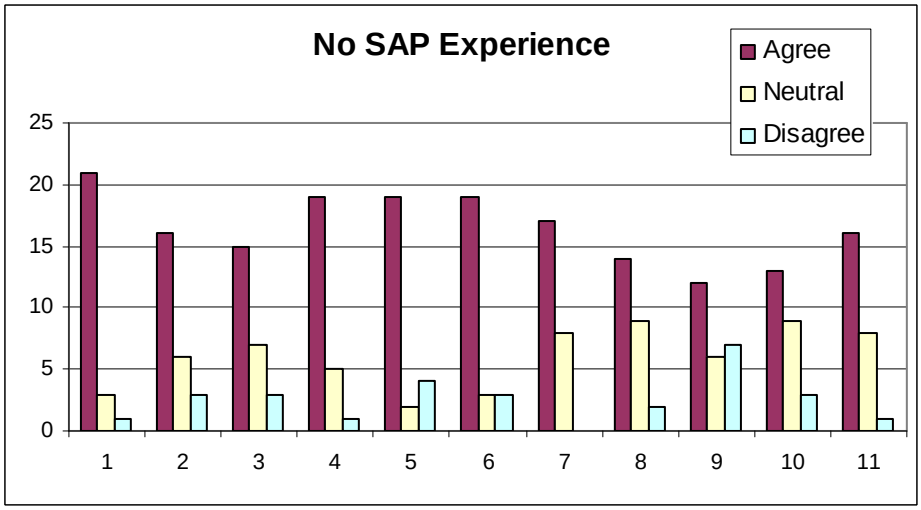
SAP Experience Breakdown

Of those with SAP experience			**Total**	11
Question:	Percent Agree	Agree	Neutral	Disagree
1	90.9	10	0	1
2	90.9	10	1	0
3	81.8	9	0	2
4	81.8	9	2	0
5	100.0	11	0	0
6	90.9	10	1	0
7	63.6	7	3	1
8	81.8	9	2	0
9	81.8	9	0	2
10	72.7	8	0	3
11	90.9	10	1	0
Average Agreement:	84.3			

Of those with no SAP Experience			**Total:**	25
Question:	Percent Agree	Agree	Neutral	Disagree
1	84.0	21	3	1
2	64.0	16	6	3
3	60.0	15	7	3
4	76.0	19	5	1
5	76.0	19	2	4
6	76.0	19	3	3
7	68.0	17	8	0
8	56.0	14	9	2
9	48.0	12	6	7
10	52.0	13	9	3
11	64.0	16	8	1
Average Agreement:	65.8			

Figure 4.9 Graphs of Survey Results Divided by SAP Experience





A summary of survey questions is provided below (the complete survey questions can be found in Appendix C)

Prototype is Better at:
1) Locate Data
2) Meaning is clear
3) Accountability
4) Timeliness
5) Data Interpretation
6) Monitor Performance
7) Drill down
8) Measures and goals connected
9) Ease of use
10) Interface
11) causally linked measures

4.5. SURVEY RESULTS ANOVA ANALYSIS

An important part of analyzing the data above was done using the one-way ANOVA analysis. The tables below show a summary of the ANOVA analysis. For complete tables of the ANOVA analysis, see Appendix D. Using an alpha value of 0.05, only three questions have significant correlation, and all three are in the SAP experience row. Questions 7, 10, and 11 have significant correlation between the respondents' answers and the breakdown between those with SAP experience and those without SAP experience.

Table 4.6 Significance Results by demographic breakdown

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
SAP Exp.	.168	.563	.148	.434	.112	.529
Major	.174	.372	.453	.544	.755	.469
gender	.832	.911	.652	.950	.461	.908

	Question 7	Question 8	Question 9	Question 10	Question 11
SAP Exp.	**.014**	.235	.373	**.008**	**.022**
Major	.088	.718	.317	.371	.067
gender	.376	.162	.578	.461	.949

4.6. SURVEY RESULTS SUMMARY

The survey clearly indicates an overall preference for the software prototype. On no question, in any breakdown, does the number of people who disagree outweigh those who agree. Rarely is it close. Overall agreement for the prototype was 71%. Finding measures of interest had overall agreement of 86%. Interpreting the data had overall agreement of 83%. This is very significant agreement in these areas.

The SAP interface seemed to be a problem for a number or respondents. Agreement that the prototype was easier to use was only 58%, as was agreement that the prototype had a more user-friendly interface. These numbers are mitigated by the fact

that the disagreement percentages were very low in these areas as well. The level of agreement went down because the number of neutral answers to these questions went up. The level of disagreement went up only slightly.

There is significant difference between respondents with SAP experience and those without on several questions. Based on the ANOVA analysis, questions 7, 10, and 11 all had significant correlation between the respondent's SAP experience and their answers at $\alpha = 0$.. Those questions dealt with drilling down, a user-friendly interface, and a connection between measures and goals, respectively. Users without SAP experience agreed to the questions by a much smaller margin than users with SAP experience. This difference in margin of agreement leads to the conclusion that SAP's interface was a significant factor on respondents' feelings toward the benefit of the prototype.

Overall, the survey confirmed the hypothesis that the Balanced Scorecard would greatly improve MoDOT's performance measurement presentation. It was not confirmed that SAP should be the interface to support the Balanced Scorecard.

5. CONCLUSION

The presentation of the Tracker would lead a person to believe it is meant for public consumption. The pretty, colorful pictures and the nice layout are pleasing to someone looking through the document. The graphs and short explanations seem to present the data concisely.

However, very few members of the general public would find the Tracker useful in its present form. Anyone trying to evaluate MoDOT as a whole will get lost in the mountain of data. If a person happened to be interested in one of the eighteen sections, the person would have to examine many different measurements and be able to interpret the raw data presented. If people are interested in a specific measurement, they need to know exactly where it is located because the few hundred pages of the Tracker publication are too many to search one by one. The only people who would find the Tracker useful are those interested in specific measurements who know exactly where the measurements are located in the Tracker. Almost all people falling into this category are MoDOT employees themselves. Most MoDOT employees do not need all the data from MoDOT, but only data from their immediate area. It is questionable the Tracker is useful to anyone in its present form.

Because MoDOT provides very little evaluation itself in the Tracker, a person must perform the evaluation themselves with the hundreds of measurements in different forms and spreads across hundreds of pages. Each graph has its own interpretation. Each objective is completely disassociated with all the others. As shown in this work, these issues could be resolved if MoDOT implemented a Balanced Scorecard. Much of MoDOT's current performance evaluation could be used in the BSC. The only piece MoDOT is missing is planning and connecting the measurements to an overall strategy. In fact, many of MoDOT's measurements are extraneous and could be eliminated without losing information about MoDOT performance.

MoDOT's need for the BSC is confirmed by the survey included in this work. Using SAP to improve MoDOT's performance measurement presentation was not confirmed. It is likely SAP would benefit MoDOT in ways beyond presentation of performance measurement, but that is beyond the scope of this study. Implementing the BSC would not cost as much as implementing SAP. MoDOT should take the small step

to convert its current performance measurement to a more productive Balanced Scorecard framework.

5.1. LIMITATIONS

The survey for this study focused on highly educated users as most of the respondents were students at the University of Missouri-Rolla. It would be valuable to administrate another survey to include other stakeholders for more representative of the general public.

Another limitation is that this study does not include consideration of how MoDOT uses its Tracker internally as the general public usage of the Tracker was the main focus of the proposed prototype. Some adjustments may be needed if the Tracker is also used primarily by MoDOT employees for their work in MoDOT.

While this study uses actual data from MoDOT, it only uses data available to the general public. It is possible that MoDOT has more usable data and evaluations of that data that it does not release. The evaluations of MoDOT raw data would be especially useful to answering the objections raised against the Tracker in this study.

Several possibilities of tools to demonstrate the Balanced Scorecard are available. Microsoft and Oracle, for example, both have applications to implement a Balanced Scorecard prototype. As the survey showed, the use of SAP might have been a concern of usability as shown in the results of this study.

5.2. FUTURE RESEARCH

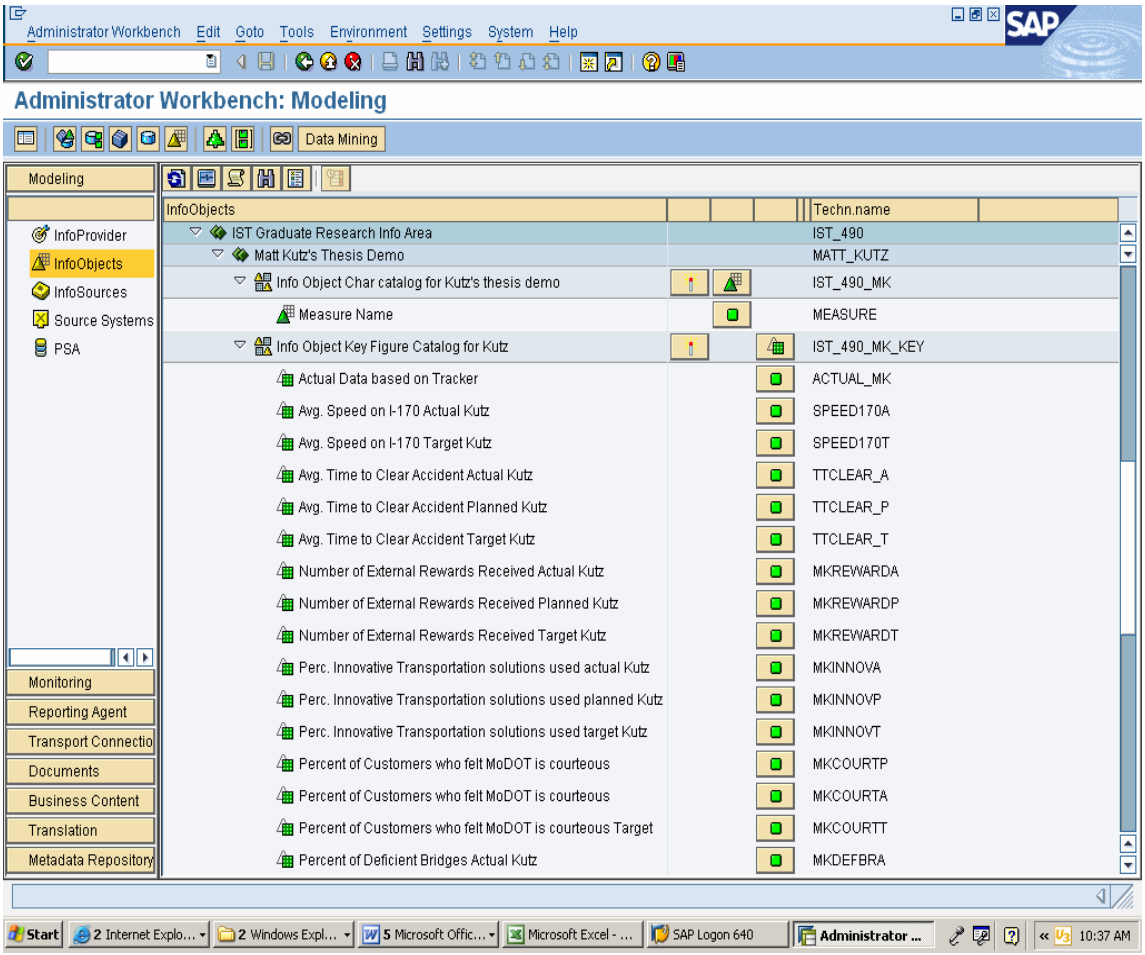
Several expansions to this study might be valuable. First, this study did not consider a cost-benefit analysis of a Balanced Scorecard implementation and the topic could be a valuable expansion of the current study. With the time constraints, MoDOT employees were not fully utilized for their knowledge of MoDOT practices or their opinion about the proposed BSC prototype. Both would be useful future research directions.

APPENDIX A

INFO CUBE CREATION

This appendix will show details of creating the info cube and the queries for the Balanced Scorecard prototype used in this study. Figure A.1 is a screen shot of the end result of creating the info objects for the info cube. The info objects combine to create the info cube. The following screen shot shows the info area catalog, as well as one characteristic and a long list of key figures. This is not the ideal info cube, but it serves the purposes of this study very well. Usually the info cube would have fewer key figures and more characteristics to allow more flexibility using the data.

Figure A.1



Figures A.2 and A.3 show two of the three tabs in the Info Cube. Figure A.2 is one characteristic in the info cube. The Measure characteristic is empty in this

implementation. As mentioned, this info cube was created for the BSC prototype, which did not require various characteristics with which to sort the data.

Figure A.3 shows the one time characteristic needed by the info cube to break down the data by months. Loading data into this characteristic was tricky and will be discussed in detail below.

Figure A.2

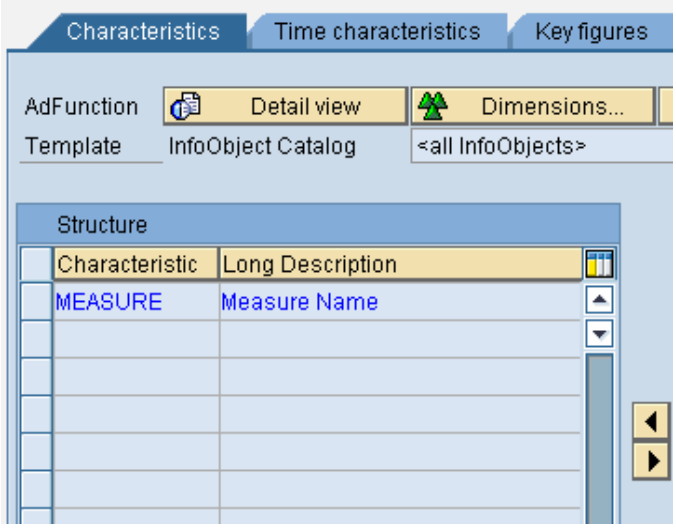


Figure A.3

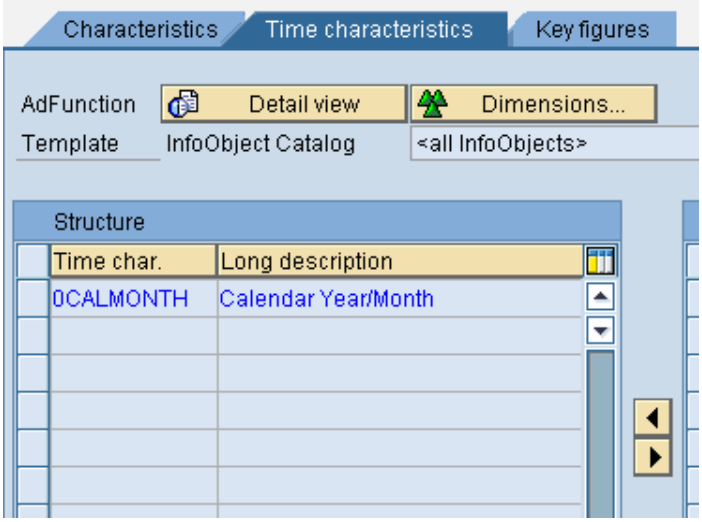
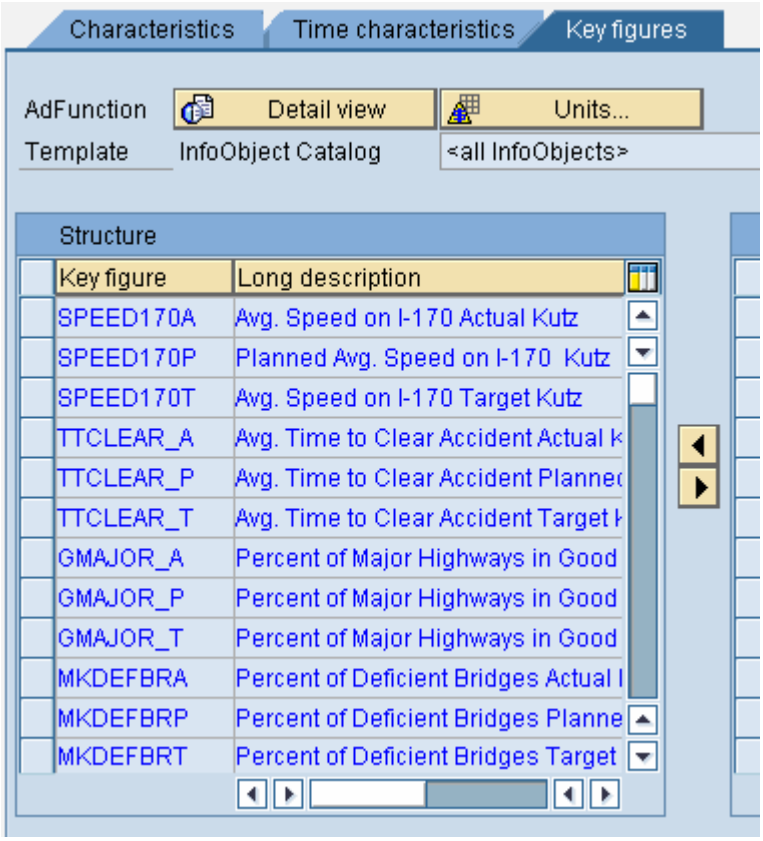


Figure A.4 is the third tab in the info cube, showing some of the key figures in the info cube. These key figures hold the data that would be presented in the Balanced Scorecard.

Figure A.4



Creating an info source, as shown in Figure A.5 below, is necessary to connect to an external source of data. In this case, the external source of data was an excel file that is shown later. Figure A.5 shows the info source, and Figure A.6 shows the info source connected to the info cube.

Figure A.5

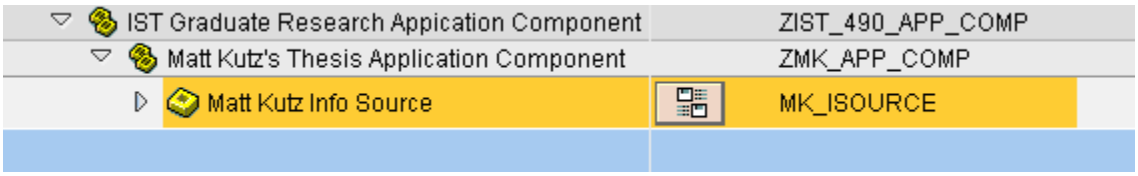
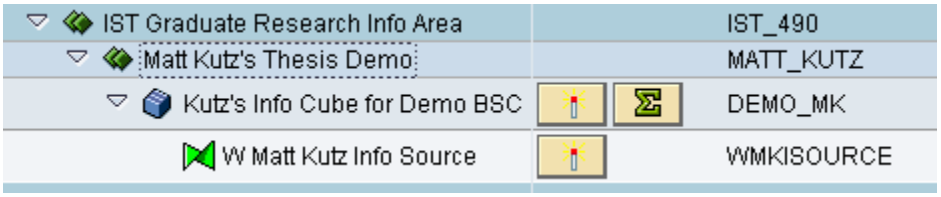
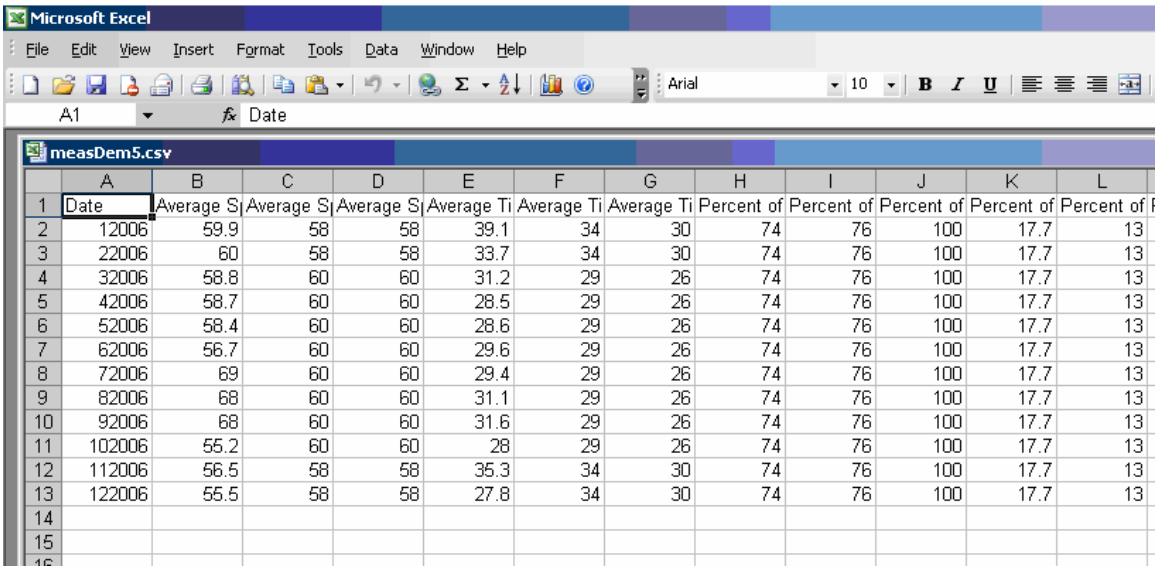


Figure A.6



Figures A.10 and A.11 are two screen shots of the data that was loaded into the info cube. The first is the data displayed in Excel. The second is a notepad view that shows the data in raw comma separated value format. Notice the leading zeros before the single digit months. This is necessary for accurate conversion to the SAP time characteristic used. Because Excel truncates leading zeros, the zeros were added using notepad.

Figure A.7



Microsoft Excel

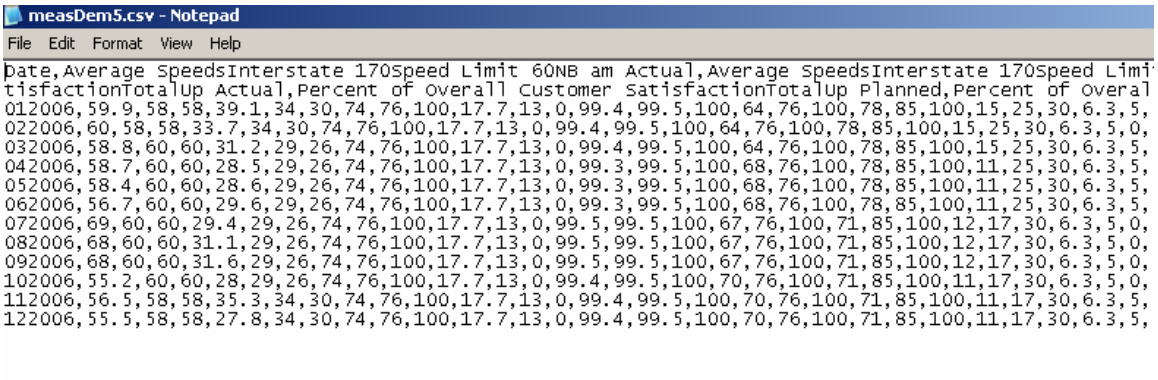
File Edit View Insert Format Tools Data Window Help

A1 Date

measDem5.csv

	A	B	C	D	E	F	G	H	I	J	K	L
1	Date	Average S	Average S	Average S	Average Ti	Average Ti	Average Ti	Percent of	Percent of	Percent of	Percent of	Percent of
2	12006	59.9	58	58	39.1	34	30	74	76	100	17.7	13
3	22006	60	58	58	33.7	34	30	74	76	100	17.7	13
4	32006	58.8	60	60	31.2	29	26	74	76	100	17.7	13
5	42006	58.7	60	60	28.5	29	26	74	76	100	17.7	13
6	52006	58.4	60	60	28.6	29	26	74	76	100	17.7	13
7	62006	56.7	60	60	29.6	29	26	74	76	100	17.7	13
8	72006	69	60	60	29.4	29	26	74	76	100	17.7	13
9	82006	68	60	60	31.1	29	26	74	76	100	17.7	13
10	92006	68	60	60	31.6	29	26	74	76	100	17.7	13
11	102006	55.2	60	60	28	29	26	74	76	100	17.7	13
12	112006	56.5	58	58	35.3	34	30	74	76	100	17.7	13
13	122006	55.5	58	58	27.8	34	30	74	76	100	17.7	13
14												
15												

Figure A.8



measDem5.csv - Notepad

File Edit Format View Help

```
Date,Average SpeedsInterstate 170Speed Limit 60NB am Actual,Average SpeedsInterstate 170Speed Limi
tisfactionTotalUp Actual,Percent of Overall Customer SatisfactionTotalUp Planned,Percent of Overal
012006,59.9,58,58,39.1,34,30,74,76,100,17.7,13,0,99.4,99.5,100,64,76,100,78,85,100,15,25,30,6.3,5,
022006,60,58,58,33.7,34,30,74,76,100,17.7,13,0,99.4,99.5,100,64,76,100,78,85,100,15,25,30,6.3,5,0,
032006,58.8,60,60,31.2,29,26,74,76,100,17.7,13,0,99.4,99.5,100,64,76,100,78,85,100,15,25,30,6.3,5,
042006,58.7,60,60,28.5,29,26,74,76,100,17.7,13,0,99.3,99.5,100,68,76,100,78,85,100,11,25,30,6.3,5,
052006,58.4,60,60,28.6,29,26,74,76,100,17.7,13,0,99.3,99.5,100,68,76,100,78,85,100,11,25,30,6.3,5,
062006,56.7,60,60,29.6,29,26,74,76,100,17.7,13,0,99.3,99.5,100,68,76,100,78,85,100,11,25,30,6.3,5,
072006,69,60,60,29.4,29,26,74,76,100,17.7,13,0,99.5,99.5,100,67,76,100,71,85,100,12,17,30,6.3,5,0,
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122006,55.5,58,58,27.8,34,30,74,76,100,17.7,13,0,99.4,99.5,100,70,76,100,71,85,100,11,17,30,6.3,5,
```

Figure A.9 is a screen shot of the results page after successfully loading the info cube. It summarizes the data about the Info Cube, including the Request number, the Application name, and the Info Source.

Figure A.9

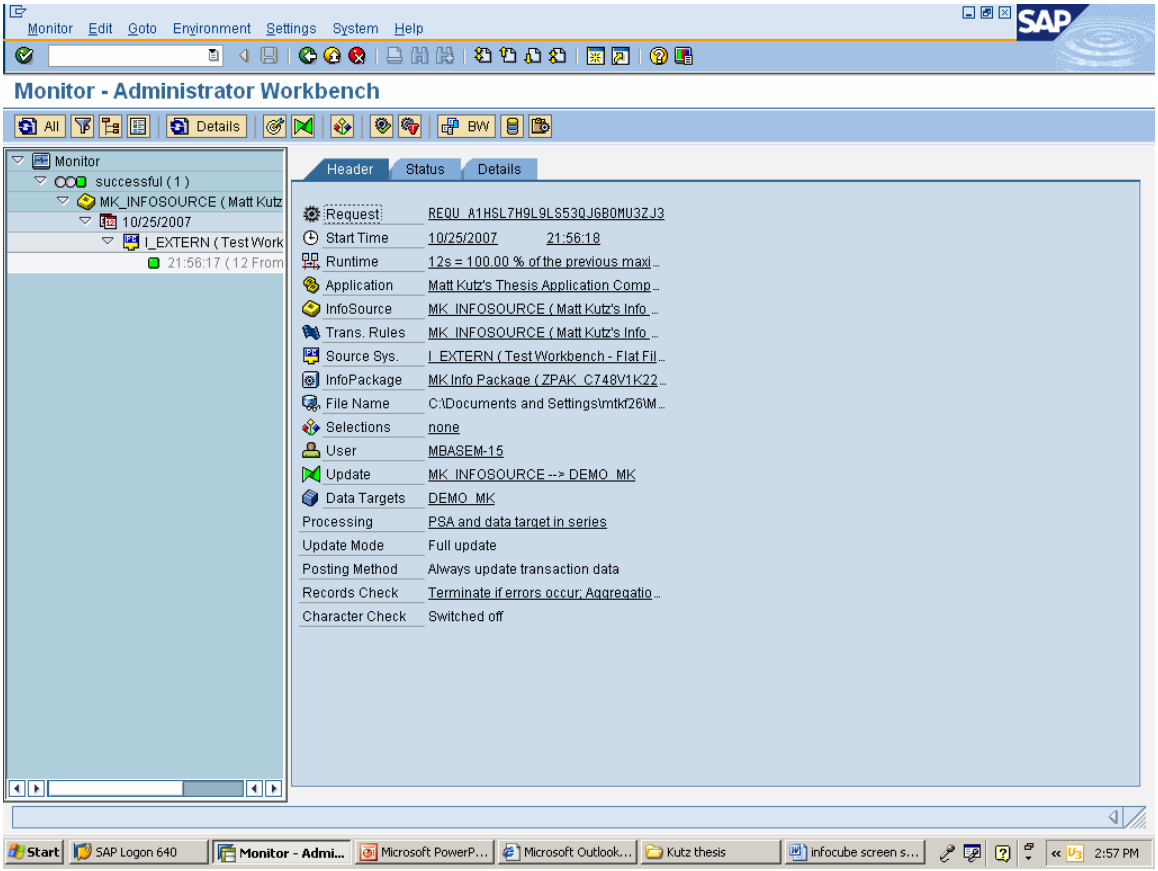


Figure A.10 is another screen shot of the green lights after loading the data. Figure A.11 is a shot of the data from the info cube after being loaded. Notice that the date characteristic reversed the order of the month and year as it loaded the data.

Figure A.10

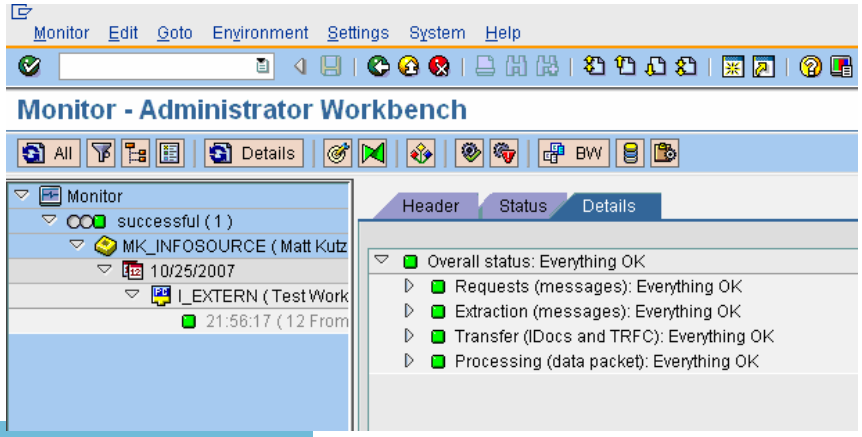
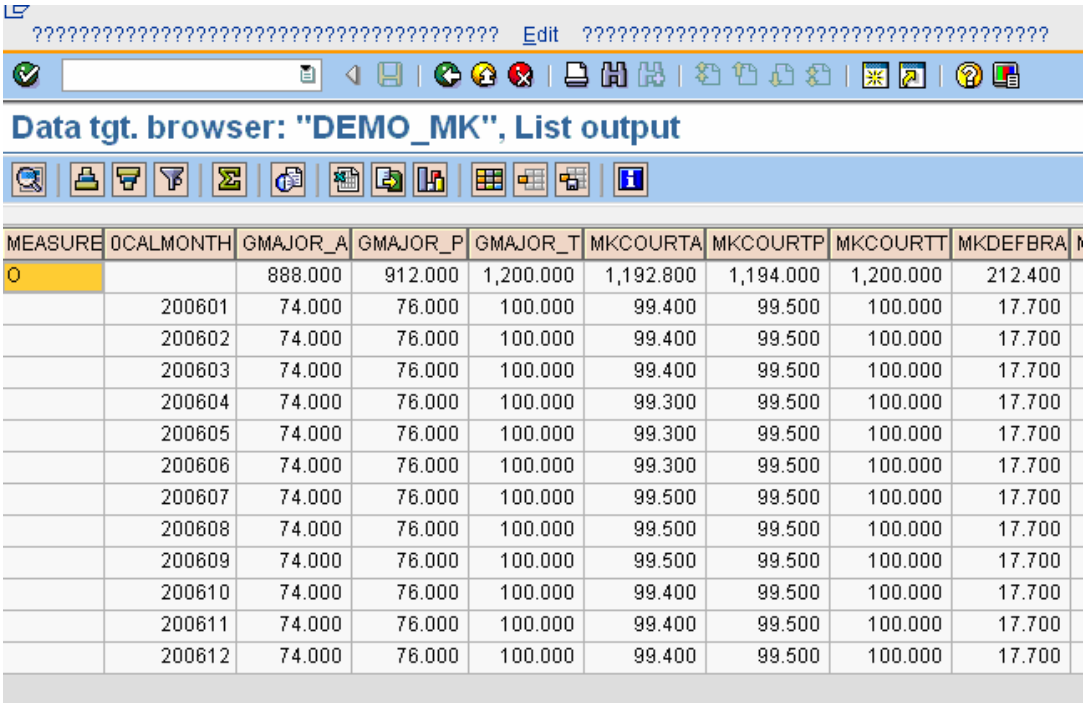


Figure A.11



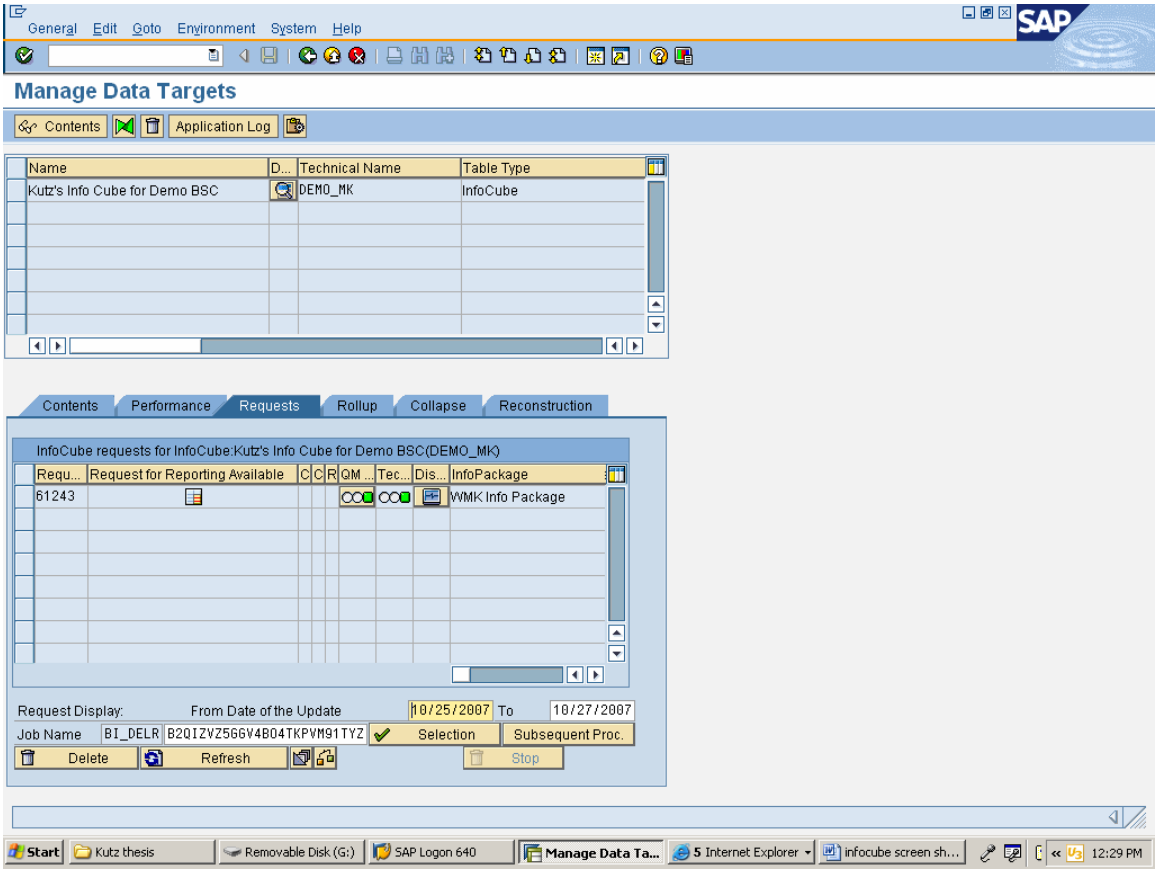
Edit

Data tgt. browser: "DEMO_MK", List output

MEASURE	0CALMONTH	GMAJOR_A	GMAJOR_P	GMAJOR_T	MKCOURTA	MKCOURTP	MKCOURTT	MKDEFBRA
0		888.000	912.000	1,200.000	1,192.800	1,194.000	1,200.000	212.400
	200601	74.000	76.000	100.000	99.400	99.500	100.000	17.700
	200602	74.000	76.000	100.000	99.400	99.500	100.000	17.700
	200603	74.000	76.000	100.000	99.400	99.500	100.000	17.700
	200604	74.000	76.000	100.000	99.300	99.500	100.000	17.700
	200605	74.000	76.000	100.000	99.300	99.500	100.000	17.700
	200606	74.000	76.000	100.000	99.300	99.500	100.000	17.700
	200607	74.000	76.000	100.000	99.500	99.500	100.000	17.700
	200608	74.000	76.000	100.000	99.500	99.500	100.000	17.700
	200609	74.000	76.000	100.000	99.500	99.500	100.000	17.700
	200610	74.000	76.000	100.000	99.400	99.500	100.000	17.700
	200611	74.000	76.000	100.000	99.400	99.500	100.000	17.700
	200612	74.000	76.000	100.000	99.400	99.500	100.000	17.700

One obstacle in loading the data was the presence of some requests for reporting with errors in the upload. In other words, attempts to upload the data that resulted in errors became a problem later. The requests with errors had to be deleted. After deleting that one, Figure A.12 shows the request for reporting is available.

Figure A.12



After loading the data, the Balanced Scorecard requires queries to use the data. Queries were made for each measure. Figure A.13 shows one query being made. Each query had three characteristics, actual, planned, and target data.

Figure A.13

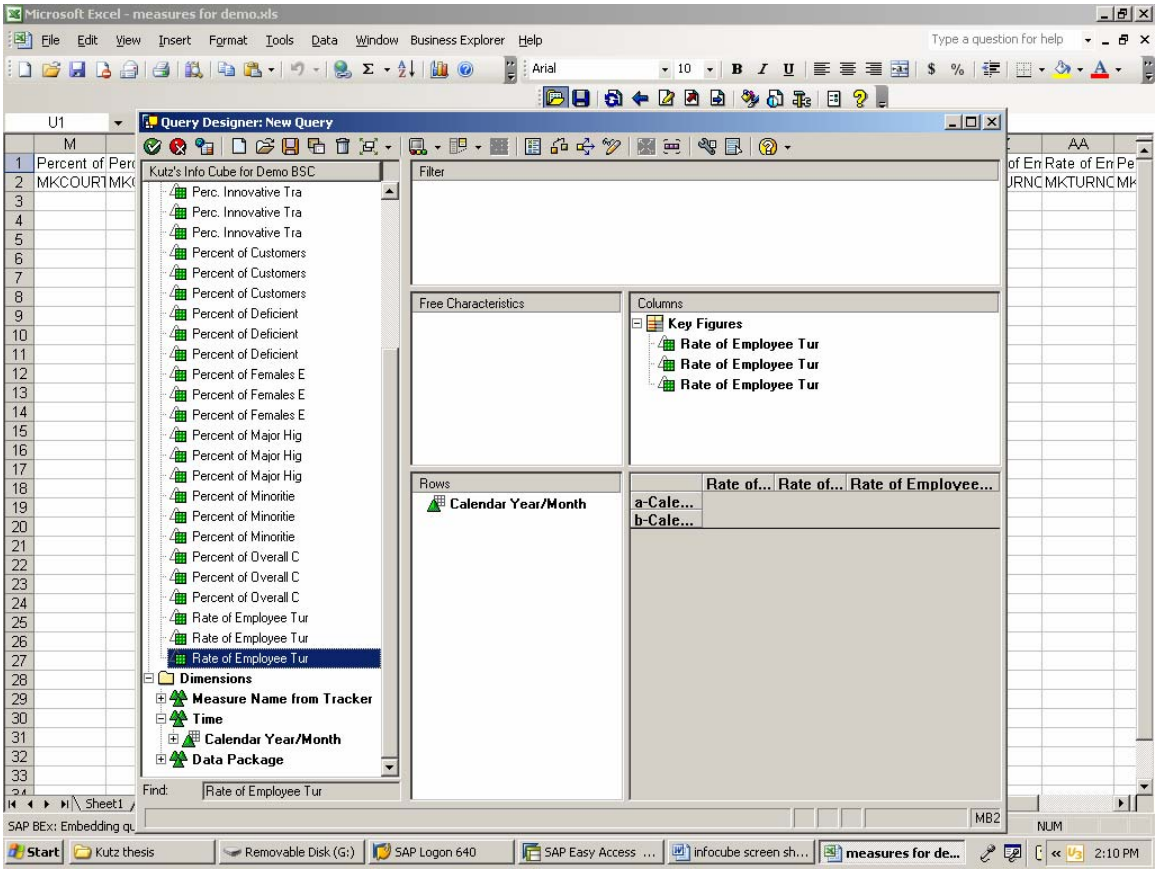
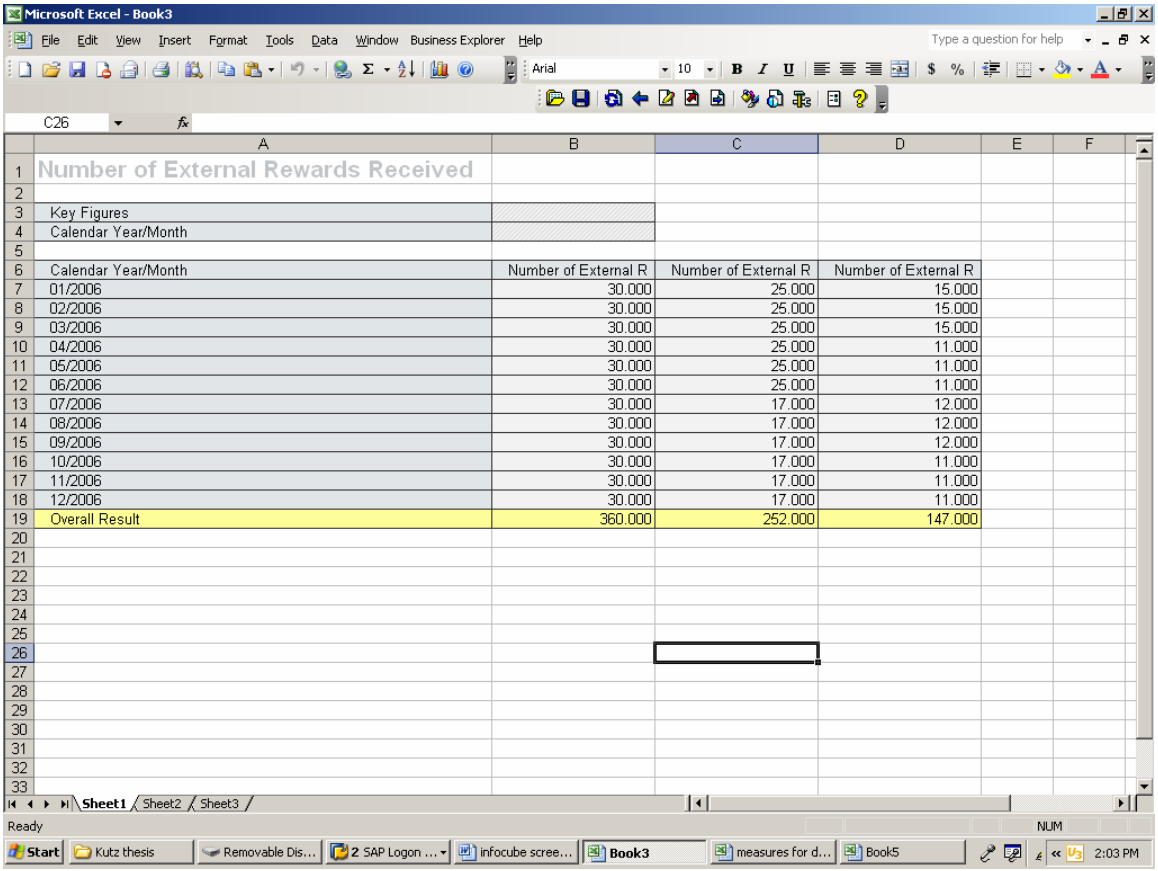


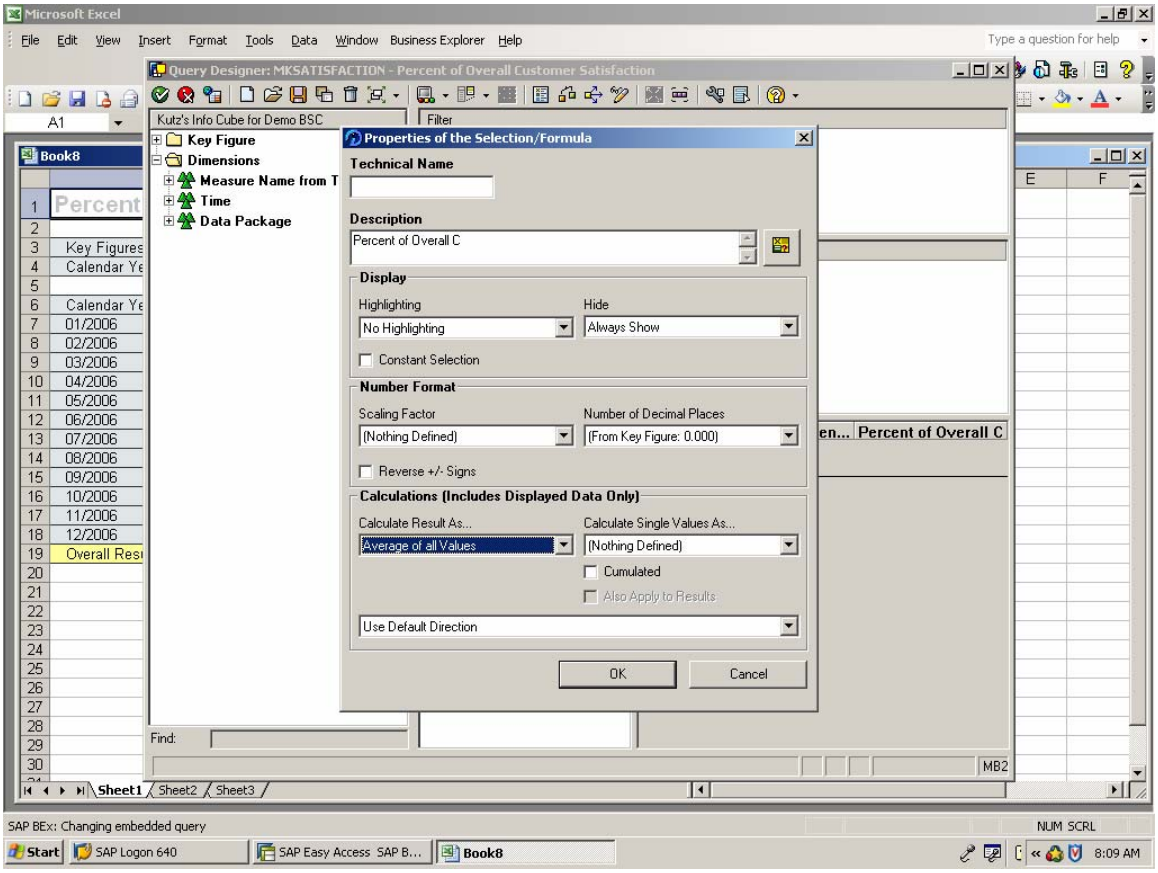
Figure A.14 is one of 11 queries that were made for the measures. Each query has three columns, one for target, one for planned, and one for actual data values. The overall row highlighted in yellow is a sum of the individual months. For most measures, this sum was changed to an average, which is what was to be presented in the Balanced Scorecard.

Figure A.14



To change the totals from a sum to an average after creating the query, right click on the characteristic or key figure and select properties. Then for Calculating Results As, choose average, as shown in Figure A.15. Hit OK and save the query. This overrides changes made to the key figure in the info cube.

Figure A.15



The info cube created for this study is very limited. Most info cubes have several characteristics that allow a user to choose data from the cube that meets criteria based on the various characteristics. This study needed all of the data in the cube and had no need to characterized the data.

APPENDIX B

CREATION OF THE BALANCED SCORECARD SAP PROTOTYPE

This appendix will show some details about how the Balanced Scorecard was created for this study. The SAP BW Balanced Scorecard application was used for this implementation. This application is found by following the path The steps used were 1) create the measures for the scorecard in the SAP Scorecard application 2) create the strategy, perspectives, and objectives to be used in the scorecard in the SAP Scorecard application 3) Create the Balanced Scorecard by inserting the created pieces, including the measures and measure details. Figure B.2 shows the opening screen for creating the measures, perspectives, objectives, strategies and Balanced Scorecard itself. This screen is reached by following the path shown in Figure B.1.

Figure B.1

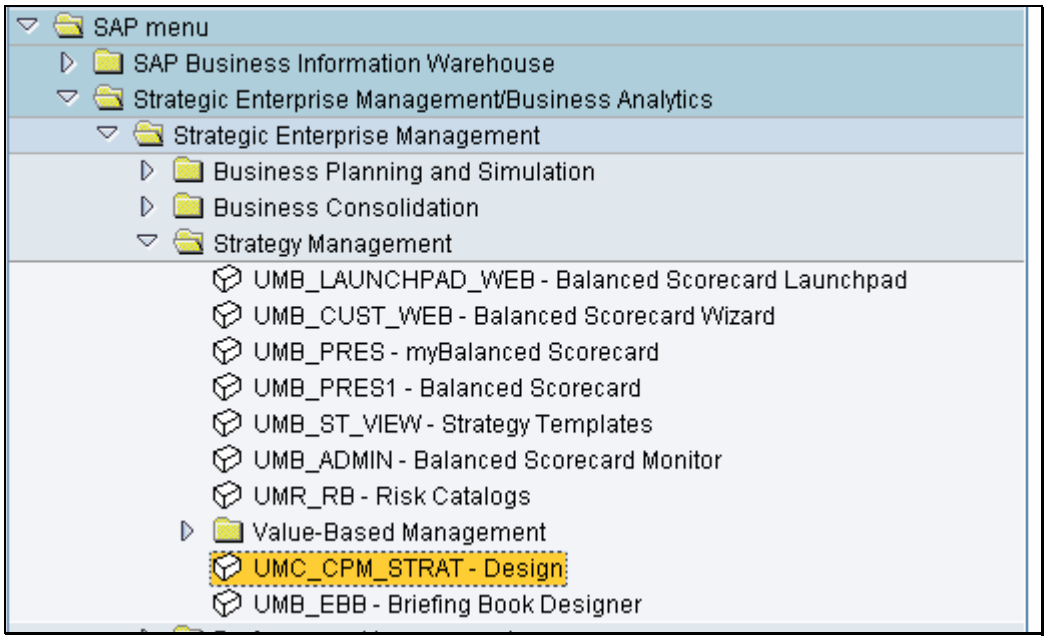


Figure B.2

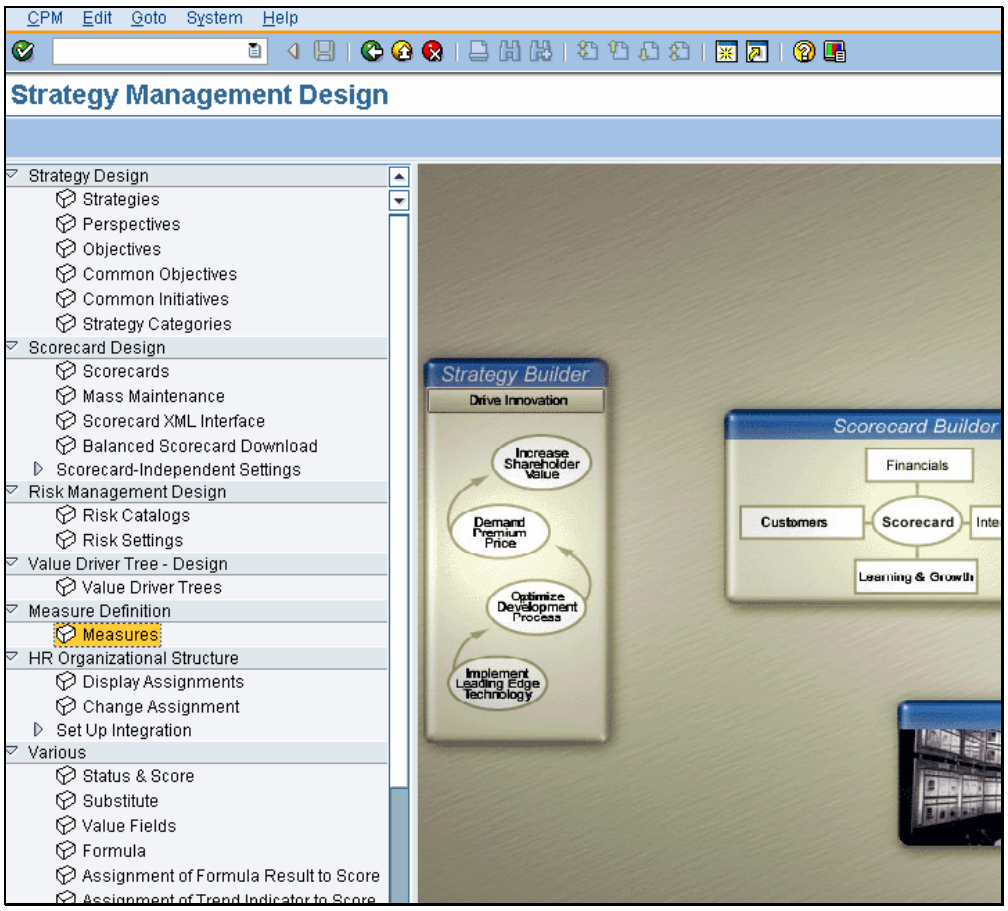
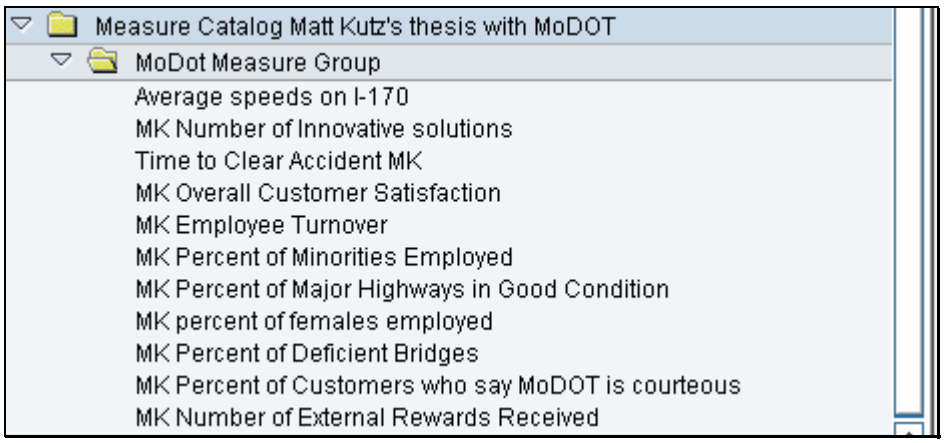


Figure B.3 shows a list of the measures created for this study. The SAP system had measures already created, but they were not specific enough for this study. The measures came directly from the MoDOT Tracker, the source of the data for the prototype.

Figure B.3



After creating the measure, in order to have data, it needs to be connected to an Info Cube. Figure B.4 shows the Data Source tab where the connection to the Info Cube is made. The list on the right shows the Info Cubes that have queries available to add to the measure. To add a query to the measure, simply drag the query and drop it in the area to the left.

Figure B.4

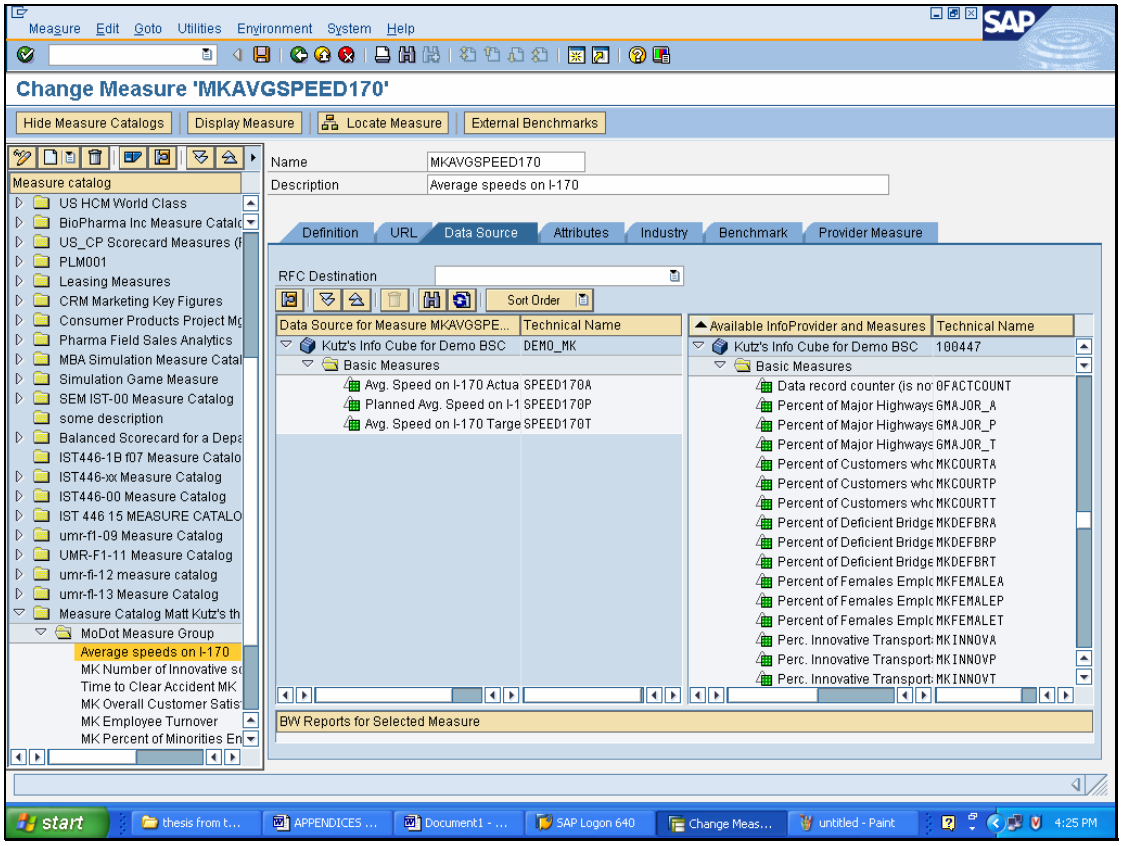
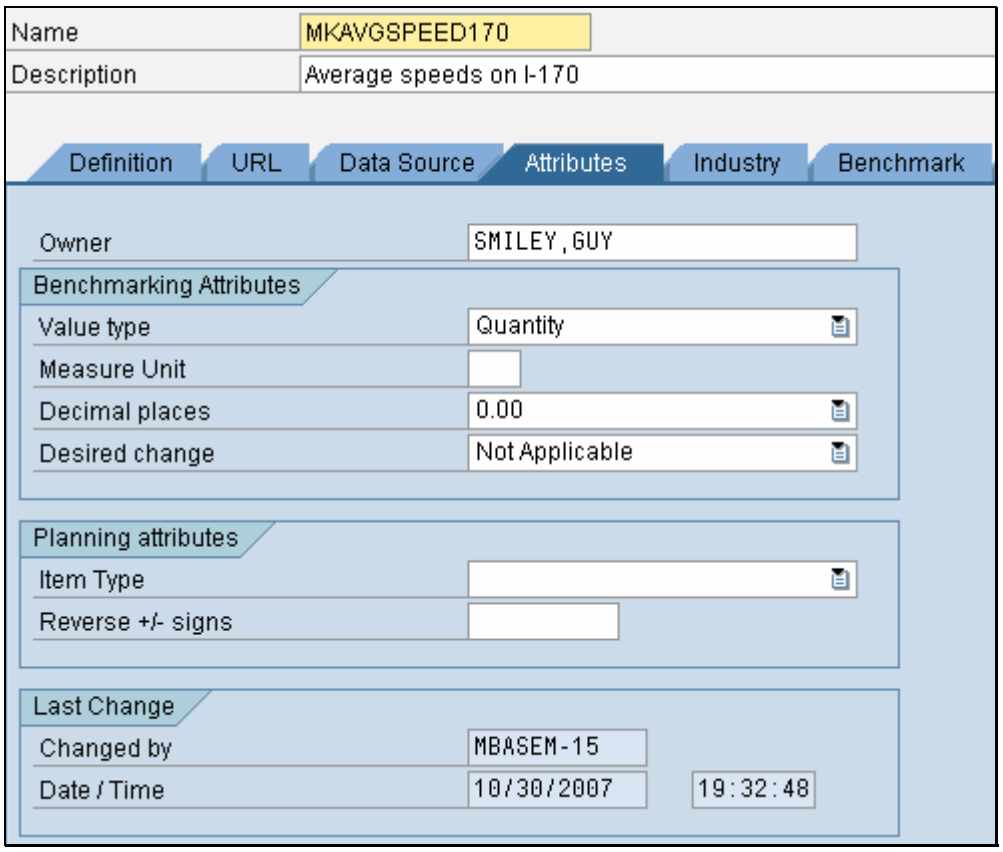


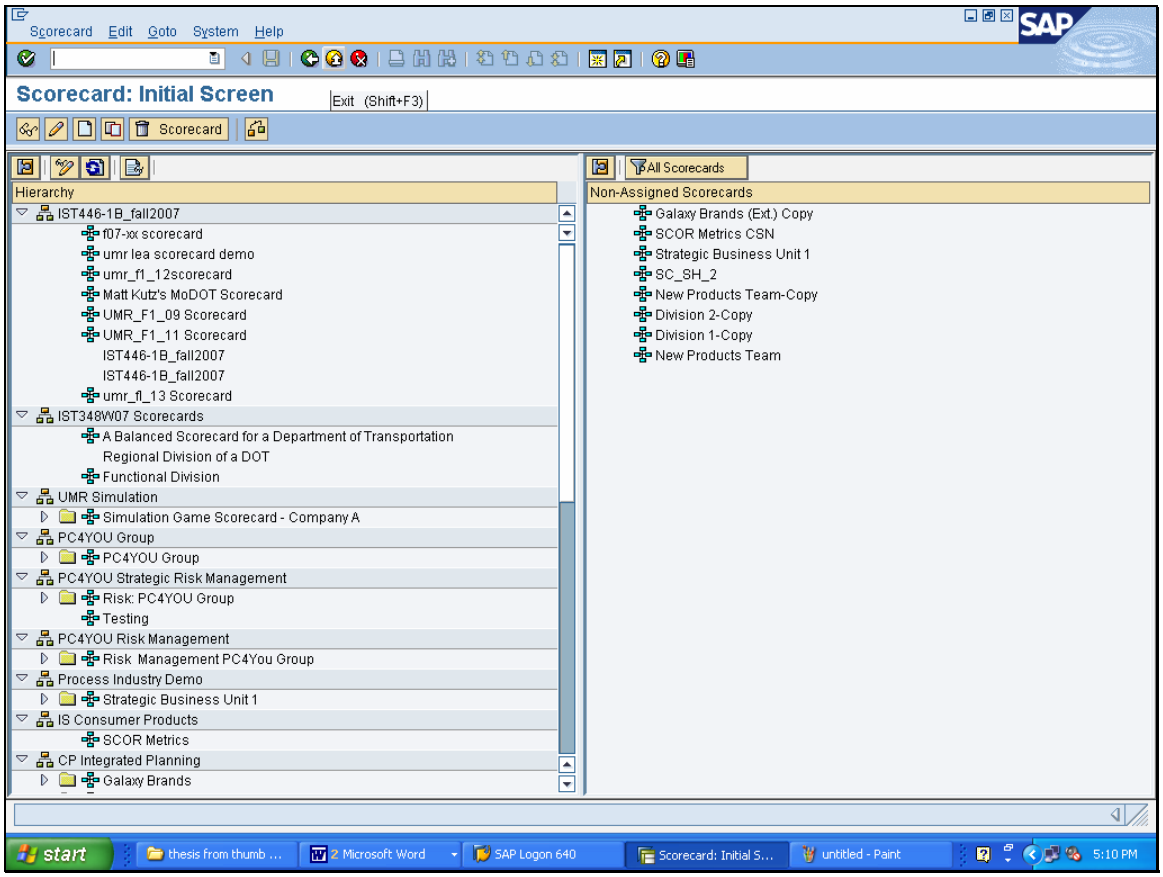
Figure B.5 shows the attributes tab where the owner is defined. This is also where the value type is defined that corresponds to the data in the data sources. The figure also shows the definition tab that, if selected, allows the user to write a definition of the measure.

Figure B.5



Many perspective, objectives, and strategies were selected from the items already present in the SAP system. For the few objectives not already present, they can be created similarly to creating measures, as described above. After all of these items are created, a Balanced Scorecard can be created. The beginning screen for creating a scorecard is shown in Figure B.6.

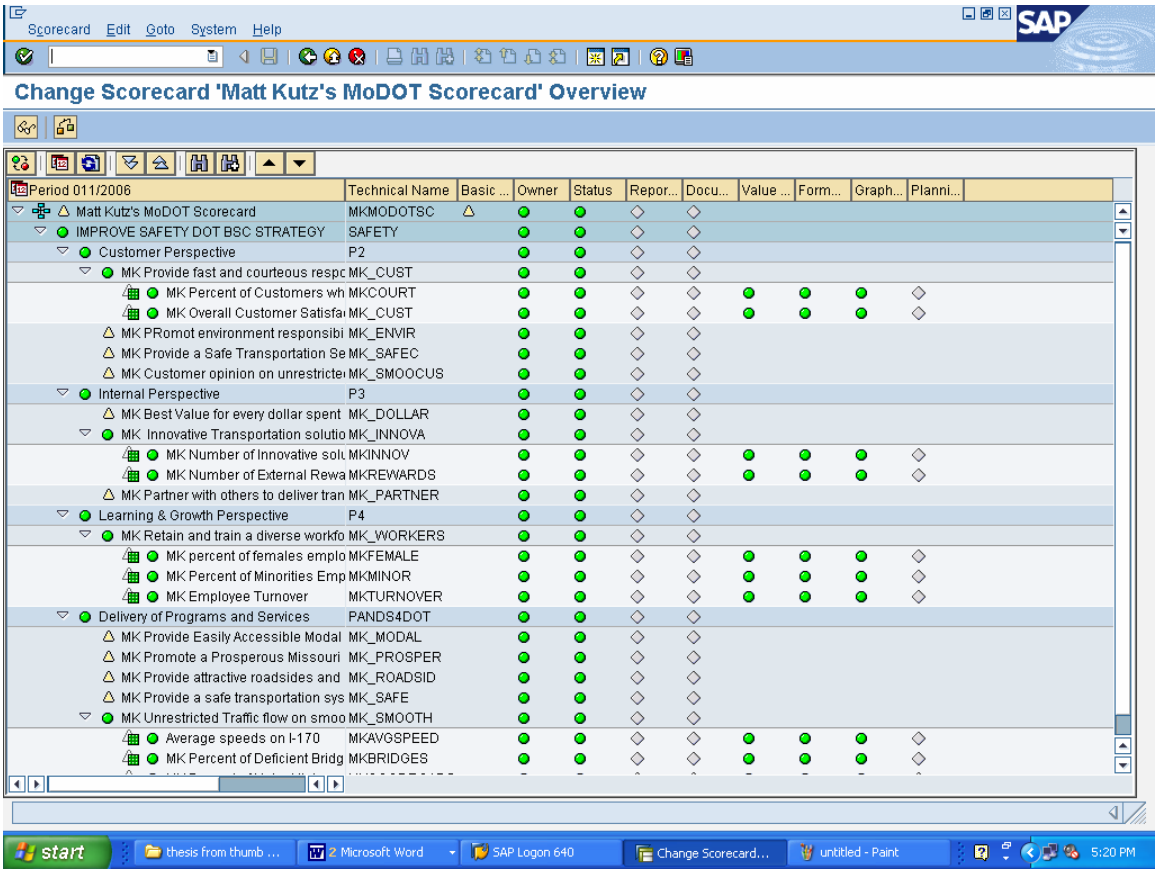
Figure B.6



After a scorecard is created, it will appear in the box on the right. Then it needs to be assigned to a hierarchy on the left. The scorecard created for this study is Matt Kutz's MoDOT Scorecard under the IST446-1B_fall2007 hierarchy.

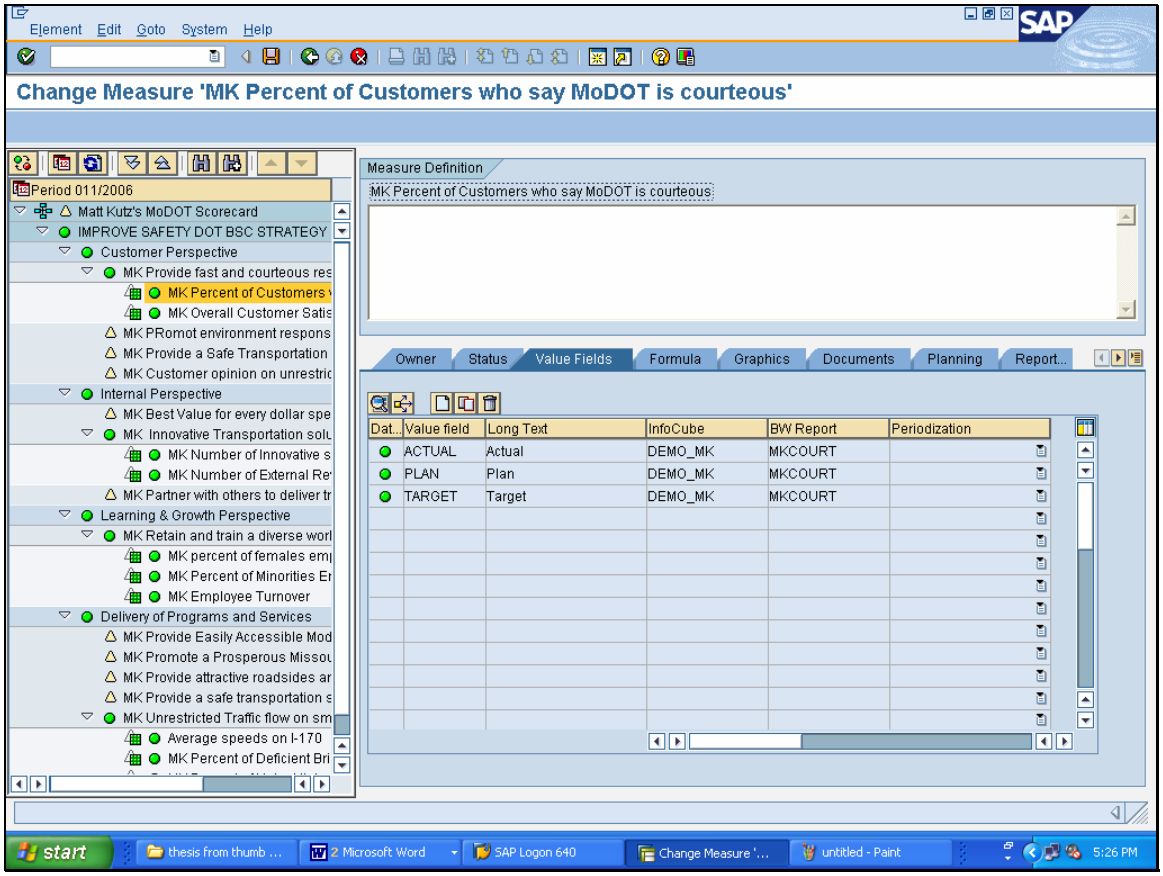
Figure B.7 shows the Scorecard Creation screen. SAP has green, yellow, and red signals to alert the user to items that need attention. As the figure shows, when the scorecard is complete, the signals should all be green.

Figure B.7



SAP wizards make collecting the parts of the scorecard very easy. After using a wizard to insert a measure, the user needs to define value fields based on the measure. The measures have built in queries from when they are created, as shown above. The user selects from these built in queries to determine what values the scorecard will show. The measures in this study all showed an actual value, a planned value, and a target value, as shown in Figure B.8.

Figure B.8



Figures B.9 and B.10 show two more aspects of creating a measure that are required by SAP. Figure B.9 shows the Formula tab, where the evaluation of the measure's values is determined. The user determines what values are excellent, good, need attention, bad, and should be stopped. Figure B.10 shows the Graphics screen, where the BSC creator can decide how the data is shown in graphic form. Several graph options are offered.

Figure B.9

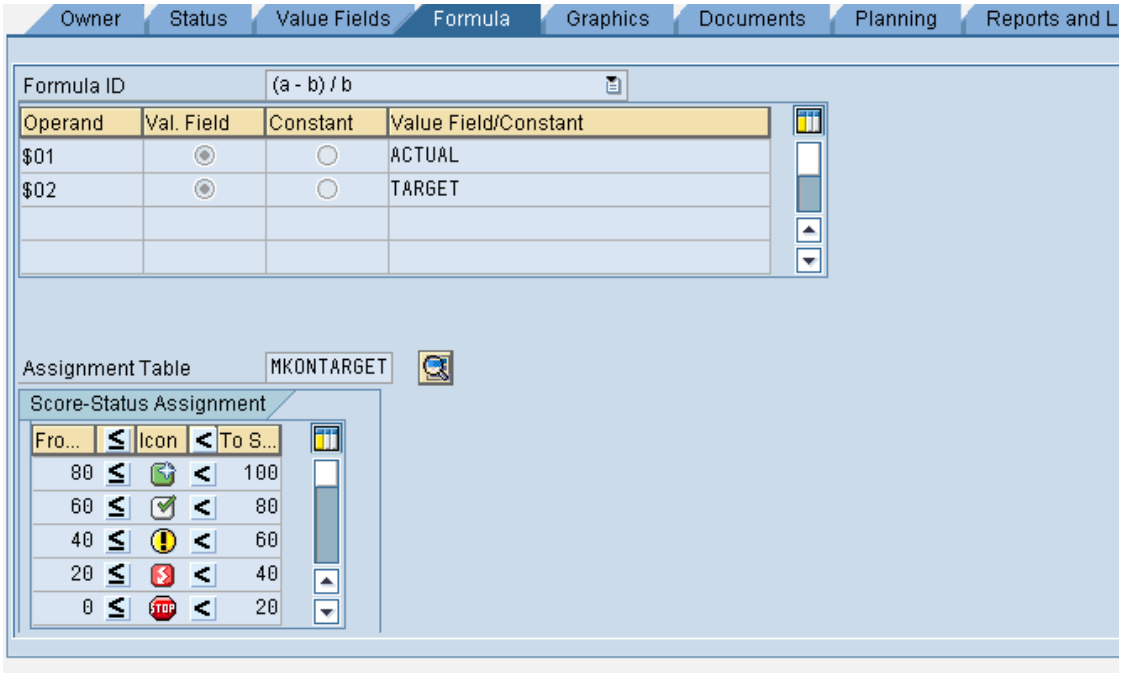
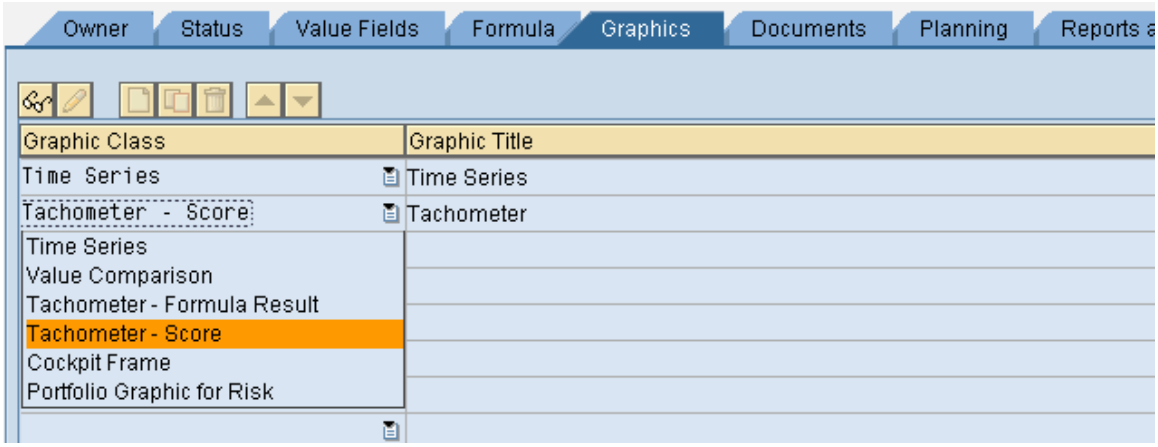
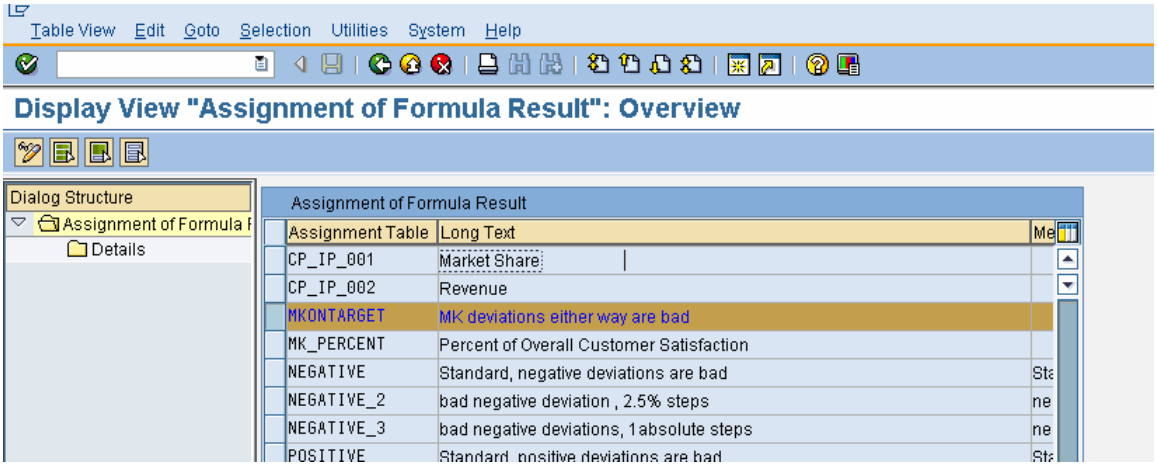


Figure B.10



When creating the formula that assigns an evaluation to a measure based on the measure's values, the creator of the scorecard can create a new "Assignment of Formula Result to Score" from the opening screen shown in Figure B.2. Figure B.11 shows two assignments created for this study.

Figure B.11



In most cases, every measure will have a formula that matches its raw data to a score that is evaluated by the BSC software. The BSC creator decides what performance is a good score for a particular measure. Then the formula maps that performance measure to scores that relate to the different BSC rankings.

APPENDIX C

SURVEY AND SUPPORTING MATERIALS

Exercises to precede survey questions

Improving Performance Measurement for Missouri's Department of Transportation

On-line published version of the Missouri's Department of Transportation (MoDOT) Tracker.

Go to MoDOT Tracker website. www.modot.org
On the left side of the screen, select the "About" button, then select **Tracker: Performance Measures** from the dropdown menu. You will see a table of contents linking you to the sections of the Tracker. Scroll down and you will see Tracker's from previous periods. Click on the Tracker from January 2007. *Don't spend more than 20 seconds answering any of these questions. This is not the survey, this is just an exercise to get you familiar with the format.*

How is MoDOT doing in the Uninterrupted Traffic Flow in October of 2006?

Who is in charge of a measure in this Uninterrupted Traffic Flow?

How is MoDOT doing in the Uninterrupted Traffic Flow in January of 2006?

How is MoDOT doing in the Advocate for Transportation Issues area in October of 2006?

How is MoDOT doing in the Advocate for Transportation Issues area in January of 2006?

Pull up the SAP window.

You will see four tables that illustrate four main goals of MoDOT. This is called a Balanced Scorecard. Notice the period selected is October 2006.

Each of the tables has a list of goals. Next to each goal is a symbol. A gray X means that goal has not been implemented. This is a prototype of what MoDOT's scorecard might look like. It is not complete. The other symbols mean something.

Click on the 'i' in the upper right section of the screen. That will tell you what the symbols mean.

Answer the following questions. If you have trouble, ask Matt.

How is MoDOT doing in the Delivery of Programs and Services area in October of 2006?

How is MoDOT doing in the Learning and Growth Perspective in October of 2006?

Change the period to January 2006.

How is MoDOT doing in the Delivery of Programs and Services area in January of 2006?

How is MoDOT doing in the Learning and Growth Perspective in January of 2006?

Click on the analysis button.

Expand the list of goals under MK Unrestricted Traffic Flow on smooth roads, at the bottom.
At which of the three goals under "MK Unrestricted Traffic Flow on smooth roads" is MoDOT doing the best?

The worst?

Change the period to April 2006.
Expand the list of goals under Provide unrestricted smooth roads.
How is MoDOT doing at Avg speeds on I-170 in April 2006 best?

One clarification on how this BSC works: The individual goal evaluations are combined to give the overall goal average. So the three goals under Provide Unrestricted smooth roads are averaged to give the evaluation of that goal.

A Performance Measurement System Software Prototype

Introduction:
This survey will give us an idea of how effective our prototype will be for MoDOT. Part of the purpose of reporting for MoDOT is to give the general public access to the information. You will be testing the availability of the information.

Demographic Information

1. What is your gender? _____ Female _____ Male

2. Please check your class status
   ___ Freshman
   ___ Sophomore
   ___ Junior
   ___ Senior
   ___ Graduate student

3. Please indicate your major (check all that applies)
   ___ Information Science and Technology
   ___ Business Administration
   ___ Other, please specify _____

4. Please indicate your experience level with SAP, the platform used to create the software prototype.

□ No experience at all □ less than average □ Average – have used SAP before □ better than average □ Expert

Please provide your feedback based on the software prototype demonstration and the on-line published formats:

The proposed software prototype is better than the published format at the following:

1. Finding performance measures of interest.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

2. Understanding the meaning of the performance measures.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

3. Providing a better means to track accountability (i.e. who is in charge of the measure)

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

4. Providing timeliness of information (the published format is published four times a year).

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

5. Providing overall data and results *interpretation*.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

6. Providing a better means to monitor performance.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

7. Presenting different information details for different interested parties for different purposes (i.e., users are provided with drill down capability to obtain more detailed information as needs arise).

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

8. Providing a better connection between performance measures and organizational strategies and goals.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

9. Ease of use.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

10. Providing a more user friendly user-interface.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

11. Providing an easier means to identify a causally linked relationship between performance measures.

□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

12. Please provide any additional comments that you may have about the proposed software prototype.

Survey Waiver Form

This survey will present two kinds of data presentation. You will become familiar with both and then answer 10 multiple choice questions about your experience. The survey will last about twenty minutes. For participating in the survey, you will receive bonus points toward your Java grade.

If you do not want to participate in this survey, you may earn the same number of bonus points by completing an additional program dealing with Linked Lists. The program would use a linked list that you created to store data. It would have methods to add and remove nodes, as well as sorting the data. If you want to exercise this option, please let Matt Kutz know and he will give you more details.

By signing below, I confirm that I am 18 years of age or older.

_____

Signature

APPENDIX D

STATISTICAL EVALUATIONS OF SURVEY RESULTS

One-way ANOVA Results

Question 1 Finding performance measures of interest.

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	7	2.14	1.464	.553	.79	3.50	1	4
	2	21	1.57	1.076	.235	1.08	2.06	1	4
	3	3	1.00	.000	.000	1.00	1.00	1	1
	4	1	4.00	.	.	.	.	4	4
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	7	2.00	1.414	.535	.69	3.31	1	5
	2	21	2.14	1.558	.340	1.43	2.85	1	6
	3	3	2.00	1.732	1.000	-2.30	6.30	1	4
	4	1	6.00	.	.	.	.	6	6
	5	1	1.00	.	.	.	.	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	7	3.43	1.134	.429	2.38	4.48	2	5
	2	21	3.19	1.209	.264	2.64	3.74	2	5
	3	3	3.00	.000	.000	3.00	3.00	3	3
	4	1	5.00	.	.	.	.	5	5
	5	1	2.00	.	.	.	.	2	2
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	7	1.29	.488	.184	.83	1.74	1	2
	2	21	1.14	.359	.078	.98	1.31	1	2
	3	3	1.33	.577	.333	-.10	2.77	1	2
	4	1	1.00	.	.	.	.	1	1
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	8.970	4	2.242	1.744	.168
	Within Groups	36.000	28	1.286		
	Total	44.970	32			
Major	Between Groups	16.338	4	4.084	1.718	.174
	Within Groups	66.571	28	2.378		
	Total	82.909	32			
class	Between Groups	5.108	4	1.277	.968	.441
	Within Groups	36.952	28	1.320		
	Total	42.061	32			
gender	Between Groups	.242	4	.061	.364	.832
	Within Groups	4.667	28	.167		
	Total	4.909	32			

Question 2 Understanding the meaning of the performance measures.

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	11	2.09	1.300	.392	1.22	2.96	1	4
	2	12	1.75	1.357	.392	.89	2.61	1	4
	3	7	1.29	.756	.286	.59	1.98	1	3
	4	2	1.00	.000	.000	1.00	1.00	1	1
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	11	2.55	1.864	.562	1.29	3.80	1	6
	2	12	2.58	1.782	.514	1.45	3.72	1	6
	3	7	1.29	.488	.184	.83	1.74	1	2
	4	2	1.50	.707	.500	-4.85	7.85	1	2
	5	1	1.00	.	.	.	.	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
Class	1	11	3.45	1.214	.366	2.64	4.27	2	5
	2	12	3.17	1.267	.366	2.36	3.97	2	5
	3	7	3.29	1.113	.421	2.26	4.31	2	5
	4	2	3.00	.000	.000	3.00	3.00	3	3
	5	1	2.00	.	.	.	.	2	2
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
Gender	1	11	1.18	.405	.122	.91	1.45	1	2
	2	12	1.25	.452	.131	.96	1.54	1	2
	3	7	1.14	.378	.143	.79	1.49	1	2
	4	2	1.00	.000	.000	1.00	1.00	1	1
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	4.382	4	1.096	.756	.563
	Within Groups	40.588	28	1.450		
	Total	44.970	32			
Major	Between Groups	11.337	4	2.834	1.109	.372
	Within Groups	71.573	28	2.556		
	Total	82.909	32			
Class	Between Groups	2.238	4	.560	.393	.812
	Within Groups	39.823	28	1.422		
	Total	42.061	32			
Gender	Between Groups	.166	4	.041	.244	.911
	Within Groups	4.744	28	.169		
	Total	4.909	32			

Question 3 Providing a better means to track accountability (i.e. who is in charge of the measure)

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	9	2.33	1.323	.441	1.32	3.35	1	4
	2	13	1.62	1.193	.331	.89	2.34	1	4
	3	7	1.00	.000	.000	1.00	1.00	1	1
	4	2	2.50	2.121	1.500	-16.56	21.56	1	4
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	9	1.78	.972	.324	1.03	2.52	1	4
	2	13	2.62	1.938	.538	1.44	3.79	1	6
	3	7	1.71	1.113	.421	.69	2.74	1	4
	4	2	3.50	3.536	2.500	-28.27	35.27	1	6
	5	2	1.50	.707	.500	-4.85	7.85	1	2
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	9	3.56	1.236	.412	2.61	4.51	2	5
	2	13	3.46	1.127	.312	2.78	4.14	2	5
	3	7	2.71	.756	.286	2.02	3.41	2	4
	4	2	3.50	2.121	1.500	-15.56	22.56	2	5
	5	2	2.00	.000	.000	2.00	2.00	2	2
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	9	1.11	.333	.111	.85	1.37	1	2
	2	13	1.15	.376	.104	.93	1.38	1	2
	3	7	1.29	.488	.184	.83	1.74	1	2
	4	2	1.50	.707	.500	-4.85	7.85	1	2
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	9.393	4	2.348	1.848	.148
	Within Groups	35.577	28	1.271		
	Total	44.970	32			
Major	Between Groups	9.848	4	2.462	.944	.453
	Within Groups	73.061	28	2.609		
	Total	82.909	32			
class	Between Groups	6.679	4	1.670	1.321	.286
	Within Groups	35.382	28	1.264		
	Total	42.061	32			
gender	Between Groups	.399	4	.100	.620	.652
	Within Groups	4.510	28	.161		
	Total	4.909	32			

Question 4 Providing timeliness of information (the published format is published four times a year)

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	11	2.09	1.300	.392	1.22	2.96	1	4
	2	14	1.36	.929	.248	.82	1.89	1	4
	3	7	1.86	1.464	.553	.50	3.21	1	4
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	11	2.73	1.737	.524	1.56	3.89	1	6
	2	14	1.93	1.439	.385	1.10	2.76	1	6
	3	7	2.00	1.826	.690	.31	3.69	1	6
	5	1	1.00	.	.	.	.	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	11	3.45	1.214	.366	2.64	4.27	2	5
	2	14	3.21	1.051	.281	2.61	3.82	2	5
	3	7	3.14	1.345	.508	1.90	4.39	2	5
	5	1	2.00	.	.	.	.	2	2
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	11	1.18	.405	.122	.91	1.45	1	2
	2	14	1.21	.426	.114	.97	1.46	1	2
	3	7	1.14	.378	.143	.79	1.49	1	2
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	3.989	3	1.330	.941	.434
	Within Groups	40.981	29	1.413		
	Total	44.970	32			
Major	Between Groups	5.799	3	1.933	.727	.544
	Within Groups	77.110	29	2.659		
	Total	82.909	32			
class	Between Groups	2.119	3	.706	.513	.677
	Within Groups	39.942	29	1.377		
	Total	42.061	32			
gender	Between Groups	.058	3	.019	.116	.950
	Within Groups	4.851	29	.167		
	Total	4.909	32			

Question 5 Providing overall data and results interpretation

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	9	2.56	1.509	.503	1.40	3.72	1	4
	2	18	1.50	.985	.232	1.01	1.99	1	4
	3	2	1.00	.000	.000	1.00	1.00	1	1
	4	2	1.00	.000	.000	1.00	1.00	1	1
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	9	2.44	2.007	.669	.90	3.99	1	6
	2	18	2.06	1.514	.357	1.30	2.81	1	6
	3	2	3.00	1.414	1.000	-9.71	15.71	2	4
	4	2	2.50	2.121	1.500	-16.56	21.56	1	4
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	9	3.89	1.269	.423	2.91	4.86	2	5
	2	18	3.11	1.079	.254	2.57	3.65	2	5
	3	2	2.50	.707	.500	-3.85	8.85	2	3
	4	2	2.50	.707	.500	-3.85	8.85	2	3
	5	2	3.00	1.414	1.000	-9.71	15.71	2	4
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	9	1.22	.441	.147	.88	1.56	1	2
	2	18	1.11	.323	.076	.95	1.27	1	2
	3	2	1.50	.707	.500	-4.85	7.85	1	2
	4	2	1.50	.707	.500	-4.85	7.85	1	2
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	10.247	4	2.562	2.066	.112
	Within Groups	34.722	28	1.240		
	Total	44.970	32			
Major	Between Groups	5.242	4	1.311	.472	.755
	Within Groups	77.667	28	2.774		
	Total	82.909	32			
class	Between Groups	6.394	4	1.598	1.255	.311
	Within Groups	35.667	28	1.274		
	Total	42.061	32			
gender	Between Groups	.576	4	.144	.930	.461
	Within Groups	4.333	28	.155		
	Total	4.909	32			

Question 6 Providing a better means to monitor performance

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	11	2.18	1.401	.423	1.24	3.12	1	4
	2	16	1.50	1.095	.274	.92	2.08	1	4
	3	3	1.67	1.155	.667	-1.20	4.54	1	3
	4	2	1.00	.000	.000	1.00	1.00	1	1
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	11	1.91	1.375	.415	.99	2.83	1	5
	2	16	2.38	1.708	.427	1.46	3.29	1	6
	3	3	3.33	2.309	1.333	-2.40	9.07	2	6
	4	2	1.00	.000	.000	1.00	1.00	1	1
	5	1	1.00	.	.	.	.	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	11	3.64	1.286	.388	2.77	4.50	2	5
	2	16	3.06	.998	.249	2.53	3.59	2	5
	3	3	3.33	1.528	.882	-.46	7.13	2	5
	4	2	3.00	1.414	1.000	-9.71	15.71	2	4
	5	1	2.00	.	.	.	.	2	2
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	11	1.18	.405	.122	.91	1.45	1	2
	2	16	1.19	.403	.101	.97	1.40	1	2
	3	3	1.33	.577	.333	-.10	2.77	1	2
	4	2	1.00	.000	.000	1.00	1.00	1	1
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	4.667	4	1.167	.811	.529
	Within Groups	40.303	28	1.439		
	Total	44.970	32			
Major	Between Groups	9.583	4	2.396	.915	.469
	Within Groups	73.326	28	2.619		
	Total	82.909	32			
class	Between Groups	3.911	4	.978	.718	.587
	Within Groups	38.150	28	1.362		
	Total	42.061	32			
gender	Between Groups	.169	4	.042	.249	.908
	Within Groups	4.741	28	.169		
	Total	4.909	32			

Question 7 Presenting different information details for different interested parties for different purposes (i.e., users are provided with drill down capability to obtain more detailed information as needs arise).

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	6	2.67	1.366	.558	1.23	4.10	1	4
	2	17	1.35	.996	.242	.84	1.87	1	4
	3	9	1.44	.882	.294	.77	2.12	1	3
	4	1	4.00	.	.	.	.	4	4
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	6	1.67	1.211	.494	.40	2.94	1	4
	2	17	2.24	1.562	.379	1.43	3.04	1	6
	3	9	2.00	1.581	.527	.78	3.22	1	6
	4	1	6.00	.	.	.	.	6	6
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	6	4.17	1.169	.477	2.94	5.39	2	5
	2	17	3.00	1.000	.243	2.49	3.51	2	5
	3	9	2.89	1.054	.351	2.08	3.70	2	5
	4	1	5.00	.	.	.	.	5	5
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	6	1.00	.000	.000	1.00	1.00	1	1
	2	17	1.29	.470	.114	1.05	1.54	1	2
	3	9	1.11	.333	.111	.85	1.37	1	2
	4	1	1.00	.	.	.	.	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	13.532	3	4.511	4.161	.014
	Within Groups	31.438	29	1.084		
	Total	44.970	32			
Major	Between Groups	16.517	3	5.506	2.405	.088
	Within Groups	66.392	29	2.289		
	Total	82.909	32			
class	Between Groups	10.338	3	3.446	3.150	.040
	Within Groups	31.722	29	1.094		
	Total	42.061	32			
gender	Between Groups	.491	3	.164	1.074	.376
	Within Groups	4.418	29	.152		
	Total	4.909	32			

Question 8 Providing a better connection between performance measures and organizational strategies and goals

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	5	2.80	1.643	.735	.76	4.84	1	4
	2	15	1.60	1.056	.273	1.02	2.18	1	4
	3	11	1.45	1.036	.312	.76	2.15	1	4
	4	1	1.00	.	.	.	.	1	1
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	5	2.60	2.302	1.030	-.26	5.46	1	6
	2	15	2.47	1.552	.401	1.61	3.33	1	6
	3	11	1.73	1.489	.449	.73	2.73	1	6
	4	1	2.00	.	.	.	.	2	2
	5	1	1.00	.	.	.	.	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	5	4.20	1.095	.490	2.84	5.56	3	5
	2	15	3.20	1.014	.262	2.64	3.76	2	5
	3	11	2.82	1.250	.377	1.98	3.66	2	5
	4	1	3.00	.	.	.	.	3	3
	5	1	4.00	.	.	.	.	4	4
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	5	1.20	.447	.200	.64	1.76	1	2
	2	15	1.07	.258	.067	.92	1.21	1	2
	3	11	1.27	.467	.141	.96	1.59	1	2
	4	1	2.00	.	.	.	.	2	2
	5	1	1.00	.	.	.	.	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	7.842	4	1.961	1.479	.235
	Within Groups	37.127	28	1.326		
	Total	44.970	32			
Major	Between Groups	5.794	4	1.448	.526	.718
	Within Groups	77.115	28	2.754		
	Total	82.909	32			
class	Between Groups	7.224	4	1.806	1.452	.243
	Within Groups	34.836	28	1.244		
	Total	42.061	32			
gender	Between Groups	.994	4	.248	1.777	.162
	Within Groups	3.915	28	.140		
	Total	4.909	32			

Question 9 Ease of use.

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	9	2.00	1.225	.408	1.06	2.94	1	4
	2	9	2.00	1.500	.500	.85	3.15	1	4
	3	6	1.00	.000	.000	1.00	1.00	1	1
	4	6	1.83	1.329	.543	.44	3.23	1	4
	5	3	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	9	2.89	1.691	.564	1.59	4.19	1	6
	2	9	1.89	1.616	.539	.65	3.13	1	6
	3	6	1.67	1.211	.494	.40	2.94	1	4
	4	6	2.67	1.966	.803	.60	4.73	1	6
	5	3	1.00	.000	.000	1.00	1.00	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	9	3.67	1.000	.333	2.90	4.44	2	5
	2	9	3.33	1.414	.471	2.25	4.42	2	5
	3	6	2.50	.548	.224	1.93	3.07	2	3
	4	6	3.50	1.225	.500	2.21	4.79	2	5
	5	3	2.67	1.155	.667	-.20	5.54	2	4
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	9	1.11	.333	.111	.85	1.37	1	2
	2	9	1.11	.333	.111	.85	1.37	1	2
	3	6	1.33	.516	.211	.79	1.88	1	2
	4	6	1.33	.516	.211	.79	1.88	1	2
	5	3	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	6.136	4	1.534	1.106	.373
	Within Groups	38.833	28	1.387		
	Total	44.970	32			
Major	Between Groups	12.465	4	3.116	1.239	.317
	Within Groups	70.444	28	2.516		
	Total	82.909	32			
class	Between Groups	6.394	4	1.598	1.255	.311
	Within Groups	35.667	28	1.274		
	Total	42.061	32			
gender	Between Groups	.465	4	.116	.732	.578
	Within Groups	4.444	28	.159		
	Total	4.909	32			

Question 10 Providing a more user friendly user-interface

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	9	2.33	1.323	.441	1.32	3.35	1	4
	2	9	1.33	1.000	.333	.56	2.10	1	4
	3	9	1.00	.000	.000	1.00	1.00	1	1
	4	4	3.00	1.414	.707	.75	5.25	1	4
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	9	2.78	1.787	.596	1.40	4.15	1	6
	2	9	2.00	1.581	.527	.78	3.22	1	6
	3	9	1.67	1.000	.333	.90	2.44	1	4
	4	4	3.00	2.449	1.225	-.90	6.90	1	6
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	9	4.00	.866	.289	3.33	4.67	3	5
	2	9	2.67	1.000	.333	1.90	3.44	2	5
	3	9	2.56	.726	.242	2.00	3.11	2	4
	4	4	4.50	1.000	.500	2.91	6.09	3	5
	5	2	3.00	1.414	1.000	-9.71	15.71	2	4
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	9	1.11	.333	.111	.85	1.37	1	2
	2	9	1.11	.333	.111	.85	1.37	1	2
	3	9	1.22	.441	.147	.88	1.56	1	2
	4	4	1.50	.577	.289	.58	2.42	1	2
	5	2	1.00	.000	.000	1.00	1.00	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	16.970	4	4.242	4.242	.008
	Within Groups	28.000	28	1.000		
	Total	44.970	32			
Major	Between Groups	11.354	4	2.838	1.111	.371
	Within Groups	71.556	28	2.556		
	Total	82.909	32			
class	Between Groups	18.838	4	4.710	5.679	.002
	Within Groups	23.222	28	.829		
	Total	42.061	32			
gender	Between Groups	.576	4	.144	.930	.461
	Within Groups	4.333	28	.155		
	Total	4.909	32			

Question 11 Providing an easier means to identify a causally linked relationship between performance measures

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SAP_exp	1	7	2.86	1.345	.508	1.61	4.10	1	4
	2	16	1.50	1.095	.274	.92	2.08	1	4
	3	9	1.22	.667	.222	.71	1.73	1	3
	4	1	1.00	.	.	.	.	1	1
	Total	33	1.70	1.185	.206	1.28	2.12	1	4
Major	1	7	3.57	2.225	.841	1.51	5.63	1	6
	2	16	1.88	1.360	.340	1.15	2.60	1	6
	3	9	1.78	.972	.324	1.03	2.52	1	4
	4	1	1.00	.	.	.	.	1	1
	Total	33	2.18	1.610	.280	1.61	2.75	1	6
class	1	7	4.29	.951	.360	3.41	5.17	3	5
	2	16	3.00	1.033	.258	2.45	3.55	2	5
	3	9	2.78	1.093	.364	1.94	3.62	2	5
	4	1	4.00	.	.	.	.	4	4
	Total	33	3.24	1.146	.200	2.84	3.65	2	5
gender	1	7	1.14	.378	.143	.79	1.49	1	2
	2	16	1.19	.403	.101	.97	1.40	1	2
	3	9	1.22	.441	.147	.88	1.56	1	2
	4	1	1.00	.	.	.	.	1	1
	Total	33	1.18	.392	.068	1.04	1.32	1	2

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SAP_exp	Between Groups	12.557	3	4.186	3.745	.022
	Within Groups	32.413	29	1.118		
	Total	44.970	32			
Major	Between Groups	17.889	3	5.963	2.660	.067
	Within Groups	65.020	29	2.242		
	Total	82.909	32			
class	Between Groups	11.076	3	3.692	3.456	.029
	Within Groups	30.984	29	1.068		
	Total	42.061	32			
gender	Between Groups	.059	3	.020	.117	.949
	Within Groups	4.850	29	.167		
	Total	4.909	32			

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VITA

Matthew Thomas Kutz was born on November 4, 1976. He earned his Diploma from Bellarmine Preparatory School in Tacoma, Washington, in 1995. He earned a Bachelors of Arts from the University of Notre Dame in 1999. He will receive a Masters of Science from the University of Missouri-Rolla on December 15, 2007.

Following graduation, Matthew will become a Software Engineer for Cerner Corporation in Kansas City. He and his wife, Sarah, will move to North Kansas City with their daughter, Olivia.