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Competency Assessment for State Highway Agency Project Managers

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science

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To Rty
To my family; Michael and our precious Talya

Acknowledgements

I would like to start by thanking Professor Awad Hanna who gave me the opportunity of joining one of the most prestigious Construction Management programs in the country. As Professor Hanna always says, we join the program as a blank page and our experiences, trials, failures, and triumphs fill this page along the way. Without Professor Hanna's guidance, this page would have much less on it.

I would also like to thank Mr. Gary Whited who has been a true mentor to me and many others during our time at UW-Madison. His dedication and attention to detail are two of the main driving forces behind the success of this research and his patience and understanding allowed me to feel at ease during my most stressful times. Overall, his continuous support was invaluable during the past two years.

Also, I would like to thank Professor Jeffrey Russell for his cooperation, and influential leadership. His willingness to be a member of my graduate committee has added prodigious significance to my research.

Moreover, I would like to thank the members of the WisDOT research team who met once every two weeks for six months at 7:00 am to work on this research. Dan Meinen, Chuck Karow, Matt Thorsen, Brenda Schoenfeld, Dan Segerstrom and Frank Pritzlaff, without their dedication this research would not have been possible. I would also like to thank Brian Roper for his interest in the research and his dedication to get it out to more DOT professionals.

Furthermore, I would like to thank Atharva Patel and Sanjay Rajmohan, the tool development team, who put in hours of coding and meetings to create a working product with all excellent functionality, user-interface, and outputs.

Additionally, I would like to thank the outstanding group of CEM graduate students each of whom has helped in shaping my experience in Madison. Karim Iskandar, Youssef Nagy, Hala Nassereddine, Stefanie Reichman, Heidi Lawrenz, Ramy Abdel Malak, Tia Endres, and Dilibe Offiah thank you all for your friendship and support during the past two years.

I would also like to thank my loving and supportive family for always doing their best to ensure my success. My parents, Dr. Nabil Nassif and Dr. Samira Lamei, my dear brother Youssef, my other parents Dr. Wadid William and Dr. Sawsan Girgis, my second set of siblings, Andrew and Christine, and my niece, Lara.

Finally, I could not have done any of this without the love and support of my life companion, my wonderful husband Michael Ibrahim who encourages me to do better every day. Through the good times and the difficult times, he is always there to make it worth the while. I cannot wait for the rest of our journey together as a family of three.

Abstract

Project Managers (PMs) play a key role in the successful completion and smooth delivery of construction projects. PM competencies have been studied thoroughly over the past few decades to identify the skills, traits, and knowledge areas that are essential for PMs. This research often focused on two types of skills; “hard” and “soft” where hard skills include technical knowledge and skills while soft skills often include leadership style and personal traits.

This extensive body of knowledge, however, was lacking the focus on PMs of transportation construction and of PMs that worked in the public sector, such as State Highway Agency (SHA) PMs. Therefore, this research aimed on identifying the competencies that are essential for SHA PMs generally and for the Wisconsin Department of Transportation (WisDOT) specifically. It also aimed to relate this research, through a practical application, to the industry professional to ensure its usability.

Many organizations have used this body of knowledge to create assessments that would allow industry professionals to reap the benefits of the research. Similarly, the researcher wanted to create an assessment that was tailored to SHA PMs, is easy to use and provides outputs that are relevant and useful for SHA PMs.

To achieve these goals the researcher collaborated with six WisDOT professionals and two academic professionals from the University of Wisconsin-Madison (UW-Madison) who gave regular feedback and suggestions to the researcher. The following eight steps were followed to reach the research objectives:

1. Clearly defining the job description of PMs

2. Compiling a comprehensive list of competencies needed for SHA PMs: 55 essential competencies were identified based on previous literature as well as expert opinion
3. Classifying the competencies into relevant categories: the competencies were classified into five categories: Project Management Knowledge and Experience, Leadership, DOT Operational Knowledge and Experience, Industry Knowledge and Experience, and Cognitive/Personal Effectiveness
4. Defining each of the categories and competencies that eliminates the room for interpretation by people filling in the assessment
5. Creating a set of questions for each competency to make the assessment quantitative and objective: 145 questions were created to ensure that the assessment is quantitative and objective (Combine these two sentences. Redundant.)
6. Collecting data point to calculate the relative weights of the competencies in the assessment and to identify benchmarks: 90 data points were collected from 12 states
7. Performing weights calculations and identifying benchmarks for overall scores as well as for each category within the assessment: the top 20 competencies in the assessment were all from the following three categories: Project Management Knowledge and Experience, Leadership and Cognitive/Personal Effectiveness. The benchmark calculated for the overall score was 73%
8. Developing a user-friendly, Excel-based tool that allows industry professionals to perform 360° evaluation of PMs. The tool has five main outputs that are most relevant and useful for SHA PMs:
 - a) Project Manager Index (PMX) which reflects the overall score of the PM as compared to industry averages and organization set targets

- b) Spider and Bar Charts which show the score of the PM in each of the different categories as compared to set targets. It also shows the PM's score for three consecutive assessments which allows the PM to monitor his/her progress over time
- c) Project Manager Strengths which highlight the distinguishing competencies that the PM excels at
- d) PM Training Needs which outlines the distinguishing competencies where the PM could improve
- e) Recommended Training Programs where the person filling in the assessment can input training programs to tackle the different training needs of the PM

All the research components were validated through regular meetings with WisDOT professionals as well as an academic team from UW-Madison to ensure its relevance to SHA and its importance in terms of filling a research gap.

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Introduction

Transportation construction projects are a key component of the construction industry. People interact with their products on a daily basis and they can have a huge impact on their everyday experiences. Since these projects are highly labor intensive, their success depends on the abilities and strengths of their Project Managers (PMs). The role of the PM is to keep a project on schedule, to keep it within budgetary and resource constraints, and to ensure quality. As the average State Highway Agency (SHA) projects become more complex in terms of technology and scope, the competencies of PMs must evolve and expand to include skills and traits needed for their challenging roles.

PM competencies are broadly divided into hard skills and soft skills. Each group of competencies has been heavily studied by researchers from several decades. The term ‘hard skills’ commonly refers to skills and capabilities which ensure that the PM has an adequate knowledge of the technical aspects of their respective discipline. For project development PMs, these include: knowledge of engineering principles, knowledge and application of relevant software, and knowledge of codes and policies. The term ‘soft skills’ refers to a different set of competencies needed by PMs that are more difficult to measure and improve. These competencies usually reflect personal traits and personality attributes which affect the PM’s performance. These competencies usually include leadership aspects as well as cognitive traits that exceptional PMs should have.

Several entities have worked on building on the existing body of knowledge to create comprehensive frameworks of the competencies that PMs of different fields should have in order to excel at their roles. Some of these entities include the Project Management Institute (PMI) and the Construction Industry Institute.

Traditionally, these frameworks were used to assess the performance of PMs in a more qualitative way. This presented several challenges to organizations like the Wisconsin Department of Transportation (WisDOT) who have found these frameworks to be more subjective. Additionally, there were no assessments that were particularly tailored to fit the job description of SHA PMs. Therefore, WisDOT has partnered with the Construction and Materials Support Center (CMSC) at the University of Wisconsin–Madison (UW-Madison) to work on this research. The team identified 55 key competencies, which span five categories, that effective SHA PMs need, to define a system to measure them objectively and quantitatively. The five main categories which were identified were: Project Management Knowledge and Experience, Industry Knowledge and Experience, WisDOT Operational Knowledge and Experience, Leadership and Cognitive/Personal Effectiveness. To make the assessment less subjective, a detailed definition was created for each competency that would reduce the room for interpretation while filling in the assessment and would provide a clear idea of all aspects of the competency that are needed by the PM. To make the assessment quantitative, a set of questions were crafted for each competency where a five-point scale is used for answers. Along with the questions, a weight was determined for each competency which reflects its relative importance to the performance of PMs. Finally, to make sure that the assessment is put to its best use, a user-friendly, excel-based tool was developed that makes the assessment process simple and automatically provides outputs which are useful to the PMs, their supervisors, and the organization.

This document highlights explains, in detail, the processes followed to reach the research findings as well as the outputs of the research.

Research Objectives

Project Managers (PMs) are key individuals in the success of any highway project. Their roles become more complex as the projects they manage become more demanding, not only on a technical level but also on a management level. That is why evolving their skills is essential to keep up with their highly demanding role in projects. State Highway Agencies (SHAs), like the Wisconsin Department of Transportation (WisDOT) devote a lot of resources to the development of their PMs. WisDOT made several attempts to create a comprehensive assessment tool that would help in improving the evaluation process of its PMs. These attempts have resulted in a rich body of knowledge that was not applied within the organization due to difficulty of use. Therefore, creating a comprehensive assessment in an easy to use format would give WisDOT a targeted way to train and improve the skills of its PMs while the PMs would gain an understanding of their own strengths and training needs, which they can use to advance their careers. Existing literature has extensively discussed the competencies that are key for PMs in traditional, vertical, private sector construction, but there is a literature gap concerning public-sector PMs, especially those who usually work in horizontal construction.

Furthermore, and specific to WisDOT, there is a lack of such a PM assessment tool. By adapting tools used in vertical construction and in other horizontal construction settings, this research creates a more objective and quantitative method of assessing PMs.

Therefore, this research had five main objectives:

Compile a list of competencies that are essential for SHA PMs

There was heavy reliance on literature to identify the competencies needed for SHA PMs. A team of subject matter experts was gathered to identify the hard skills in the assessment, which are the

more technical aspects. For soft skills, there was a reliance on the PM assessments that were created for different construction sectors as well as for different industries. A clear definition was created for each of the competencies with the help of the team that allowed them to have a relevance to SHA PMs.

Classify the competencies into categories that are relevant for SHA PMs

The categories chosen for the assessment reflected the needs of SHA PMs while being inspired by the categories in the CII frameworks. This framework covers a variety of areas which all PMs need. Definitions were also developed for the categories to make them specific to SHA PMs and they were reviewed with the research team to ensure their relevance.

Prepare a quantitative and objective assessment

One of the main challenges faced in creating the assessment was the subjectivity of the person filling it especially because it asks about some personal traits that can highly be impacted by the relationship of that person to the PM. Therefore, the research team followed the outline of the assessment created by CII. The team developed a set of questions for each competency that was specific enough to reduce the subjectivity of the assessment significantly.

Create a user-friendly digital tool

The team believes that the use of a digital, interactive tool rather than a 'static' assessment would not only make it easier to use but will also allow the output to be automatically generated and displayed in a way that would be beneficial to its users.

Produce output that is useful for SHA PMs

After identifying the competencies that the PMs need, it was important to use that information to yield the best output possible in terms of usability to the PMs as well as the organizations using the tool. This was especially clear after attending the Transportation Research Board conference where the members of different SHAs highlighted the difficulties they face in applying current research because of the lack of direct application. Therefore, it was crucial for the team members to identify ways that would make the outputs of this assessment useful to SHAs and their PMs. Thus, the following goals were identified.

- Identifying the strengths of PMs. This would allow the organization to better allocate its resources in terms of project demands.
- Identify individual training needs. This will allow the individual to pinpoint the skills s/he needs to work on improving and will allow them to set short and long-term goals for their personal development.
- Demonstrate the ‘evolution’ of the PMs skills over time. This will allow both the organization and the PM to monitor how the progress of the PM’s skills in response to training received. It will also allow the PM to track the progress made towards certain professional goals set for him/her.
- Identify organization-wide training needs. This helps the organization in identifying needs that are common among its PMs, which could help them in focusing on hiring more individuals that possess these skills.
- Identify organizational training gaps. This allows the organization to see where its training programs are lacking and, therefore, where they should allocate more effort into creating training programs.

Literature Review

PM competencies are very popular when it comes to research. While previous research has mostly focused on a set of competencies referred to as “hard-skills”, technical skills and field experiences of PMs, more recent research is focusing on “soft-skills”, such as management and leadership skills (Ingason and Jónasson, 2009). These skills that are more difficult to identify and measure, but they tend to have a significant impact on differentiating between the performance of average and excellent PMs. Previous research has covered topics like emotional intelligence (Zhang 2013), team management (Starkweather and Stevenson 2011) and leadership skills (Odusami 2002). In most of the aforementioned studies, these competencies are not only considered to be essential, they are also considered to effectively differentiate average PMs from excellent ones. In contrast, “hard-skills” are considered to be entry level skills which are necessary but not sufficient for superior performance (Stevenson and Starkweather 2010).

Table 1: Literature Review Summary Table

| Authors | Year | Project Management Knowledge and Experience | Industry Knowledge and Experience | Leadership | Cognitive and Personal Effectiveness | SHA Operational Knowledge and Experience |
|--------------------------------|-------------|--|--|-------------------|---|---|
| Lantelme, Elvira M. V., et al. | 2017 | x | x | x | | |
| Wang, D., et al. | 2017 | | | | x | |
| WisDOT | 2014 | x | x | | | x |
| CMSC at UW-Madison | 2013 | x | x | x | x | |
| CII RT-281 | 2012 | x | x | x | x | |
| Fisher E. | 2011 | | | x | x | |

| | | | | | | |
|--|------|---|---|---|---|--|
| Gillard S. | 2009 | x | x | x | x | |
| Cheng M., Dainty A. and Moore D. | 2005 | x | x | | x | |
| Udo, N., Koppensteiner, S. | 2004 | x | x | x | x | |
| F.T. Edum- Fotwe, R. McCaffer | 2000 | x | x | x | | |

Table 1 highlights some of the literature that discussed PM competencies and the areas which each reference focused on. Most notably, Wang et al (Wang 2017) look at the human values that have a major effect on PMs. These values present a way for supervisors to motivate PMs by adjusting their expectations to meet these values. The most relevant values include: Honest, Reliable, Capable, Logical, Independent, Helpful, Broadminded, Ambitious, Intellectual, Self-controlled, Polite, and Courageous. Lantelme et al (Lantelme 2017) emphasize that the PMs struggle with the “human and social context” of the problems that they face in the field. The paper also mentions that the skills required for these management roles are reflected through how the PM applies his/her previous knowledge and values to situations they are put in. This means that the development of such skills and capabilities take a lot of time and effort. Therefore, the paper suggests a “cyclical learning process” where the PMs would first become aware of the way they act in certain situations and improve their management and leadership skills that are needed to solve complex problems that they are faced with every day in their work environment.

In an attempt to evaluate PMs’ skills, traits and competencies comprehensively, several entities have created PM assessments that combine both soft and hard skills. The Project Manager Competency Development Framework (Project Management Institutes, PMI, 2002), and the

Project Manager Competency Assessment Tool (Construction Industry Institute, CII, 2014) are examples of these assessments.

The Project Manager Competency Development Framework (PMI 2002) divides PM competencies into three pillars: Knowledge, Personal (Cognitive), and Performance (Leadership and Management), each of which includes sub pillars that go into detail regarding the areas that the assessment is built on. These include general management skills, personality traits, and “project currencies” which include time, money, etc... Each of these sub pillars has a set of competencies that are important for the performance of construction PMs.

The Construction Industry Institute (CII) is one of the most highly regarded organizations in the field of construction research. This is because the organization combines the academic expertise of the best academicians in the construction field with the practical experience of the biggest construction companies in the world. The result is research that is not only important and relevant to construction companies but that also contains outputs useful for these companies. There is no doubt that the research performed by CII has transformed many aspects of the industry for the better.

The CII RT-306 worked on creating an assessment for project managers where the main goal was for the assessment to be quantitative. The structure of the assessment allowed for its automation. Since it did not rely completely on the qualitative and subjective assessment of PM, either by their supervisors or themselves, the calculations could be run through a digital tool that would provide the user with a set of questions which s/he can answer and then automatically compute the scores and display the outputs.

The competencies in the assessment relied on various different sources to compile the most comprehensive list that would provide an accurate assessment of the PM as well as demonstrate

all the skills and abilities that a PM needs to excel at his/her job. Therefore, the assessment includes a wide variety of hard and soft skills that PMs needs. However, this list was created for PMs that, firstly, work mostly on vertical construction projects and, secondly, work for companies within the private sector. Therefore, the assessment was not directly applicable to SHA PMs.

To make the assessment quantitative rather than qualitative, RT-306 created a set of questions that corresponded to each of the identified competencies. They also created a clear and specific definition for each of the competencies, ensuring that they were relevant to the targeted PMs. This reduces the subjectivity of such an assessment significantly.

RT-306 finally created an excel based tool that was easy to use and that provided three main outputs; the strengths of the PM, the training needs of the PM, and the PM's benchmark score, which showed the relative competence of the PM in comparison with a database of previous scores. These outputs were highly appreciated by industry members who subsequently used the tool.

The research team found that the core structure of the CII assessment was very strong and, therefore, has decided to adopt a similar structure for the assessment that would be created for SHA PMs. This would include the different competencies with a definition and a set of questions for each, to reduce subjectivity. The team also wanted to create a digital tool that would allow for the ease of its use and the clarity of the output presented at the end.

WisDOT has previously attempted to use some of these assessments to evaluate its PMs. However, these assessments are tailored to PMs that manage vertical construction projects and that work for the private sector. Therefore, they are not directly relevant to WisDOT PMs. WisDOT has also worked on creating a PM assessment that is tailored to its PMs. The result of this effort was the WisDOT Engineering Competency Model (WisDOT 2013) which includes competencies

necessary for their PMs. However, this assessment lacks a robust scoring system that allows for the ease of its use. Building on this existing body of knowledge, the research team aims to create an assessment that evaluates soft and hard skills of WisDOT PMs in a quantitative and objective way and to present its outputs in an easily understandable format.

The Wisconsin Department of Transportation (WisDOT) is a large employer for construction projects in the state of Wisconsin. Each year, it spends hundreds of millions of dollars on constructing, operating, and maintaining highways, bridges, and other modes of transportation such as public transit, rail transport, and air transport. It not only initiates and funds these projects but also has participated greatly in the design and oversight of the construction of these projects. As the nature of its projects becomes more complex, WisDOT focuses on evolving the skills and capabilities of its employees, especially its Project Managers.

WisDOT PMs perform many different tasks and their responsibilities vary greatly from one project to the next. In an effort to create a system to improve the capabilities and skills of PMs, WisDOT has created two models that were intended to assess these capabilities and highlight the areas that PMs could work on improving in the future.

The first document was created in 2014 and titled the Project Management Development Competency Framework. It was based on the Project Management Institute's (PMI) Project Manager Competency Development Framework, which is a self-assessment. This document covered a large range of competencies needed for PMs. It was based on the PMI assessment, but it was also adapted to cover WisDOT-specific aspects such as processes, software and policies. The WisDOT assessment also differed from the PMI self-assessment in that it had another section called Reviewer Assessment to be filled by a supervisor.

The assessment had a list of the competencies needed for a WisDOT PM, but it did not have specific definitions or guiding statements that would allow a better understanding of what the creators of the assessment meant by each competency. The competencies were divided into five main categories; Project Management Knowledge Competence, Project Management Performance Competence, Project Management Personal Competence, Project Management Organizational Competence, and Project Management Industry Specific Competence. Even though the list of competencies was thorough and included most of the essential competencies, the ambiguity created room for interpretation on the part of the person filling the assessment. It used a three-point scale that was: Below Expectations, Meets Expectations, and Exceeds Expectations. This also allowed for subjectivity where each person filling the assessment could have different expectations for different tasks.

Finally, the scoring for this assessment would be computed by hand and plotted on a chart that simply showed a number for each category available. This process was time consuming and did not inform the PMs or WisDOT of which specific competencies they needed to work on to improve their overall performance.

The second document was created in 2013 and is titled the WisDOT Competency Model Project. This document covered the competencies needed for WisDOT PMs as well as specialty engineers. The model is composed of six categories; Domain Knowledge: Civil Engineering, Commitment to Standards, Modeling, Analysis, and Design, Project Management, Tools and Support Systems, and Personal Effectiveness. This model is very detailed. Each category is divided into three parts; concepts that the PM needs to understand, methods and techniques that the PM needs to apply, confirming behaviors that explain in detail the observable actions that the PM does to demonstrate the understanding, and application of the previous two sections.

This model was very helpful to our team in creating a compiled list of competencies that would be more specific to SHA PMs. However, this model was not used as an assessment. All the skills and abilities mentioned were presented in the form of statements, so there is no scale that the PMs or their supervisors can use to get an indication of their performance. Therefore, the model did not provide an output that is usable by PMs or the organization. It only demonstrates a set of competencies that the PMs and the organization can reference but not to assess individual performance.

While preparing the assessment for SHA PMs, there was a reliance on these resources to extract the competencies that are most relevant to horizontal construction as well as public sector PMs. The documents prepared by WisDOT served as a good base for the specifics of this type of work and the skills and competencies needed to excel at managing its projects.

Research Motivation

Modern construction is constantly evolving and changing. As such, Project Managers (PMs) must also constantly be assessing and addressing their weaknesses to keep pace with their highly demanding roles. As part of the self-improvement process, PMs must have a way to impartially and thoroughly assess their own competencies.

Various frameworks and methodologies to assess the role of PMs have been developed by entities such as the Construction Industry Institute (CII) and National Aeronautics and Space Administration (NASA). These frameworks cover a wide variety of competencies which can be divided into two main sets: hard skills, such as industry knowledge and experience, and soft skills, such as personal traits and leadership style. While the soft skills are usually generalized and not organization specific, the hard skills can be highly variable. Therefore, it is important to have an assessment that is especially tailored to the organization's needs to ensure the relevance of the assessment to the PMs that will use it.

The Wisconsin Department of Transportation (WisDOT) is one of the largest executors of highway projects in the state of Wisconsin. Its projects impact people's lives on a daily basis. WisDOT primarily work on horizontal construction projects such as bridges and highways which are extremely challenging on many levels. These projects require PMs to have a wide range of skills and traits to ensure their success. WisDOT PMs are evaluated yearly using a process titled Performance Evaluation Planning Employee Development (PEPED) which is a performance-based assessment. This evaluation process helps the management in identifying issues retroactively and directs them to ways that will help them improve.

WisDOT has also worked on creating an assessment that measured the qualifications of PMs. Through various programs, the department has created two assessments that were more WisDOT specific to assess the competencies of PMs. These assessments, however, were not put into practice or used regularly by WisDOT PMs or supervisors. Even though the content of the assessments were tailored to fit the needs of WisDOT PMs and could provide valuable insight into the competencies of PMs, neither of these assessments were used regularly due to issues with their design.

The first document that WisDOT presented to the PMs was the PM Competency Development Framework which is based on the PM self-assessment created by the Project Management Institute(PMI). This assessment provides a list of important competencies that every PM needs to advance their career. However, this list does not include any specific definitions for the competencies or any guidelines that explain what exactly the organization is looking for when asking about a competency. This gives room for interpretation, making the assessment subjective and biased in many cases. Moreover, the assessment would be completed manually once by the PM and once by the supervisor and the scores need to be manually calculated. The calculated score only shows a numerical outcome for each category that does not present any personalized output. Therefore, even if the PM completes and scores the assessment, the results would not be extremely helpful in guiding him/her in what s/he should work on improving in the future.

The second document that WisDOT created was the WisDOT Competency Model Development. This document provided a highly detailed explanation of the competencies needed for WisDOT PMs in terms of knowledge and application. The level of detail presented in the assessment reduces the subjectivity that arises from interpretation. However, it lacked a scoring system that would allow it to be useful. It only presented the competencies and their descriptions

without specifying how each impacts the performance of the PM. This means that the research effort, as detailed as it was, did not produce a usable format for the PMs or their supervisors. Moreover, this document did not provide a wide array of soft skills that would allow the assessment to be comprehensive.

Therefore, the researcher saw an opportunity in creating a user-friendly, interactive tool that would present the competencies in a way that was easy to understand and minimize the area for interpretation. This would be achieved by creating specific definitions to every competency as well as a set of questions that can be answered to assess the PM. This not only standardizes the assessment and provides good benchmarks, it also helps in reducing the subjectivity of the assessment.

The researcher also wanted the output of the tool to be useful to WisDOT and to provide the PMs and their supervisors with personalized results that highlight the strengths of each PM as well as his/her training needs and areas in need of improvement. This would allow the PM to create a detailed plan of the competencies that s/he need to work on in the future. It would also allow the PM to monitor his/her progress in response to the trainings and courses they receive to enhance their capabilities and broaden their skill set.

Research Methodology:

The main goal of this research was to create an assessment that is most useful to SHA PMs. This includes identifying the most important competencies that the PMs should have in order to excel at their jobs. It also includes reducing the subjectivity of the assessment. This eliminates the biases that could result from any personal relationships between the PM and the person filling in the assessment. It also provides a set standard for the expectations of the organizations for individuals rather than letting each individual interpret the competencies differently.

After examining different resources and discussing PM competencies in different sectors of the construction industry, it was clear that there was a gap when it comes to PMs that work for the transportation sector. Therefore, the research team proposed working with the Wisconsin Department of Transportation (WisDOT) on creating such an assessment.

WisDOT provided great assistance throughout the whole project. Six professionals from WisDOT were assigned to help with the development of this project; **Chuck Karow**: Project Supervisor, Northeast Region, **Dan Meinen**: PM Unit Supervisor, Bureau of Project Development, **Frank Pritzlaff**: Project Manager, Southeast Region, **Brenda Schoenfeld**: Project Supervisor, Southwest Region, **Dan Segerstrom**: Project Supervisor, Northeast Region and **Matthew Thorsen**: PE Project Manager, Northwest Region. These individuals worked closely with the UW-Madison team to ensure that the assessment was as relevant and useful as possible to WisDOT and SHA PMs. They had a major role in creating all parts of the assessment and their roles will be highlighted more in the following sections.

Although the literature was lacking an assessment that was tailored to SHA PMs, there is a large number of competencies that are globally needed by PMs across all sectors. These, paired

with some SHA specific competencies, would help in creating an assessment that is most useful to SHA PMs.

To reach the final goals of the research and ensure their relevance to SHA PMs, the research followed eight steps that are shown in figure 1 and are detailed below.



Figure 1: Research Flow Chart

Step 1

As a first step for the research, the team worked with WisDOT to define key concepts and terms that are needed for the assessment. These are concepts and terms that are commonly used in the public sector, however, their definitions vary from one organization to another.

Transportation Improvement Project

A well-defined sequence of activities that, when completed, result in a tangible transportation improvement project. Tangible projects result from project development activities and include such things as planning and scoping documents, roadway design plans and specifications, construction contract administration, right-of-way plats, signing, marking, and signal plans, structure design plans, pavement reports, and construction of a transportation improvement project.

Project Manager

Person having primary responsibility over the scope, schedule, budget, resource management and overall quality of multiple projects. The project manager manages all aspects of the project and is considered to have primary project management decision-making authority, second to the supervisor. The project manager is responsible for managing projects in their assigned area of expertise using project management process to ensure milestones are met, key tasks are performed to standards, contract changes are evaluated and implemented, and projects are completed on schedule and on budget.

Project Supervisor

Person in first-line management who is responsible for overall delivery of a project and meeting performance targets and goals assigned to the project managers. The project supervisor manages

a portfolio of projects and is responsible for providing engineering supervision to several project managers. The supervisor makes project assignments, assigns project personnel, gives instructions, provides feedback on performance and is responsible for conducting annual Performance, Evaluation, Planning and Employee Development (PEPED) assessments of project managers. The project supervisor assists project managers in identifying professional development and training needs.

Project Leader

Person having responsibility for coordinating and performing project activities under the direction of a PM. Project Leaders generally concentrate in a functional area, such as design and construction, and typically focus on a single project, but may be assigned to more than one project if projects are similar in nature or have different delivery timelines.

Competency

An umbrella term that encompasses the knowledge, skills, attributes, and behaviors that represent the ability of a PM to perform specific duties, manage projects, and successfully meet project goals. Competencies are a combination of trained and practical knowledge, traits, values, and personal characteristics that distinguish exceptional performance from average performance. Competencies must be observable and measurable so that competency proficiency levels can be quantified. These levels are used to identify training needs and develop strategies to raise the level of proficiency for an individual or the organization.

These definitions helped the project team in creating an assessment that is tailored to the right people within the organization. It also helps in identifying the main roles and responsibilities

of the PMs which ensures that all the important aspects of their job description are covered in the assessment.

Step 2

The second step of the research was to compile a comprehensive list of competencies that are essential for PMs and that would allow them to excel at their jobs. The team compiled this list from a number of different resources. This allowed the team to get a large number of competencies which were verified and narrowed down by the six WisDOT professionals participating in the research.

Step 3

The third step was to classify each of the competencies identified into major categories. The categories identified were the most relevant to WisDOT and they also covered all the competencies that in the finalized competency list. Five categories were identified for the assessment: Project Management Knowledge and Experience, Leadership, WisDOT Knowledge and Experience, Industry Knowledge and Experience, and Cognitive/Personal Effectiveness. A definition was created for each of the categories identified to ensure that the headings are relevant to WisDOT and that they are easy to understand. This also helped in clarifying these headings and reducing subjectivity. The categories, their definitions, and the competency classification were all reviewed by the six WisDOT professionals working on the research.

Step 4

After placing each of the competencies into their categories, the fourth step was to make each of the competencies identified specific to WisDOT PMs specifically, and SHA PMs generally. This was achieved through creating a definition for each competency that reflected the

expectations of the organization regarding the role of the PM. Each of the definitions was reviewed by the WisDOT professionals working on the research to ensure that they reflected the organization's PM job description perfectly.

Step 5

The fifth step of the research focused on making the assessment process more objective. This was done through creating a set of questions for each competency that would be answered by the person filling in the assessment. These detailed questions help reflect the real capabilities of the PM rather than a person's opinion of him/her. The WisDOT team of professionals reviewed the questions to ensure that they covered all aspects of the competency that are important to the organization and to the role of a SHA PM.

Step 6

The next step of the research was to collect data that would enable the team to identify which competencies have a bigger impact on the performance of PMs. The data collected would also allow us to set a cut-off score between competency and highly competent PMs. This was done through collecting the answers to the assessment from supervisors. Each supervisor was asked to assess two PMs; one that s/he identified as exceptional and another that s/he identified as average. The distinction between the two performances would allow the researcher to identify the competencies that had the highest impact on the performance of PMs.

Step 7

It is important to highlight the impact of different competencies on the performance of the PMs. Therefore, the data collected from the data collection phase was analyzed and a specific weight was calculated for each competency. This weight reflects the importance of the competency

on the performance of the PM and sets the base of calculating a score for the PM that would reflect his/her competence level when compared to the database.

Step 8

The last step of the research was to create the interactive, user-friendly, excel-based tool that would allow the assessment to be effective in identifying the strengths of each PM as well as his/her training needs. The tool would also help the organization in identifying the training needs that are more common within the organization and would give them an idea of what training programs they need to incorporate in order to get better performing PMs in all categories.

Assessment Structure

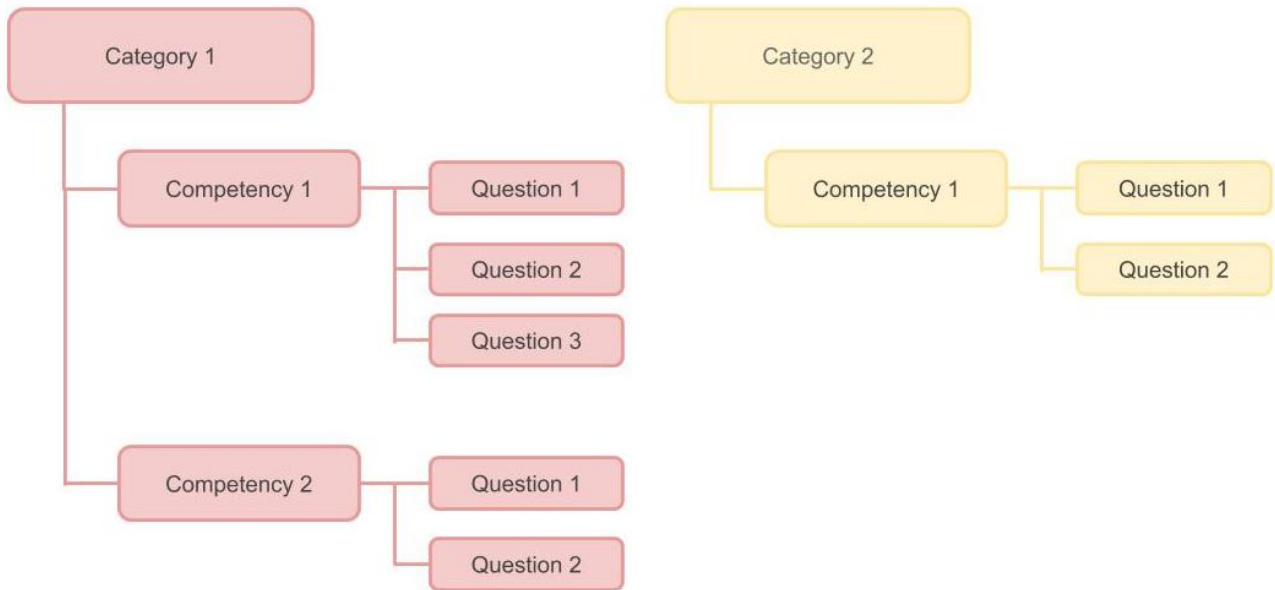


Figure 2: Assessment Structure

Figure 2 shows the basic structure of the assessment where each category has a number of competencies along with their definitions. The input to the tool comes from the list of questions associated with each competency. The person filling in the assessment provides the answers to each of these questions and the assessment tool calculates the scores for the PM and displays it along with other outputs that are personalized for the needs of the PM.

Competencies, Definitions and Questions

Compiling a comprehensive list of competencies that are relevant to SHA PMs was the most important task of the research. This is the main component of the assessment that would determine all the skills and traits that distinguish the performance of a competent PM from an exceptional one. Therefore, the process to identify and define these competencies had to involve experts that have deep knowledge of the roles and responsibilities of PMs of SHAs. That is why the UW-Madison researchers teamed with WisDOT professionals that provided that expert insight into creating a comprehensive list and relevant definitions of PM competencies.

First, the researcher compiled a preliminary list of competencies that covered various areas of skills that PMs need. The skill sets, as defined by literature, are commonly divided into hard skills; which highlight the technical abilities of PMs, and soft skills; which emphasize the PMs' personal traits as well as interpersonal capabilities that allow him/her to be a high performing PM. This compiled list relied on two types of sources, each for a different type of competencies. Since soft skills tend to be more general and can be applied to PMs from different fields and with different roles and responsibilities, there was a broader base of knowledge to rely on for identifying competencies. These included several independent studies as well as competencies from lists created by organizations such as NASA, PMI and CII. The competencies taken from these sources compose most of the following categories: Leadership, Project Management Knowledge, and Experience and Cognitive/Personal Effectiveness.

For the hard skills, which tend to be more discipline specific, the main bulk of the competencies was extracted from the frameworks developed specifically for WisDOT. These were the base of most of the Industry Knowledge and Experience category and the WisDOT/SHA Knowledge and Experience category. This not only ensured the relevance of all of the competencies mentioned but also guaranteed that all the skills and technical abilities needed by SHA PMs are included in the assessment.

After the primary list was compiled, the competencies were divided into the five main categories identified by the research team. These categories break down the assessment in an understandable way that allows PMs to have a general idea of the areas they excel at and the areas they could improve in. The five categories were closely related to those presented in the frameworks previously created by WisDOT. However, some alterations were made to ensure that they were better suited for the competencies within each category. Each category was then defined

to give the person filling the assessment an idea of the competencies they can expect to see in the category and to eliminate any ambiguities or confusion.

After defining the categories and assigning the competencies that fit into each, an online team meeting was held to get the feedback of the research committee. During this meeting The WisDOT professionals made the necessary edits to the category titles and their definitions. They also made any necessary changes to the developed competency list such as eliminating unnecessary competencies, moving competencies between categories to ensure that each fit in their category perfectly and added any competencies they thought were missing from the assessment. This process was very helpful to the team as it ensured that no important competencies were left out of the assessment and that each competency was categorized properly.

The next objective to be tackled was creating an objective and quantitative assessment which would reduce bias and subjectivity and provide instant, quantitative output for WisDOT and other SHAs. To achieve this goal, a definition was created for each of the competencies. This definition is tailored to SHA PMs job description, roles, and responsibilities. It allows the person filling in the assessment to know exactly what is meant by this competency in the context of SHA. This reduces personal interpretation of the competencies and their meanings. It also ensures that the person filling in the assessment considers all aspects of the PM that are related to this competency.

In addition to creating a definition for each of the competencies, a set of questions was created. These questions were created to be very specific. This ensures that the person filling in the assessment answers them more objectively while thinking about the actual competence of the PM rather than his/her own impression of the PM. Having specific questions also guarantees that while evaluating each competency, the person filling in the assessment considers all the aspects of

the competency that are within the roles and responsibilities of the PM. All the questions created are easy to understand and respond to. Most questions use a 5-point scale for their response where the person filling in the assessment would select one of the following options: not at all, slightly, somewhat, very, and extremely. There are a few questions that also include a 'not applicable'. This is to make the assessment more inclusive in cases where the specific skills in questions are not part of the PMs' job description. There were also a few questions that had 'yes' or 'no' as answer options.

To create the definitions and questions, the research team worked on one category at a time. Biweekly online meetings were held with the WisDOT professionals where the definitions and the questions of each competency were reviewed and refined to better suit the needs of WisDOT and other SHAs.

At the end of this process, the final assessment included 145 questions assigned to 55 competencies within 5 main categories. The questions asked within each competency are as follows:

Industry Knowledge and Experience

This category focuses on the individual's technical knowledge, experience, and skills that are particularly relevant to the transportation industry. It looks at knowledge, understanding, and application of general engineering concepts, problem solving abilities, modern software, and general policies and standards. It also acknowledges the individual's degree, certification, professional training, and registration. The list of competencies included in this category are not the basic requirements for all PM's, but rather the technical knowledge and experience that differentiate an average WisDOT PM from an exceptional one.

Awareness and use of Information Technology

Ability to apply and interpret results from computer software packages and applications used by the engineering profession and transportation industry.

1. How well does the PM understand and make use of software applications provided by WisDOT?
 - a. Word processing software
 - b. Spreadsheet software
 - c. Presentation software
 - d. Markup software (Adobe Acrobat, Bluebeam, etc.)
2. How well does the PM understand the capabilities of engineering design software?
3. How proficient is the PM in presenting and displaying data and results using the various software applications provided by the Department?
4. How effective is the PM in encouraging others to use available software and applications?

Application of relevant engineering principles

Ability to apply engineering concepts and integrate relevant Civil Engineering sub-disciplines into transportation projects.

1. How well does the PM implement design and construction solutions through application of engineering knowledge and judgment?
2. How well does the PM read and interpret engineering plans and drawings?
3. How well does the PM implement concepts and practices of efficiencies on projects?

4. How well does the PM maintain an up-to-date understanding of the concepts of multiple civil engineering disciplines?

Problem-solving

Ability to apply appropriate problem-solving methods and techniques to find feasible and reasonable solutions for engineering problems.

1. How well does the PM utilize a structured approach to problem solving? [1) Define the problem, 2) gather facts, 3) develop possible solutions, 4) analyze and compare solutions, 5) select a solution, 6) implement, 7) evaluate]

2. How well does the PM anticipate problems that affect the project?

3. How effective is the PM identifying the root causes of problems?

4. How well does the PM gather the relevant facts and information needed for effective problem solving?

5. How effective is the PM in solving problems that arise on their project?

Awareness of current research

Awareness of and ability to accumulate specialized knowledge from a variety of sources beyond the Department, such as academia, research institutions, transportation organizations, professional societies and industry companies and/or corporations.

1. How knowledgeable is the PM with materials and publications by transportation engineering organizations such as AASHTO, Transportation Research Board (TRB) and technical bulletins from industry associations?

2. How well has the PM been able to make use of non-WisDOT sources of information to expand their knowledge in a specific area or find solutions to a problem?

Degrees, Certifications and Professional Registrations

Degrees, certifications and professional registrations that have been obtained, either internally from the Department or externally from other sources.

1. The PM has achieved a Masters or PhD Degree in engineering (Y/N)
2. The PM has earned PMI's Project Management Professional certification? (Y/N)

WisDOT Operational Knowledge and Experience

This category is more specific to WisDOT standards, specifications, operational functions, computer applications, policies, and procedures. It ensures that the person being evaluated has the knowledge and understanding of necessary aspect of DOT project design and construction. This includes WisDOT design and construction standards, internal and external relations, organizational structure, and legal aspects related to all project phases. It ensures that the PM would manage all project aspects in all project phases per WisDOT standard procedures.

Policy and Procedures

Knowledge of and ability to interpret and implement Departmental policy and procedures to projects.

1. How knowledgeable is the PM with policy and guidance in the FDM (Facilities Development Manual)?

2. How well does the PM interpret and implement policy and guidance from the FDM (such as State Highway Rehabilitation (SHR) Facilities Development Process or Exceptions to Standards Process) into his or her projects?
3. How effective is the PM in administering consultant contracts?
4. How knowledgeable is the PM with the Wisconsin DNR cooperative agreement?
5. How knowledgeable is the PM with the policy and guidance in the CMM (Construction and Materials Manual)?
6. How well does the PM interpret and implement policy and guidance from the CMM (such as Construction Finals Process into his or her projects)?
7. How knowledgeable is the PM with policy and guidance in the Program Manual?
8. How well does the PM employ SDIC (Systematic Development of Informed Consent) techniques?

Standards and Specifications

Knowledge of WisDOT standards and specifications and ability to implement them to ensure quality, conformance to current engineering standards and consistency across projects.

1. How knowledgeable is the PM with Standard Specifications?
2. How knowledgeable is the PM with development and administration of contract Special Provisions?
3. How knowledgeable is the PM in non-WisDOT standards and specifications such as bicycle-pedestrian safety standards and access control requirements?

Technology and Software

Knowledge of and ability to use and interpret information provided by Department information management systems, software, and hardware devices.

1. How well does the PM know and use project management software such as Design PMP (Project Management Plan application) and pseTrak?
2. How well does the PM know and use financial software such as MIIP (Management Information for the Improvement Program) and FIIPS (Financial Integrated Improvement Programming System)?
3. How well does the PM know and use construction management software such as Field Manager, Primavera P6 and Contract Management?
4. How well does the PM implement new technology innovations (hardware, software, etc.) into their work?

Legal Issues

Knowledge of federal laws, state statutes and contracts and ability to insure compliance with all federal, state and local laws.

1. How knowledgeable is the PM with consultant contract language?
2. How knowledgeable is the PM with National Environmental Protection Act (NEPA) and Wisconsin Environmental Protection Act (WEPA)?
3. How knowledgeable is the PM with National Transportation Laws and Transportation State Statutes, such as TRANS 220, 404 Permits, USCG sections 9 and 10 permits, American Disabilities Act (ADA), etc.?
4. How well does the PM identify and properly address potential legal issues as they arise?

Performance Measures

Knowledge of and ability to interpret metrics from Department strategic goals, performance measures and indicators and initiate changes to improve performance.

1. How knowledgeable is the PM of the Department's MAPSS (Mobility, Accountability, Preservation, Safety & Service) Goals?
2. How knowledgeable is the PM with the Department's Performance Measures?
3. How knowledgeable is the PM with the Department's Performance Indicators?
4. How effective is the PM in using the performance measures and indicators to improve their projects' performance?
5. Does the PM participate in identifying and implementing changes to improve the Region's/Bureau's Performance Measures metrics?
6. How well does the PM monitor and measure the performance of consultants and contractors?

Knowledge Networks

Experience in and collaboration with more than one functional area, Regional Office, or Statewide Bureau.

1. PM has experience of working in more than one functional area of the project development process. (Y/N)
2. PM has experience of working in more than one Region Office/Statewide Bureau. (Y/N)
3. How effective is the PM in collaborating with other functional areas involved in the project development process?

4. How knowledgeable is the PM in all the phases of the project delivery process and their interrelationships?
5. How well does the PM understand the roles and capabilities of the regional and statewide bureau technical resource areas?
6. How effectively does the PM utilize available regional and statewide bureau resources to achieve project goals?
7. How effective is the PM in encouraging others to utilize available regional and statewide bureau resources?

Project Management Knowledge and Experience

This category identifies the basic set of skills and capabilities as well as knowledge of key concepts that an individual should demonstrate to be an effective and successful PM. The competencies included in this section are more focused on a project level. It highlights the skills necessary for an individual to successfully lead important projects in the environment of WisDOT while maintaining good relationships with all stakeholders. Some examples of these skills are project planning, project control in terms of time, cost and quality, risk management, and scope development.

Scope management

Ability to determine and document project requirements and deliverables, formulate a scope that defines all required work activities, monitor the project status, and manage changes to the project's baseline scope.

1. How well does the PM define project requirements?
2. How well does the PM identify all the activity tasks needed for the project?

3. How well does the PM establish the scope of a project?
4. How well does the PM manage changes to the baseline scope throughout the project?

Communication management

Ability to ensure communication occurs within the organization and between the organization and stakeholders throughout all phases of the project delivery process.

1. How effective are the communication management plans developed by the PM?
2. Does the PM ensure that sufficient communication takes place between all project stakeholders within the organization?
3. Does the PM ensure that sufficient communication takes place between project stakeholders external to the organization?
4. Does the PM ensure the exchange of high quality information that promotes comprehensive understanding and prevents communication issues?
5. Does the PM ensure that Lessons Learned on the project are shared with others to improve their projects and processes?

Stakeholder Management

Ability to identify and engage internal and external stakeholders throughout all phases of the project delivery process including the ability to monitor stakeholder relationships and adjust strategies as needed.

1. How well does the PM identify all internal and external stakeholders?
2. How well does the PM manage the relationships with internal (region and bureau) stakeholders?
3. How well does the PM manage the relationships with external stakeholders?

4. How well does the PM manage the relationships between internal and external stakeholders?
5. How well does the PM conduct negotiations with stakeholders?

Budget management

Ability to develop realistic project budgets, monitor budget performance, compare with approved expenditures and institute change management and corrective action to keep the project on budget.

1. How well does the PM develop project cost budgets?
2. Does the PM ensure that the project cost estimates are current and updated as needed?
3. How well does the PM compare actual project cost levels to budgeted cost levels?
4. How well does the PM institute corrective action to keep projects on budget?
5. How successful is the PM in keeping their projects within budget?

Schedule management

Ability to develop realistic project schedule, monitor schedule performance, and institute change management and corrective action to keep the project on schedule.

1. How well does the PM develop project delivery schedules?
2. Does the PM ensure that the progress and schedule data in PMP is accurate and up to date?
3. How well does the PM compare actual schedules to planned schedules?
4. How well does the PM institute corrective action to keep projects on schedule?
5. How successful is the PM in keeping their projects on schedule?

Project Controls

Ability to utilize and maintain established organizational project control systems to ensure projects meet delivery goals.

1. How well does the PM use department control systems and reports?
2. How well does the PM execute project control plans and adapt as necessary?

Change management

Ability to respond to requested project changes by assessing the need for a change, analyzing the impact on the project, making timely decisions regarding resolution of the requested change and efficiently implementing approved changes.

1. How well does the PM assess the need for changes and the impact of change on the project?
2. How effectively does the PM implement required changes?
3. How well does the PM react to project changes?
4. How well does the PM document the causes of the variances and reasons being the corrective actions implemented so that others can improve their projects and avoid the same issues?

Risk and Issues management

Ability to persistently identify, quantify and monitor known issues and unforeseen risks that may affect project budget and schedule, and maintain a well-planned response capability.

1. How effective is the PM in identifying potential issues and risks that are likely to affect the project?
2. How effective is the PM in quantifying the risks to determine which risk events warrant a response?

3. How effective is the PM in developing contingency plans to respond to risks and identifying triggers to implement the contingency plan?
4. How well does the PM mitigate and respond to unforeseen risks?
5. How well does the PM objectively resolve project issues while keeping a positive mindset?
6. How well does the PM develop plans to minimize problems and ensure project success?

Quality management

The ability to establish and monitor quality requirements appropriate for the project and project deliverables, and to implement necessary changes to ensure compliance with recognized standards.

1. How well does the PM monitor the quality standards for the project?
2. How well does the PM take effective corrective actions to ensure compliance with standards?
3. How well does the PM apply lessons learned?

Understand project management concepts (FDM Chapter 2)

Knows and executes the policies, processes, procedures, and best practices that lead to successful delivery of a project.

1. How well does the PM understand the Knowledge Areas and concepts of project management as presented in the Project Management Institute PMBOK guide and FDM?
2. How well does the PM execute project management processes and techniques throughout the project lifecycle?
3. How experienced is the PM in managing a variety of project types and complexities?

Leadership

This category evaluates the individual's ability to lead a team, set team performance expectations, and organize team members to work collaboratively and effectively to accomplish project goals. The category relates to the project delivery team and how effective the PM is in engaging diverse team members, recognizing and dealing with individual team member's personal styles, capabilities and preferences, resolving conflict, celebrating achievements, and creating an environment that ensures the success of the project while maintaining team effectiveness. It also assesses the PM's leadership ability to be innovative and possess strategic insight and influence others both internal and external to the organization. These capabilities are difficult to develop but they are essential for an exceptional PM.

Build coalitions with team

Creating positive relationships between all project stakeholders to ensure the overall success of the project

1. How well does the PM foster team work to achieve project objectives?
2. How effective is the PM in maintaining a collaborative work environment between project team members?
3. How well does the PM develop positive relationships with project stakeholders?

Build consensus

Reaching general agreement on critical project issues

1. How well does the PM manage conflicting interests on the project team?
2. How well does the PM manage critical issues between the project team members?

3. How well does the PM manage critical issues within the project team?
4. How effective is the PM in reaching general agreement between all stakeholders?

Build trust

Leading the team members in a way that encourages them to rely on each other

1. How well does the PM build mutual trust between team members?
2. How well does the PM instill trust in their leadership from team members?

Develop and mentor others

Showing interest in the development of team members and is willing to work with them to reach their individual career goals while maintaining the overall project goals

1. How well does the PM engage with supervisors in developing individual goals for team members?
2. How open is the PM to assisting team members to achieve their career goals?

Cultural and ethnic sensitivity/leverages diverse thinking

Valuing the differences between team members and works to use them for the benefit of the project as well as the best interest of each member

1. How well does the PM understand the important aspects of a diverse work force (background, ethnicity, language, beliefs, etc....)?
2. How well does the PM utilize the experiences and capabilities that each member of the team brings to the project?

Direct/influential

Setting clear goals and expectations for the project team and achieve project objectives

1. How well does the PM communicate the intent or directives?
2. How well does the PM exert influence on others?
3. How well does the PM show accountability for their actions and outcomes?

Innovation

Encouraging the project team to think outside the box and to embrace new ideas and technologies

1. How well does the PM demonstrate creativity or develop unique engineering solutions?
2. How well does the PM adopt new ideas and/or technologies?
3. How well does the PM encourage innovation among team members?

Team builder

Planning, deliberating, and encouraging effective working relationships that bring out the best in team members

1. How well does the PM encourage positive communications within a team?
2. How well does the PM work closely with a team to solve problems as they arose?
3. How well does the PM encourage positive interaction between team members?
4. How well does the PM identify and effectively manage team gaps?
5. How well does the PM foster a productive work environment?

Team issue management

Utilizing systematic approach to evaluate and resolve alternative and/or conflicting points of view

1. How well does the PM evaluate issues that arise within the project team?

2. How well does the PM resolve conflicts between team members?

Communication

Using principles and practices of communication for complex technical and business information to relevant team members and stakeholders

1. How well does the PM ensure that efficient communication takes place between team members?

2. How effective is the PM in communicating technical and business information to relevant team members?

3. How well does the PM demonstrate active listening?

Timely decision making

Making important decisions related to the project or project team members in a timely manner to ensure highest project efficiency

1. How effective is the PM in making timely decisions that ensure project success?

Cognitive/Personal Effectiveness

This section is divided into two parts. The first addresses personal traits that are preferable in a PM in general. Some examples of these traits are self-awareness, courage, and personal effectiveness. The second part relates to personal attributes that make the person accountable, adaptable, enthusiastic, and mature. These competencies demonstrate personality traits that differentiate the performance of PM's while dealing with all project parties. It allows the person to have a greater and more positive impact during all project phases and also on the final product. It is worth noting the competencies highlighted in this category are the hardest to acquire as it takes a long time to develop a different behavior or a personality trait. However, with continuous

monitoring, small improvements can be tracked to ensure the success of improvement methods used.

1. The PM has impact and influence on project team members
2. The PM has initiative
3. The PM is accountable, responsible and Reliable
4. The PM is approachable, listens and relates to others
5. The PM is assertive
6. The PM is decisive
7. The PM is honest, ethical and trustworthy
8. The PM is energetic and enthusiastic
9. The PM is mature and professional
10. The PM values achievement and action
11. The PM possesses analytical thinking skills
12. The PM is courageous
13. The PM is personally effective
14. The PM is self-aware
15. The PM has vision
16. The PM is adaptable
17. The PM is credible and has integrity
18. The PM is detail oriented and organized

19. The PM has a positive attitude
20. The PM possesses adequate stress management
21. The PM is loyal
22. The PM is selfless
23. The PM is empathetic

The last category of the assessment, Cognitive/Personal Effectiveness includes specific personality traits which are self-explanatory and are reflected through interaction with the PM. Therefore, no definitions or questions were required to clarify them. These competencies are also the hardest to develop and take the longest time to enhance. This personal development should be a journey that every PM takes where s/he works with a mentor and reflects on activities that s/he have taken part of to enhance these traits that improve the performance of leaders in general and SHA PMs specifically.

Data Collection and Overview:

All the competencies identified within the assessment are of high importance to the exceptional performance of SHA PMs. However, some of these competencies are essential for every PM and are therefore considered basic. This means that their presence is a given and does not differentiate between average and exceptional performance. On the other hand, the possession of some of the competencies identified differentiates the performance of PMs from average to exception.

To create a quantitative assessment and one that provides results based on robust calculations, the relative importance of the competencies had to be identified numerically. This was done through collecting 90 data points that allowed the researcher to conduct analysis and create a structure for the assessment and, therefore, the tool. This was done through calculating a weight for each of the competencies which would allow the tool to compute a score based on the answers provided for the set of questions of each competency. Moreover, the tool computes a score for each category of the assessment and an overall score for the PM. Finally, the tool helps the PMs, supervisors, and organization in interpreting the results of the assessment by identifying the specific strengths and weaknesses of each PM being evaluated.

Creating the Survey

To achieve these results, a survey was created to collect the data needed for the analysis. The survey used Qualtrics, a survey platform provided by the University of Wisconsin-Madison. The main target audience for the survey were PM supervisors. Each supervisor was requested to go through the full length of the assessment twice; once for a PM that s/he believed was exceptional and once for a PM that s/he believed was average. Collecting two contrasting data points from

supervisors reduced the subjectivity of the responses between the different supervisors. This is because the analysis (detailed in the Data Analysis chapter) is based on the difference between the exceptional and average PMs rather than the absolute values provided by each supervisor.

For each of the two PMs that the supervisor filled the assessment for, there were two main sections. Firstly, a general information section, which aimed to identify any factors that had an effect on the PMs performance that were not related to the competencies. Secondly, the assessment section, where the supervisor answered each of the 145 questions relative to the PM in question.

Challenges

As mentioned in earlier sections, this assessment was created with the help of WisDOT professionals who worked tirelessly on tailoring it to the precise job description of WisDOT PMs in different regions. Unfortunately, however, when it came time to collect data, WisDOT was facing some internal management issues that led to putting all research efforts on hold. Their future involvement was not guaranteed, which created a major challenge for the completion of the research on time.

Consequently, the researcher had to reach out to other SHAs that would be willing to participate in such a research. This also meant that the survey needed to be more generic to include all SHAs and not have technical questions that only applied to WisDOT. Therefore, the researcher along with the other participants from the UW-Madison team worked on creating a similar survey which would be compatible with all SHAs. The researcher then reached out to 94 contacts in 47 SHAs that could provide useful input to the research. As a result, 50 supervisors participated, providing 90 data points from 12 states (distribution shown in figure 3). The cooperation of these SHAs allowed the researcher to proceed with the data analysis in a timely manner.

After several attempts, WisDOT granted the researcher the permission to collect data from WisDOT supervisors as well. This allowed for the collection of 55 more data points which made the sample more diverse and the analysis more robust.

Outputs

i. Geographical distribution

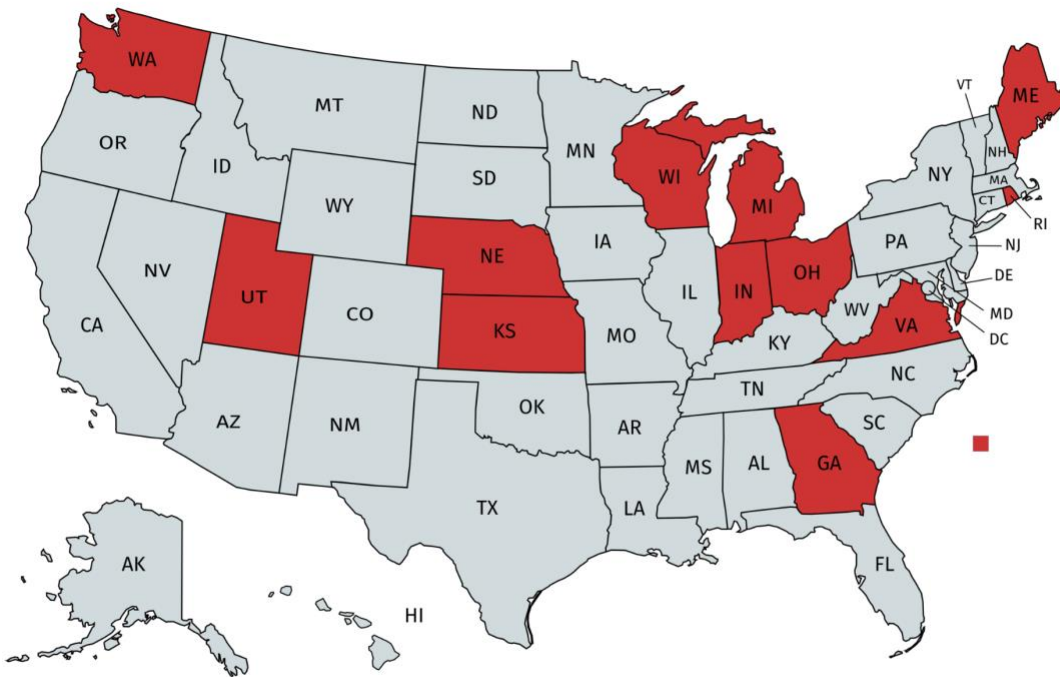


Figure 3: Geographic Distribution of Data Points

The data was collected from 12 different states around the US. These states are highlighted in red in figure 3. The majority of the points, however, were provided by WisDOT as they were the primary collaborators on this research effort.

ii. Demographics

This section reveals some of the general information that was collected for PMs included in this study. This section asked about the PMs’ experience in the construction field both within and outside of a SHA. This aimed to identify other causes that might lead to the difference in performance between “average” and “exceptional” PMs that is related to field experience rather than specific hard and soft skills.

For data collected from SHAs other than WisDOT:

Table 2: Demographics Summary Table - Non WisDOT

| Factor | Exceptional | | Average | |
|---|-------------|--------|---------|--------|
| | Mean | Median | Mean | Median |
| Years of experience in the construction industry | 19.4 | 17.5 | 14.4 | 10.0 |
| Years of field experience outside of a SHA | 5.2 | 2.0 | 5.2 | 2.0 |
| Years of field experience within a SHA | 17.4 | 18.0 | 12.6 | 9.0 |
| Years of experience as a PM outside of a SHA | 2.7 | 0.0 | 1.0 | 0.0 |
| Years of experience as a PM within a SHA | 10.3 | 8.0 | 7.2 | 5.3 |
| Number of projects managed outside of a SHA | 6.9 | 0.0 | 1.9 | 0.0 |
| Number of projects managed within SHA | 40.4 | 31.0 | 62.8 | 30.0 |

As shown in table 2, in most of these demographic metrics, the “exceptional” SHA PMs had more experience than the “average” SHA PMs. This is especially clear in the years of experience in the construction industry, the years of field experience within the SHA, years of experience as a PM outside and within the SHA, and the number of project managed outside of the SHA. The amount of field experience outside of the SHA was exactly the same for both classes of PMs. The only metric, however, where the “average” PMs exceeded the “exceptional” PMs was the number of projects managed within the SHA, where the “exceptional” PMs had a mean of 40.4 projects while the “average” PMS had a mean of 62.8 projects. This also contrasts the median

scores of the same category where “exceptional” PMs had a median of 31 projects and the “average” PMs had a median of 30 projects.

From these results, it can be interpreted that the “exceptional” PMs of SHAs other than WisDOT, generally, have more experience than the “average” PMs, most notably in the years of experience in the construction industry, the years of field experience within the organization, and the number of projects managed outside of the organization.

For data collected for WisDOT:

Table 3: Demographics Summary Table - WisDOT

| Factor | Exceptional | | Average | |
|---|--------------------|---------------|----------------|---------------|
| | Mean | Median | Mean | Median |
| Years of experience in the construction industry | 19.8 | 21.0 | 12.5 | 10.0 |
| Years of field experience outside of WisDOT | 3.7 | 2.5 | 4.6 | 2.5 |
| Years of field experience within WisDOT | 17.3 | 16.5 | 12.7 | 11.0 |
| Years of experience as a PM outside of WisDOT | 1.3 | 0.0 | 0.9 | 0.0 |
| Years of experience as a PM within WisDOT | 8.3 | 7.0 | 7.6 | 5.0 |
| Number of projects managed outside of WisDOT | 26.3 | 0.0 | 2.4 | 0.0 |
| Number of projects managed within WisDOT | 41.2 | 30.0 | 37.9 | 20.0 |

Table 3 shows that WisDOT PMs have a similar trend to the PMs of other SHAs. The experience for “exceptional” PMs exceeds the experience of “average” PMs in the years of experience in the construction industry, the years of field experience within WisDOT, the years of experience as a PM outside and within WisDOT and the number of projects managed within WisDOT. The most notable difference, however, is the number of projects managed outside WisDOT where “exceptional” PMs had an average of 26.3 while “average” PMs had an average of 2.4. The only exception in this case is the years of field experience outside of WisDOT, where the “exceptional” PMs had a mean of 3.7 years of experience and the “average” PMs had a mean of 4.6 years. Looking at the years of experience outside the organization as well as the number of projects managed outside the organization, it could be deducted that “exceptional” PMs might have been able to manage more projects in a shorter time period than the “average” PMs.

Combine analysis from WisDOT and other SHAs:

Table 4: Demographics Summary Table- Combined Data

| Factor | Exceptional | | Average | |
|---|--------------------|---------------|----------------|---------------|
| | Mean | Median | Mean | Median |
| Years of experience in the construction industry | 19.6 | 20.0 | 13.7 | 10.0 |
| Years of field experience outside of the SHA | 4.7 | 2.0 | 4.9 | 2.3 |
| Years of field experience within the SHA | 17.4 | 18.0 | 12.6 | 10.0 |
| Years of experience as a PM outside of the SHA | 2.2 | 0.0 | 1.0 | 0.0 |
| Years of experience as a PM within the SHA | 9.5 | 7.0 | 7.4 | 5.0 |
| Number of projects managed outside of the SHA | 14.9 | 0.0 | 2.1 | 0.0 |
| Number of projects managed within the SHA | 40.7 | 31.0 | 53.2 | 30.0 |

The results from both the WisDOT as well as the other states were close in terms of demographic metrics. Therefore, combining the results from both groups also show similar values. In this case, the “exceptional” PMs have higher values than the “average” PMs in the years of experience in the construction industry, the years of field experience within the organization, the years of experience as a PM within and outside the organization, and the number of projects managed outside of the organization (14.9 for “exceptional” PMs and 2.1 for “average” PMs). The two exceptions in this case were the years of field experience outside the organization and, most notably, the number of projects managed within the organization where the “average” PMs had a mean of 53.2 projects while the “exceptional” PMs had a mean of 40.7.

Comparative analysis between the means of WisDOT and other SHAs:

Table 5: Comparative Demographics Table - WisDOT vs. Other States

| Factor | WisDOT | | Other SHAs | |
|---|--------------------|----------------|--------------------|----------------|
| | Exceptional | Average | Exceptional | Average |
| Years of experience in the construction industry | 19.8 | 12.5 | 19.4 | 14.4 |
| Years of field experience outside of the SHA | 3.7 | 4.6 | 5.2 | 5.2 |
| Years of field experience within the SHA | 17.3 | 12.7 | 17.4 | 12.6 |
| Years of experience as a PM outside of the SHA | 1.3 | 0.9 | 2.7 | 1 |
| Years of experience as a PM within the SHA | 8.3 | 7.6 | 10.3 | 7.2 |
| Number of projects managed outside of the SHA | 26.3 | 2.4 | 6.9 | 1.9 |
| Number of projects managed within the SHA | 41.2 | 37.9 | 40.4 | 62.8 |

Comparing the results of “exceptional” PMs in both cases, the results are close in the years of experience in the construction industry, the years of field experience within the SHA and the number of projects managed within the SHA. The years of field experience outside of the SHA is a metric where WisDOT PMs are behind other SHAs as well as the years of experience as a PM outside and within the SHA. However, WisDOT PMs far exceed other SHA PMs in the number of projects managed outside the organization.

Taking a closer look at the “average” PMs for both states, the results are close in the years of experience in the construction industry, the years of field experience within and outside the organization, and the years of experience as a PM within and outside the organization. WisDOT PMs exceed other SHA PMs in the number of projects managed outside of the organization while other SHA PMs exceed WisDOT PMs in the number of projects managed within the organization.

Data Analysis

There were two main goals for the data analysis process.

1. Finding the relative importance of the competencies to the performance of PMs
2. Creating a quantitative assessment
3. Setting a benchmark scores that allowed the PMs to assess their competence as compared to others in the organization

Methodology

Finding the relative importance of the competencies is a challenging task. As detailed as the definitions and questions are, there is still the chance that supervisors perceive the scale differently; some would never give a perfect score, even to exceptional PMs, while others are more liberal with their judgement. Therefore, the researcher used a mathematical model that was created by a team of UW-Madison students. This model calculates a weight for every competency by using a comparison between each data point collected. This eliminates the bias that might arise from the variation between the supervisors filling in the assessment and produces data driven weights that reflect actual relative importance of competencies.

The weights obtained from the model were used to create the interactive assessment tool to provide WisDOT with a quantitative assessment.

The weights obtained were also used to find a score for each of PMs' assessments obtained during the data collection period. Given the distinction between exceptional and average, a cut-off score was calculated. Due to the diversity in locations that the data is obtained from, this cut-off score can be used as an industry-wide benchmark for PMs. This is reflected in the overall score of the PM at the end of the assessment.

Calculation of Weights

The main goal of the mathematical model used to calculate the weights is to identify the competencies that have the biggest impact on PMs' performance. To achieve this goal, the model works on maximizing the numerical difference between the responses obtained for exceptional and average PMs.

As all the input into the tool was in terms of questions, not competencies, a weight was calculated for each question separately. The weights of the questions within each competency were, then, combined to find a weight for the competency. Figure 4 shows the process of obtaining the weights for each question.

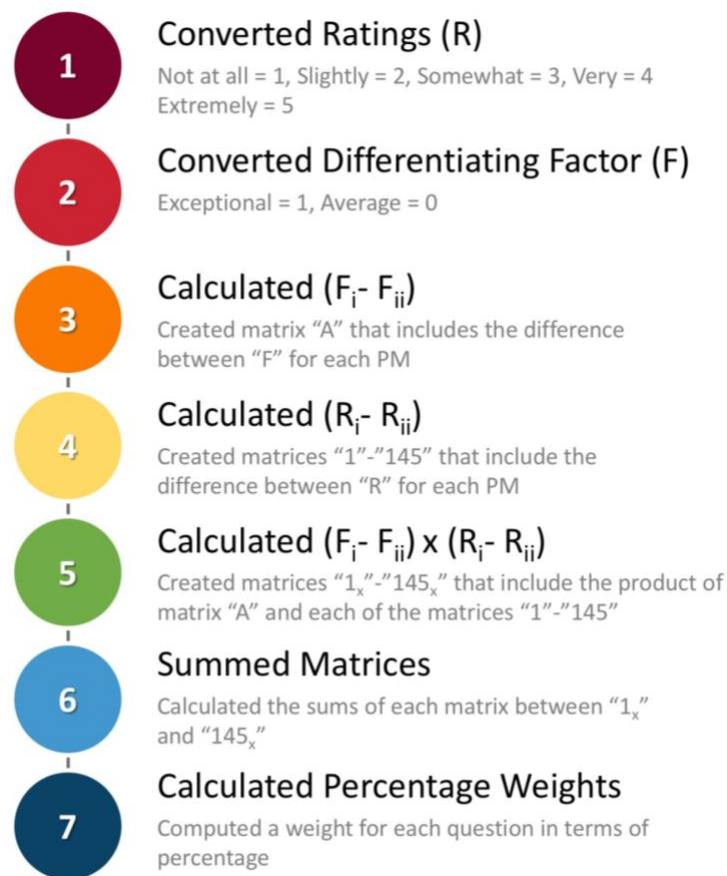


Figure 4: Mathematical Model Flow Chart

Diagram Explanation

Step 1

As the answers to all the questions of the assessment were obtained on the five-point scale: not at all, slightly, somewhat, very and extremely, the researcher had to convert it to a numerical scale that would allow for performing calculations. Therefore each response referred to by the researcher as a rating “R” was converted to a corresponding number where:

Not at all = 1

Slightly = 2

Somewhat = 3

Very = 5

Extremely = 5

Step 2

Another main piece of information needed for the model is the fact that each PM was classified by the supervisor as either exceptional or average – differentiating factor “F”. This was the key to creating a comparative model. Therefore, the differentiating factor “F” was converted into numerical terms where:

Exceptional = 1

Average = 0

Step 3

The researcher created a matrix “A” that showed the difference between the differentiating factor “F” for each pair of PMs. The following equation was used as a basis for creating the matrix:

$$F_i - F_{ii}$$

Where F_i is the differentiating factor for the first PM and F_{ii} is the differentiating factor for the second PM.

Table 6 shows the final layout of the matrix.

Table 6: Sample Matrix Layout

| | PM1 | PM2 | PM3 | PM4 | PM5 |
|------------|------------|------------|------------|------------|------------|
| PM1 | PM1 - PM1 | PM1 - PM2 | PM1 - PM3 | PM1 - PM4 | PM1 - PM5 |
| PM2 | PM2 - PM1 | PM2 - PM2 | PM2 - PM3 | PM2 - PM4 | PM2 - PM5 |
| PM3 | PM3 - PM1 | PM3 - PM2 | PM3 - PM3 | PM3 - PM4 | PM3 - PM5 |
| PM4 | PM4 - PM1 | PM4 - PM2 | PM4 - PM3 | PM4 - PM4 | PM4 - PM5 |
| PM5 | PM5 - PM1 | PM5 - PM2 | PM5 - PM3 | PM5 - PM4 | PM5 - PM5 |

Step 4

The researcher created matrices “1” to “145”, one for each question within the assessment, that show the difference between the rating “R” of each pair of PMs where the following equation was applied:

$$R_i - R_{ii}$$

Where R_i is the rating for the question of the first PM and R_{ii} is the rating for the question of the second PM. Table 6 shows the final layout of these matrices.

Step 5

The researcher created matrices “1_x” to “145_x”, one for each question, that showed the multiplication of matrix “A” by each of the matrices “1” to “145”. This calculation applied the following equation:

$$(F_i - F_{ii}) \times (R_i - R_{ii})$$

These matrices also take a similar form to that in table 6.

Step 6

A sum was calculated for each of the matrices “1_x” to “145_x”. This sum reflects the weight of this question within the assessment.

Step 7

The final step in the process of calculating a weight for each question was to get the weight of the competency in terms of a percentage. This was done by dividing the sum of each matrix “1_x” to “145_x” by the sum of the weights of all questions in the assessment.

Outputs: Overall

Table 7 shows each question along with its percentage weight as calculated using the mathematical model explained previously.

The table also shows the corresponding competency that the question was part of.

Table 7: Assessment Questions Arranged by Descending Order of Weights

| Competency | Question | Weight |
|--|---|--------|
| Communication management | 4. Does the PM ensure the exchange of high quality information that promotes comprehensive understanding and prevents communication issues? | 1.07% |
| Stakeholder Management | 2. How well does the PM manage the relationships with internal (region and bureau) stakeholders? | 1.03% |
| Communication management | 2. Does the PM ensure that sufficient communication takes place between all project stakeholders within the organization? | 1.02% |
| Communication management | 1. How effective are the communication management plans developed by the PM? | 1.01% |
| Budget management | 3. How well does the PM compare actual project cost levels to budgeted cost levels? | 1.00% |
| Understand project management concepts (FDM Chapter 2) | 2. How well does the PM execute project management processes and techniques throughout the project lifecycle? | 0.99% |
| The PM is accountable, responsible and Reliable | 3. The PM is accountable, responsible and Reliable | 0.98% |
| Build consensus | 3. How well does the PM manage critical issues within the project team? | 0.96% |
| Change management | 1. How well does the PM assess the need for changes and the impact of change on the project? | 0.95% |

| | | |
|---|--|-------|
| Understand project management concepts (FDM Chapter 2) | 3. How experienced is the PM in managing a variety of project types and complexities? | 0.95% |
| Communication management | 3. Does the PM ensure that sufficient communication takes place between project stakeholders external to the organization? | 0.95% |
| Risk and Issues management | 1. How effective is the PM in identifying potential issues and risks that are likely to affect the project? | 0.94% |
| Budget management | 2. Does the PM ensure that the project cost estimates are current and updated as needed? | 0.94% |
| Schedule management | 4. How well does the PM institute corrective action to keep projects on schedule? | 0.94% |
| Scope management | 1. How well does the PM define project requirements? | 0.93% |
| Communication | 1. How well does the PM ensure that efficient communication takes place between team members? | 0.93% |
| Build coalitions with team | 1. How well does the PM foster team work to achieve project objectives? | 0.92% |
| Stakeholder Management | 5. How well does the PM conduct negotiations with stakeholders? | 0.92% |
| Budget management | 1. How well does the PM develop project cost budgets? | 0.92% |
| Team issue management | 2. How well does the PM resolve conflicts between team members? | 0.91% |
| Develop and mentor others | 2. How open is the PM to assisting team members to achieve their career goals? | 0.91% |
| The PM has vision | 15. The PM has vision | 0.90% |
| Policy and Procedures | 3. How effective is the PM in administering consultant contracts? | 0.90% |
| Cultural and ethnic sensitivity/leverages diverse thinking | 2. How well does the PM utilize the experiences and capabilities that each member of the team brings to the project? | 0.89% |

| | | |
|---|--|-------|
| Scope management | 2. How well does the PM identify all the activity tasks needed for the project? | 0.89% |
| Budget management | 4. How well does the PM institute corrective action to keep projects on budget? | 0.88% |
| Quality management | 3. How well does the PM apply lessons learned? | 0.88% |
| The PM has initiative | 2. The PM has initiative | 0.88% |
| Risk and Issues management | 5. How well does the PM objectively resolve project issues while keeping a positive mindset? | 0.87% |
| Schedule management | 1. How well does the PM develop project delivery schedules? | 0.87% |
| Communication | 2. How effective is the PM in communicating technical and business information to relevant team members? | 0.86% |
| Quality management | 1. How well does the PM monitor the quality standards for the project? | 0.86% |
| Cultural and ethnic sensitivity/leverages diverse thinking | 1. How well does the PM understand the important aspects of a diverse work force (background, ethnicity, language, beliefs, etc....)? | 0.85% |
| Project Controls | 2. How well does the PM execute project control plans and adapt as necessary? | 0.84% |
| Team issue management | 1. How well does the PM evaluate issues that arise within the project team? | 0.84% |
| Change management | 4. How well does the PM document the causes of the variances and reasons being the corrective actions implemented so that others can improve their projects and avoid the same issues? | 0.83% |
| Risk and Issues management | 6. How well does the PM develop plans to minimize problems and ensure project success? | 0.83% |
| Schedule management | 5. How successful is the PM in keeping their projects on schedule? | 0.82% |
| Risk and Issues management | 4. How well does the PM mitigate and respond to unforeseen risks? | 0.82% |
| The PM is detail oriented and organized | 18. The PM is detail oriented and organized | 0.82% |
| Communication | 3. How well does the PM demonstrate active listening? | 0.82% |

| | | |
|--|---|-------|
| Scope management | 4. How well does the PM manage changes to the baseline scope throughout the project? | 0.81% |
| Change management | 2. How effectively does the PM implement required changes? | 0.81% |
| Risk and Issues management | 2. How effective is the PM in quantifying the risks to determine which risk events warrant a response? | 0.81% |
| Scope management | 3. How well does the PM establish the scope of a project? | 0.81% |
| Build coalitions with team | 3. How well does the PM develop positive relationships with project stakeholders? | 0.80% |
| Project Controls | 1. How well does the PM use department control systems and reports? | 0.80% |
| Problem Solving | 3. How effective is the PM identifying the root causes of problems? | 0.79% |
| Build consensus | 2. How well does the PM manage critical issues between the project team members? | 0.79% |
| Policy and Procedures | 7. How knowledgeable is the PM with policy and guidance in the Program Manual? | 0.79% |
| The PM has impact and influence on project team members | 1. The PM has impact and influence on project team members | 0.78% |
| Problem Solving | 2. How well does the PM anticipate problems that affect the project? | 0.78% |
| Stakeholder Management | 3. How well does the PM manage the relationships with external stakeholders? | 0.78% |
| Risk and Issues management | 3. How effective is the PM in developing contingency plans to respond to risks and identifying triggers to implement the contingency plan? | 0.77% |
| Understand project management concepts (FDM Chapter 2) | 1. How well does the PM understand the Knowledge Areas and concepts of project management as presented in the Project Management Institute PMBOK guide and FDM? | 0.77% |
| Schedule management | 3. How well does the PM compare actual schedules to planned schedules? | 0.77% |

| | | |
|--|--|-------|
| Stakeholder Management | 4. How well does the PM manage the relationships between internal and external stakeholders? | 0.77% |
| The PM is decisive | 6. The PM is decisive | 0.77% |
| Quality management | 2. How well does the PM take effective corrective actions to ensure compliance with standards? | 0.77% |
| Team builder | 1. How well does the PM encourage positive communications within a team? | 0.76% |
| Build coalitions with team | 2. How effective is the PM in maintaining a collaborative work environment between project team members? | 0.75% |
| The PM values achievement and action | 10. The PM values achievement and action | 0.75% |
| Team builder | 4. How well does the PM identify and effectively manage team gaps? | 0.75% |
| Innovation | 2. How well does the PM adopt new ideas and/or technologies? | 0.75% |
| Problem Solving | 4. How well does the PM gather the relevant facts and information needed for effective problem solving? | 0.74% |
| Innovation | 1. How well does the PM demonstrate creativity or develop unique engineering solutions? | 0.74% |
| Build consensus | 1. How well does the PM manage conflicting interests on the project team? | 0.74% |
| The PM is personally effective | 13. The PM is personally effective | 0.74% |
| Team builder | 2. How well does the PM work closely with a team to solve problems as they arose? | 0.72% |
| Change management | 3. How well does the PM react to project changes? | 0.71% |
| The PM is approachable, listens and relates to others | 4. The PM is approachable, listens and relates to others | 0.71% |
| Team builder | 5. How well does the PM foster a productive work environment? | 0.71% |
| Innovation | 3. How well does the PM encourage innovation among team members? | 0.70% |
| The PM is adaptable | 16. The PM is adaptable | 0.70% |

| | | |
|---|--|-------|
| The PM is self-aware | 14. The PM is self-aware | 0.70% |
| Stakeholder Management | 1. How well does the PM identify all internal and external stakeholders? | 0.70% |
| Schedule management | 2. Does the PM ensure that the progress and schedule data in PMP is accurate and up to date? | 0.70% |
| Team builder | 3. How well does the PM encourage positive interaction between team members? | 0.70% |
| Build trust | 1. How well does the PM build mutual trust between team members? | 0.70% |
| Build consensus | 4. How effective is the PM in reaching general agreement between all stakeholders? | 0.69% |
| Budget management | 5. How successful is the PM in keeping their projects within budget? | 0.69% |
| The PM is assertive | 5. The PM is assertive | 0.68% |
| Policy and Procedures | 4. How knowledgeable is the PM with the Wisconsin DNR cooperative agreement? | 0.68% |
| Develop and mentor others | 1. How well does the PM engage with supervisors in developing individual goals for team members? | 0.67% |
| The PM has a positive attitude | 19. The PM has a positive attitude | 0.67% |
| Problem Solving | 1. How well does the PM utilize a structured approach to problem solving? [1) Define the problem, 2) gather facts, 3) develop possible solutions, 4) analyze and compare solutions, 5) select a solution, 6) implement, 7) evaluate] | 0.67% |
| Application of relevant engineering principles | 4. How well does the PM maintain an up-to-date understanding of the concepts of multiple civil engineering disciplines? | 0.67% |
| Application of relevant engineering principles | 2. How well does the PM read and interpret engineering plans and drawings? | 0.66% |
| Knowledge Networks | 2. PM has experience of working in more than one Region Office/Statewide Bureau. (Y/N) | 0.66% |
| Direct/influential | 1. How well does the PM communicate the intent or directives? | 0.66% |
| Direct/influential | 3. How well does the PM show accountability for their actions and outcomes? | 0.65% |

| | | |
|--|---|-------|
| Performance Measures | 6. How well does the PM monitor and measure the performance of consultants and contractors? | 0.65% |
| Policy and Procedures | 5. How knowledgeable is the PM with the policy and guidance in the CMM (Construction and Materials Manual)? | 0.65% |
| Policy and Procedures | 1. How knowledgeable is the PM with policy and guidance in the FDM (Facilities Development Manual)? | 0.64% |
| Policy and Procedures | 2. How well does the PM interpret and implement policy and guidance from the FDM (such as State Highway Rehabilitation (SHR) Facilities Development Process or Exceptions to Standards Process) into his or her projects? | 0.63% |
| Knowledge Networks | 3. How effective is the PM in collaborating with other functional areas involved in the project development process? | 0.62% |
| Knowledge Networks | 5. How well does the PM understand the roles and capabilities of the regional and statewide bureau technical resource areas? | 0.62% |
| The PM is courageous | 12. The PM is courageous | 0.62% |
| Awareness and use of Information Technology | 4. How effective is the PM in encouraging others to use available software and applications? | 0.61% |
| The PM is credible and has integrity | 17. The PM is credible and has integrity | 0.61% |
| The PM is energetic and enthusiastic | 8. The PM is energetic and enthusiastic | 0.61% |
| Performance Measures | 1. How knowledgeable is the PM of the Department's MAPSS (Mobility, Accountability, Preservation, Safety & Service) Goals? | 0.60% |
| Performance Measures | 5. Does the PM participate in identifying and implementing changes to improve the Region's/Bureau's Performance Measures metrics? | 0.59% |
| Technology and Software | 3. How well does the PM know and use construction management software such as Field Manager, Primavera P6 and Contract Management? | 0.58% |

| | | |
|---|--|-------|
| The PM possesses adequate stress management | 20. The PM possesses adequate stress management | 0.57% |
| The PM is mature and professional | 9. The PM is mature and professional | 0.57% |
| Application of relevant engineering principles | 3. How well does the PM implement concepts and practices of efficiencies on projects? | 0.57% |
| Application of relevant engineering principles | 1. How well does the PM implement design and construction solutions through application of engineering knowledge and judgment? | 0.57% |
| Direct/influential | 2. How well does the PM exert influence on others? | 0.56% |
| Knowledge Networks | 6. How effectively does the PM utilize available regional and statewide bureau resources to achieve project goals? | 0.56% |
| The PM possesses analytical thinking skills | 11. The PM possesses analytical thinking skills | 0.55% |
| The PM is selfless | 22. The PM is selfless | 0.55% |
| Performance Measures | 4. How effective is the PM in using the performance measures and indicators to improve their projects' performance? | 0.55% |
| Communication management | 5. Does the PM ensure that Lessons Learned on the project are shared with others to improve their projects and processes? | 0.54% |
| Technology and Software | 1. How well does the PM know and use project management software such as Design PMP (Project Management Plan application) and pseTrak? | 0.54% |
| Build trust | 2. How well does the PM instill trust in their leadership from team members? | 0.54% |
| Performance Measures | 3. How knowledgeable is the PM with the Department's Performance Indicators? | 0.50% |
| The PM is honest, ethical and trustworthy | 7. The PM is honest, ethical and trustworthy | 0.50% |

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| Timely decision making | 1. How effective is the PM in making timely decisions that ensure project success? | 0.50% |
| Awareness and use of Information Technology | 2. How well does the PM understand the capabilities of engineering design software? | 0.47% |
| Knowledge Networks | 4. How knowledgeable is the PM in all the phases of the project delivery process and their interrelationships? | 0.47% |
| Standards and Specifications | 1. How knowledgeable is the PM with Standard Specifications? | 0.46% |
| Technology and Software | 4. How well does the PM implement new technology innovations (hardware, software, etc.) into their work? | 0.45% |
| Legal Issues | 1. How knowledgeable is the PM with consultant contract language? | 0.45% |
| Performance Measures | 2. How knowledgeable is the PM with the Department's Performance Measures? | 0.45% |
| Standards and Specifications | 3. How knowledgeable is the PM in non-DOT standards and specifications such as bicycle-pedestrian safety standards and access control requirements? | 0.45% |
| Policy and Procedures | 6. How well does the PM interpret and implement policy and guidance from the CMM (such as Construction Finals Process into his or her projects)? | 0.44% |
| Legal Issues | 4. How well does the PM identify and properly address potential legal issues as they arise? | 0.43% |
| The PM is loyal | 21. The PM is loyal | 0.43% |
| Awareness and use of Information Technology | 3. How proficient is the PM in presenting and displaying data and results using the various software applications provided by the Department? | 0.42% |
| Technology and Software | 2. How well does the PM know and use financial software such as MIIP (Management Information for the Improvement Program) and FIIPS (Financial Integrated Improvement Programming System)? | 0.42% |
| Legal Issues | 3. How knowledgeable is the PM with National Transportation Laws and Transportation State Statutes, such as TRANS 220, 404 Permits, USCG sections 9 and 10 permits, American Disabilities Act (ADA), etc.? | 0.41% |
| Awareness and use of Information Technology | b. Spreadsheet software | 0.41% |
| The PM is empathetic | 23. The PM is empathetic | 0.40% |

| | | |
|---|--|-------|
| Policy and Procedures | 8. How well does the PM employ SDIC (Systematic Development of Informed Consent) techniques? | 0.39% |
| Legal Issues | 2. How knowledgeable is the PM with National Environmental Protection Act (NEPA) and Wisconsin Environmental Protection Act (WEPA)? | 0.38% |
| Knowledge Networks | 7. How effective is the PM in encouraging others to utilize available regional and statewide bureau resources. | 0.37% |
| Awareness of current research | 1. How knowledgeable is the PM with materials and publications by transportation engineering organizations such as AASHTO, Transportation Research Board (TRB) and technical bulletins from industry associations? | 0.34% |
| Awareness and use of Information Technology | 1. How well does the PM understand and make use of software applications provided by DOT? a. Word processing software | 0.34% |
| Standards and Specifications | 2. How knowledgeable is the PM with development and administration of contract Special Provisions? | 0.30% |
| Awareness and use of Information Technology | d. Markup software (Adobe Acrobat, Bluebeam, etc.) | 0.24% |
| Degrees, Certifications and Professional Registrations | 2. The PM has earned PMI's Project Management Professional certification? (Y/N) | 0.24% |
| Problem Solving | 5. How effective is the PM in solving problems that arise on their project? | 0.21% |
| Awareness and use of Information Technology | c. Presentation software | 0.18% |
| Awareness of current research | 2. How well has the PM been able to make use of non-DOT sources of information to expand their knowledge in a specific area or find solutions to a problem? | 0.09% |
| Degrees, Certifications and Professional Registrations | 1. The PM has achieved a master's or PhD Degree in engineering (Y/N) | 0.08% |
| Knowledge Networks | 1. PM has experience of working in more than one functional area of the project development process. (Y/N) | 0.08% |

By reviewing the analysis provided in table 7, it can be concluded that the questions that had the most impact on the scores of the PMs were ones related to communication, stakeholder management, and dealing with complex issues during the project lifecycle, like changes. These weights reflect the highest difference in score between “exceptional” and “average” PMs based on the calculations performed. It can also be observed that most of these competencies are part of the soft skills categories rather than the hard skills categories. They reflect the personal attributes, leadership and management skills of the PMs which, along with the technical knowledge and skills, allows them to excel at managing complex projects where many stakeholders are involved and where many communication issues arise.

Grouping these questions together by competency reveals the most important competencies that differentiate between “average” and “exceptional” PMs. This grouping process reflects the impact of each of these competencies on the performance of the PM.

It is also important to note that a lot of the technical skills do not differentiate between the performance of “average” and “exceptional” PMs. This is not because these competencies are not important. But rather, because most of these competencies are possessed by “average” and “exceptional” PMs alike and, therefore, do not differentiate their performance.

Table 8 shows the weights of the questions arranged from highest to lowest while being grouped by category.

Table 8: Assessment Questions Arranged by Descending Order of Weights Within Respective Categories

| Category | Competency | Question | Weight |
|----------------------------------|---|--|--------|
| Cognitive/Personal Effectiveness | The PM is accountable, responsible and Reliable | 3. The PM is accountable, responsible and Reliable | 0.98% |
| Cognitive/Personal Effectiveness | The PM has vision | 15. The PM has vision | 0.90% |
| Cognitive/Personal Effectiveness | The PM has initiative | 2. The PM has initiative | 0.88% |
| Cognitive/Personal Effectiveness | The PM is detail oriented and organized | 18. The PM is detail oriented and organized | 0.82% |
| Cognitive/Personal Effectiveness | The PM has impact and influence on project team members | 1. The PM has impact and influence on project team members | 0.78% |
| Cognitive/Personal Effectiveness | The PM is decisive | 6. The PM is decisive | 0.77% |
| Cognitive/Personal Effectiveness | The PM values achievement and action | 10. The PM values achievement and action | 0.75% |
| Cognitive/Personal Effectiveness | The PM is personally effective | 13. The PM is personally effective | 0.74% |
| Cognitive/Personal Effectiveness | The PM is approachable, listens and relates to others | 4. The PM is approachable, listens and relates to others | 0.71% |
| Cognitive/Personal Effectiveness | The PM is adaptable | 16. The PM is adaptable | 0.70% |
| Cognitive/Personal Effectiveness | The PM is self-aware | 14. The PM is self-aware | 0.70% |
| Cognitive/Personal Effectiveness | The PM is assertive | 5. The PM is assertive | 0.68% |
| Cognitive/Personal Effectiveness | The PM has a positive attitude | 19. The PM has a positive attitude | 0.67% |
| Cognitive/Personal Effectiveness | The PM is courageous | 12. The PM is courageous | 0.62% |
| Cognitive/Personal Effectiveness | The PM is credible and has integrity | 17. The PM is credible and has integrity | 0.61% |

| | | | |
|--|---|--|-------|
| Cognitive/Personal Effectiveness | The PM is energetic and enthusiastic | 8. The PM is energetic and enthusiastic | 0.61% |
| Cognitive/Personal Effectiveness | The PM possesses adequate stress management | 20. The PM possesses adequate stress management | 0.57% |
| Cognitive/Personal Effectiveness | The PM is mature and professional | 9. The PM is mature and professional | 0.57% |
| Cognitive/Personal Effectiveness | The PM possesses analytical thinking skills | 11. The PM possesses analytical thinking skills | 0.55% |
| Cognitive/Personal Effectiveness | The PM is selfless | 22. The PM is selfless | 0.55% |
| Cognitive/Personal Effectiveness | The PM is honest, ethical and trustworthy | 7. The PM is honest, ethical and trustworthy | 0.50% |
| Cognitive/Personal Effectiveness | The PM is loyal | 21. The PM is loyal | 0.43% |
| Cognitive/Personal Effectiveness | The PM is empathetic | 23. The PM is empathetic | 0.40% |
| Industry Knowledge and Experience | Problem Solving | 3. How effective is the PM identifying the root causes of problems? | 0.79% |
| Industry Knowledge and Experience | Problem Solving | 2. How well does the PM anticipate problems that affect the project? | 0.78% |
| Industry Knowledge and Experience | Problem Solving | 4. How well does the PM gather the relevant facts and information needed for effective problem solving? | 0.74% |
| Industry Knowledge and Experience | Problem Solving | 1. How well does the PM utilize a structured approach to problem solving? [1) Define the problem, 2) gather facts, 3) develop possible solutions, 4) analyze and compare solutions, 5) select a solution, 6) implement, 7) evaluate] | 0.67% |
| Industry Knowledge and Experience | Application of relevant engineering principles | 4. How well does the PM maintain an up-to-date understanding of the concepts of multiple civil engineering disciplines? | 0.67% |
| Industry Knowledge and Experience | Application of relevant engineering principles | 2. How well does the PM read and interpret engineering plans and drawings? | 0.66% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | 4. How effective is the PM in encouraging others to use available software and applications? | 0.61% |
| Industry Knowledge and Experience | Application of relevant engineering principles | 3. How well does the PM implement concepts and practices of efficiencies on projects? | 0.57% |
| Industry Knowledge and Experience | Application of relevant engineering principles | 1. How well does the PM implement design and construction solutions through application of engineering knowledge and judgment? | 0.57% |

| | | | |
|--|---|--|-------|
| Industry Knowledge and Experience | Awareness and use of Information Technology | 2. How well does the PM understand the capabilities of engineering design software? | 0.47% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | 3. How proficient is the PM in presenting and displaying data and results using the various software applications provided by the Department? | 0.42% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | b. Spreadsheet software | 0.41% |
| Industry Knowledge and Experience | Awareness of current research | 1. How knowledgeable is the PM with materials and publications by transportation engineering organizations such as AASHTO, Transportation Research Board (TRB) and technical bulletins from industry associations? | 0.34% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | 1. How well does the PM understand and make use of software applications provided by WisDOT? a. Word processing software | 0.34% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | d. Markup software (Adobe Acrobat, Bluebeam, etc.) | 0.24% |
| Industry Knowledge and Experience | Degrees, Certifications and Professional Registrations | 2. The PM has earned PMI's Project Management Professional certification? (Y/N) | 0.24% |
| Industry Knowledge and Experience | Problem Solving | 5. How effective is the PM in solving problems that arise on their project? | 0.21% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | c. Presentation software | 0.18% |
| Industry Knowledge and Experience | Awareness of current research | 2. How well has the PM been able to make use of non-WisDOT sources of information to expand their knowledge in a specific area or find solutions to a problem? | 0.09% |
| Industry Knowledge and Experience | Degrees, Certifications and Professional Registrations | 1. The PM has achieved a master's or PhD Degree in engineering (Y/N) | 0.08% |
| Leadership | Build consensus | 3. How well does the PM manage critical issues within the project team? | 0.96% |
| Leadership | Communication | 1. How well does the PM ensure that efficient communication takes place between team members? | 0.93% |
| Leadership | Build coalitions with team | 1. How well does the PM foster team work to achieve project objectives? | 0.92% |
| Leadership | Team issue management | 2. How well does the PM resolve conflicts between team members? | 0.91% |
| Leadership | Develop and mentor others | 2. How open is the PM to assisting team members to achieve their career goals? | 0.91% |

| | | | | |
|-------------------|--|-----------------------|---|-------|
| Leadership | Cultural and sensitivity/leverages thinking | ethnic diverse | 2. How well does the PM utilize the experiences and capabilities that each member of the team brings to the project? | 0.89% |
| Leadership | Communication | | 2. How effective is the PM in communicating technical and business information to relevant team members? | 0.86% |
| Leadership | Cultural and sensitivity/leverages thinking | ethnic diverse | 1. How well does the PM understand the important aspects of a diverse work force (background, ethnicity, language, beliefs, etc....)? | 0.85% |
| Leadership | Team issue management | | 1. How well does the PM evaluate issues that arise within the project team? | 0.84% |
| Leadership | Communication | | 3. How well does the PM demonstrate active listening? | 0.82% |
| Leadership | Build coalitions with team | | 3. How well does the PM develop positive relationships with project stakeholders? | 0.80% |
| Leadership | Build consensus | | 2. How well does the PM manage critical issues between the project team members? | 0.79% |
| Leadership | Team builder | | 1. How well does the PM encourage positive communications within a team? | 0.76% |
| Leadership | Build coalitions with team | | 2. How effective is the PM in maintaining a collaborative work environment between project team members? | 0.75% |
| Leadership | Team builder | | 4. How well does the PM identify and effectively manage team gaps? | 0.75% |
| Leadership | Innovation | | 2. How well does the PM adopt new ideas and/or technologies? | 0.75% |
| Leadership | Innovation | | 1. How well does the PM demonstrate creativity or develop unique engineering solutions? | 0.74% |
| Leadership | Build consensus | | 1. How well does the PM manage conflicting interests on the project team? | 0.74% |
| Leadership | Team builder | | 2. How well does the PM work closely with a team to solve problems as they arose? | 0.72% |
| Leadership | Team builder | | 5. How well does the PM foster a productive work environment? | 0.71% |
| Leadership | Innovation | | 3. How well does the PM encourage innovation among team members? | 0.70% |
| Leadership | Team builder | | 3. How well does the PM encourage positive interaction between team members? | 0.70% |
| Leadership | Build trust | | 1. How well does the PM build mutual trust between team members? | 0.70% |
| Leadership | Build consensus | | 4. How effective is the PM in reaching general agreement between all stakeholders? | 0.69% |

| | | | | |
|--|----------------------------------|--|---|-------|
| Leadership | Develop and mentor others | 1. How well does the PM engage with supervisors in developing individual goals for team members? | 0.67% | |
| Leadership | Direct/influential | 1. How well does the PM communicate the intent or directives? | 0.66% | |
| Leadership | Direct/influential | 3. How well does the PM show accountability for their actions and outcomes? | 0.65% | |
| Leadership | Direct/influential | 2. How well does the PM exert influence on others? | 0.56% | |
| Leadership | Build trust | 2. How well does the PM instill trust in their leadership from team members? | 0.54% | |
| Leadership | Timely decision making | 1. How effective is the PM in making timely decisions that ensure project success? | 0.50% | |
| Project Management Knowledge Experience | and | Communication management | 4. Does the PM ensure the exchange of high quality information that promotes comprehensive understanding and prevents communication issues? | 1.07% |
| Project Management Knowledge Experience | and | Stakeholder Management | 2. How well does the PM manage the relationships with internal (region and bureau) stakeholders? | 1.03% |
| Project Management Knowledge Experience | and | Communication management | 2. Does the PM ensure that sufficient communication takes place between all project stakeholders within the organization? | 1.02% |
| Project Management Knowledge Experience | and | Communication management | 1. How effective are the communication management plans developed by the PM? | 1.01% |
| Project Management Knowledge Experience | and | Budget management | 3. How well does the PM compare actual project cost levels to budgeted cost levels? | 1.00% |
| Project Management Knowledge Experience | and | Understand project management concepts (FDM Chapter 2) | 2. How well does the PM execute project management processes and techniques throughout the project lifecycle? | 0.99% |

| | | | | |
|--|------------|---|--|-------|
| Project Management Knowledge Experience | and | Change management | 1. How well does the PM assess the need for changes and the impact of change on the project? | 0.95% |
| Project Management Knowledge Experience | and | Understand project management concepts (FDM Chapter 2) | 3. How experienced is the PM in managing a variety of project types and complexities? | 0.95% |
| Project Management Knowledge Experience | and | Communication management | 3. Does the PM ensure that sufficient communication takes place between project stakeholders external to the organization? | 0.95% |
| Project Management Knowledge Experience | and | Risk and Issues management | 1. How effective is the PM in identifying potential issues and risks that are likely to affect the project? | 0.94% |
| Project Management Knowledge Experience | and | Budget management | 2. Does the PM ensure that the project cost estimates are current and updated as needed? | 0.94% |
| Project Management Knowledge Experience | and | Schedule management | 4. How well does the PM institute corrective action to keep projects on schedule? | 0.94% |
| Project Management Knowledge Experience | and | Scope management | 1. How well does the PM define project requirements? | 0.93% |
| Project Management Knowledge Experience | and | Budget management | 1. How well does the PM develop project cost budgets? | 0.92% |
| Project Management Knowledge Experience | and | Stakeholder Management | 5. How well does the PM conduct negotiations with stakeholders? | 0.92% |

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|--|------------|-----------------------------------|--|-------|
| Project Management Knowledge Experience | and | Scope management | 2. How well does the PM identify all the activity tasks needed for the project? | 0.89% |
| Project Management Knowledge Experience | and | Budget management | 4. How well does the PM institute corrective action to keep projects on budget? | 0.88% |
| Project Management Knowledge Experience | and | Quality management | 3. How well does the PM apply lessons learned? | 0.88% |
| Project Management Knowledge Experience | and | Risk and Issues management | 5. How well does the PM objectively resolve project issues while keeping a positive mindset? | 0.87% |
| Project Management Knowledge Experience | and | Schedule management | 1. How well does the PM develop project delivery schedules? | 0.87% |
| Project Management Knowledge Experience | and | Quality management | 1. How well does the PM monitor the quality standards for the project? | 0.86% |
| Project Management Knowledge Experience | and | Project Controls | 2. How well does the PM execute project control plans and adapt as necessary? | 0.84% |
| Project Management Knowledge Experience | and | Change management | 4. How well does the PM document the causes of the variances and reasons being the corrective actions implemented so that others can improve their projects and avoid the same issues? | 0.83% |
| Project Management Knowledge Experience | and | Risk and Issues management | 6. How well does the PM develop plans to minimize problems and ensure project success? | 0.83% |

| | | | | |
|--|------------|-----------------------------------|--|-------|
| Project Management Knowledge Experience | and | Schedule management | 5. How successful is the PM in keeping their projects on schedule? | 0.82% |
| Project Management Knowledge Experience | and | Risk and Issues management | 4. How well does the PM mitigate and respond to unforeseen risks? | 0.82% |
| Project Management Knowledge Experience | and | Change management | 2. How effectively does the PM implement required changes? | 0.81% |
| Project Management Knowledge Experience | and | Risk and Issues management | 2. How effective is the PM in quantifying the risks to determine which risk events warrant a response? | 0.81% |
| Project Management Knowledge Experience | and | Scope management | 4. How well does the PM manage changes to the baseline scope throughout the project? | 0.81% |
| Project Management Knowledge Experience | and | Scope management | 3. How well does the PM establish the scope of a project? | 0.81% |
| Project Management Knowledge Experience | and | Project Controls | 1. How well does the PM use department control systems and reports? | 0.80% |
| Project Management Knowledge Experience | and | Stakeholder Management | 3. How well does the PM manage the relationships with external stakeholders? | 0.78% |
| Project Management Knowledge Experience | and | Risk and Issues management | 3. How effective is the PM in developing contingency plans to respond to risks and identifying triggers to implement the contingency plan? | 0.77% |

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|--|------------|---|---|-------|
| Project Management Knowledge Experience | and | Understand project management concepts (FDM Chapter 2) | 1. How well does the PM understand the Knowledge Areas and concepts of project management as presented in the Project Management Institute PMBOK guide and FDM? | 0.77% |
| Project Management Knowledge Experience | and | Schedule management | 3. How well does the PM compare actual schedules to planned schedules? | 0.77% |
| Project Management Knowledge Experience | and | Stakeholder Management | 4. How well does the PM manage the relationships between internal and external stakeholders? | 0.77% |
| Project Management Knowledge Experience | and | Quality management | 2. How well does the PM take effective corrective actions to ensure compliance with standards? | 0.77% |
| Project Management Knowledge Experience | and | Change management | 3. How well does the PM react to project changes? | 0.71% |
| Project Management Knowledge Experience | and | Schedule management | 2. Does the PM ensure that the progress and schedule data in PMP is accurate and up to date? | 0.70% |
| Project Management Knowledge Experience | and | Stakeholder Management | 1. How well does the PM identify all internal and external stakeholders? | 0.70% |
| Project Management Knowledge Experience | and | Budget management | 5. How successful is the PM in keeping their projects within budget? | 0.69% |
| Project Management Knowledge Experience | and | Communication management | 5. Does the PM ensure that Lessons Learned on the project are shared with others to improve their projects and processes? | 0.54% |

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|---|------------------------------|---|-------|
| DOT Operational Knowledge and Experience | Policy and Procedures | 3. How effective is the PM in administering consultant contracts? | 0.90% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 7. How knowledgeable is the PM with policy and guidance in the Program Manual? | 0.79% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 4. How knowledgeable is the PM with the Wisconsin DNR cooperative agreement? | 0.68% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 2. PM has experience of working in more than one Region Office/Statewide Bureau. (Y/N) | 0.66% |
| DOT Operational Knowledge and Experience | Performance Measures | 6. How well does the PM monitor and measure the performance of consultants and contractors? | 0.65% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 5. How knowledgeable is the PM with the policy and guidance in the CMM (Construction and Materials Manual)? | 0.65% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 1. How knowledgeable is the PM with policy and guidance in the FDM (Facilities Development Manual)? | 0.64% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 2. How well does the PM interpret and implement policy and guidance from the FDM (such as State Highway Rehabilitation (SHR) Facilities Development Process or Exceptions to Standards Process) into his or her projects? | 0.63% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 3. How effective is the PM in collaborating with other functional areas involved in the project development process? | 0.62% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 5. How well does the PM understand the roles and capabilities of the regional and statewide bureau technical resource areas? | 0.62% |
| DOT Operational Knowledge and Experience | Performance Measures | 1. How knowledgeable is the PM of the Department's MAPSS (Mobility, Accountability, Preservation, Safety & Service) Goals? | 0.60% |

| | | | |
|---|-------------------------------------|--|-------|
| DOT Operational Knowledge and Experience | Performance Measures | 5. Does the PM participate in identifying and implementing changes to improve the Region's/Bureau's Performance Measures metrics? | 0.59% |
| DOT Operational Knowledge and Experience | Technology and Software | 3. How well does the PM know and use construction management software such as Field Manager, Primavera P6 and Contract Management? | 0.58% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 6. How effectively does the PM utilize available regional and statewide bureau resources to achieve project goals? | 0.56% |
| DOT Operational Knowledge and Experience | Performance Measures | 4. How effective is the PM in using the performance measures and indicators to improve their projects' performance? | 0.55% |
| DOT Operational Knowledge and Experience | Technology and Software | 1. How well does the PM know and use project management software such as Design PMP (Project Management Plan application) and pseTrak? | 0.54% |
| DOT Operational Knowledge and Experience | Performance Measures | 3. How knowledgeable is the PM with the Department's Performance Indicators? | 0.50% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 4. How knowledgeable is the PM in all the phases of the project delivery process and their interrelationships? | 0.47% |
| DOT Operational Knowledge and Experience | Standards and Specifications | 1. How knowledgeable is the PM with Standard Specifications? | 0.46% |
| DOT Operational Knowledge and Experience | Legal Issues | 1. How knowledgeable is the PM with consultant contract language? | 0.45% |
| DOT Operational Knowledge and Experience | Technology and Software | 4. How well does the PM implement new technology innovations (hardware, software, etc.) into their work? | 0.45% |
| DOT Operational Knowledge and Experience | Performance Measures | 2. How knowledgeable is the PM with the Department's Performance Measures? | 0.45% |
| DOT Operational Knowledge and Experience | Standards and Specifications | 3. How knowledgeable is the PM in non-WisDOT standards and specifications such as bicycle-pedestrian safety standards and access control requirements? | 0.45% |

| | | | |
|---|-------------------------------------|--|-------|
| DOT Operational Knowledge and Experience | Policy and Procedures | 6. How well does the PM interpret and implement policy and guidance from the CMM (such as Construction Finals Process into his or her projects)? | 0.44% |
| DOT Operational Knowledge and Experience | Legal Issues | 4. How well does the PM identify and properly address potential legal issues as they arise? | 0.43% |
| DOT Operational Knowledge and Experience | Technology and Software | 2. How well does the PM know and use financial software such as MIIP (Management Information for the Improvement Program) and FIIPS (Financial Integrated Improvement Programming System)? | 0.42% |
| DOT Operational Knowledge and Experience | Legal Issues | 3. How knowledgeable is the PM with National Transportation Laws and Transportation State Statutes, such as TRANS 220, 404 Permits, USCG sections 9 and 10 permits, American Disabilities Act (ADA), etc.? | 0.41% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 8. How well does the PM employ SDIC (Systematic Development of Informed Consent) techniques? | 0.39% |
| DOT Operational Knowledge and Experience | Legal Issues | 2. How knowledgeable is the PM with National Environmental Protection Act (NEPA) and Wisconsin Environmental Protection Act (WEPA)? | 0.38% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 7. How effective is the PM in encouraging others to utilize available regional and statewide bureau resources. | 0.37% |
| DOT Operational Knowledge and Experience | Standards and Specifications | 2. How knowledgeable is the PM with development and administration of contract Special Provisions? | 0.30% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 1. PM has experience of working in more than one functional area of the project development process. (Y/N) | 0.08% |

Table 8 helps in demonstrating the most important highly differentiating questions in each category, which also helps in highlighting the most important competencies within the categories. The different weights shown in this table emphasize the relative

importance of several competency categories over others in differentiating the performance of “average” and “exceptional” PMs which is reflected in the weight of the questions.

Competency Weights: Overall

Even though the assessment tool uses the weights of questions to calculate scores for each PM, calculating a weight for each competency was an important part of this study to provide the industry with insight into the individual competencies that have the highest impact on the performance of PMs.

As different competencies had different numbers of questions, simply adding the weights of the question would be a biased way of calculation as the competencies with more questions would be at an advantage. Therefore, weight of each individual competency was calculated using the average of the weights of all the questions corresponding to this competency. This average was then used to get a percentage weight for each competency within the assessment.

Table 9 shows the competencies, along with their corresponding categories, arranged in descending order of their weights. This table highlights the most important competencies in terms of overall weight. These are the competencies that have the highest importance in differentiating between exceptional and average performance of PMs.

Table 9: Competency Arranged in Descending Order of Weights

| Category | Competency | Weight |
|---|--|--------|
| Cognitive/Personal Effectiveness | The PM is accountable, responsible and Reliable | 2.62% |
| Project Management Knowledge and Experience | Communication management | 2.44% |
| Project Management Knowledge and Experience | Understand project management concepts (FDM Chapter 2) | 2.41% |
| Leadership | Communication leadership | 2.40% |
| Cognitive/Personal Effectiveness | The PM has vision | 2.40% |

| | | |
|--|--|-------|
| Project Management Knowledge and Experience | Budget management | 2.35% |
| Leadership | Direct/influential | 2.35% |
| Cognitive/Personal Effectiveness | The PM has initiative | 2.34% |
| Leadership | Build trust | 2.33% |
| Project Management Knowledge and Experience | Scope management | 2.29% |
| Project Management Knowledge and Experience | Risk and Issues management | 2.24% |
| Project Management Knowledge and Experience | Stakeholder Management | 2.23% |
| Project Management Knowledge and Experience | Quality management | 2.22% |
| Project Management Knowledge and Experience | Change management | 2.20% |
| Leadership | Build coalitions with team | 2.20% |
| Project Management Knowledge and Experience | Project Controls | 2.18% |
| Project Management Knowledge and Experience | Schedule management | 2.18% |
| Cognitive/Personal Effectiveness | The PM is detail oriented and organized | 2.17% |
| Leadership | Timely decision making | 2.17% |
| Cognitive/Personal Effectiveness | The PM has impact and influence on project team members | 2.08% |
| Cognitive/Personal Effectiveness | The PM is decisive | 2.04% |
| Cognitive/Personal Effectiveness | The PM values achievement and action | 2.01% |
| Leadership | Team issue management | 1.98% |
| Leadership | Team builder | 1.96% |
| Leadership | Build consensus | 1.96% |
| Cognitive/Personal Effectiveness | The PM is personally effective | 1.96% |

| | | |
|---|---|-------|
| Industry Knowledge and Experience | Problem Solving | 1.95% |
| Cognitive/Personal Effectiveness | The PM is approachable, listens and relates to others | 1.89% |
| Cognitive/Personal Effectiveness | The PM is adaptable | 1.87% |
| Cognitive/Personal Effectiveness | The PM is self-aware | 1.86% |
| Leadership | Develop and mentor others | 1.85% |
| Cognitive/Personal Effectiveness | The PM is assertive | 1.81% |
| Cognitive/Personal Effectiveness | The PM has a positive attitude | 1.78% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 1.74% |
| Leadership | Innovation | 1.66% |
| Cognitive/Personal Effectiveness | The PM is courageous | 1.64% |
| Cognitive/Personal Effectiveness | The PM is credible and has integrity | 1.63% |
| Leadership | Cultural and ethnic sensitivity/leverages diverse thinking | 1.62% |
| Cognitive/Personal Effectiveness | The PM is energetic and enthusiastic | 1.61% |
| Industry Knowledge and Experience | Application of relevant engineering principles | 1.61% |
| Cognitive/Personal Effectiveness | The PM possesses adequate stress management | 1.52% |
| Cognitive/Personal Effectiveness | The PM is mature and professional | 1.52% |
| Cognitive/Personal Effectiveness | The PM possesses analytical thinking skills | 1.48% |
| Cognitive/Personal Effectiveness | The PM is selfless | 1.46% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 1.39% |

| | | |
|--|---|-------|
| DOT Knowledge and Experience | Operational Performance Measures | 1.38% |
| Cognitive/Personal Effectiveness | The PM is honest, ethical and trustworthy | 1.33% |
| DOT Knowledge and Experience | Technology and Software | 1.32% |
| Cognitive/Personal Effectiveness | The PM is loyal | 1.14% |
| DOT Knowledge and Experience | Legal Issues | 1.12% |
| Cognitive/Personal Effectiveness | The PM is empathetic | 1.07% |
| DOT Knowledge and Experience | Standards and Specifications | 1.02% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | 0.93% |
| Industry Knowledge and Experience | Awareness of current research | 0.73% |
| Industry Knowledge and Experience | Degrees, Certifications and Professional Registrations | 0.36% |

From the results demonstrated in table 9, it is observed that the competencies with the highest scores are exclusively from three categories: Cognitive/Personal Effectiveness, Leadership, and Project Management Knowledge and Experience. These three categories are the ones that include all the soft skills, which are harder to measure and develop. These were similar observations to the ones drawn on the results in table 8 which show the weights of each question. Some of the most important competencies based on their weights are the accountability of the PM, his/her ability to handle complex communication tasks and solve issues, possessing vision, and initiative. Others include some job-specific tasks such as budget and schedule management as well as managing stakeholders, risks and issues, and quality control.

Table 10 shows the arrangement of competencies, by weight, within the categories. This table helps in highlighting the competencies with the highest weight within each category.

Table 10: Competencies Arranged Within Categories in Descending Order of Weights

| Category | Competency | Weight |
|--|---|--------|
| Cognitive/Personal Effectiveness | The PM is accountable, responsible and reliable | 2.62% |
| Cognitive/Personal Effectiveness | The PM has vision | 2.40% |
| Cognitive/Personal Effectiveness | The PM has initiative | 2.34% |
| Cognitive/Personal Effectiveness | The PM is detail oriented and organized | 2.17% |
| Cognitive/Personal Effectiveness | The PM has impact and influence on project team members | 2.08% |
| Cognitive/Personal Effectiveness | The PM is decisive | 2.04% |
| Cognitive/Personal Effectiveness | The PM values achievement and action | 2.01% |
| Cognitive/Personal Effectiveness | The PM is personally effective | 1.96% |
| Cognitive/Personal Effectiveness | The PM is approachable, listens and relates to others | 1.89% |
| Cognitive/Personal Effectiveness | The PM is adaptable | 1.87% |
| Cognitive/Personal Effectiveness | The PM is self-aware | 1.86% |
| Cognitive/Personal Effectiveness | The PM is assertive | 1.81% |
| Cognitive/Personal Effectiveness | The PM has a positive attitude | 1.78% |
| Cognitive/Personal Effectiveness | The PM is courageous | 1.64% |
| Cognitive/Personal Effectiveness | The PM is credible and has integrity | 1.63% |
| Cognitive/Personal Effectiveness | The PM is energetic and enthusiastic | 1.61% |
| Cognitive/Personal Effectiveness | The PM possesses adequate stress management | 1.52% |
| Cognitive/Personal Effectiveness | The PM is mature and professional | 1.52% |
| Cognitive/Personal Effectiveness | The PM possesses analytical thinking skills | 1.48% |
| Cognitive/Personal Effectiveness | The PM is selfless | 1.46% |
| Cognitive/Personal Effectiveness | The PM is honest, ethical and trustworthy | 1.33% |
| Cognitive/Personal Effectiveness | The PM is loyal | 1.14% |
| Cognitive/Personal Effectiveness | The PM is empathetic | 1.07% |
| Industry Knowledge and Experience | Problem Solving | 1.95% |
| Industry Knowledge and Experience | Application of relevant engineering principles | 1.61% |
| Industry Knowledge and Experience | Awareness and use of Information Technology | 0.93% |
| Industry Knowledge and Experience | Awareness of current research | 0.73% |
| Industry Knowledge and Experience | Degrees, Certifications and Professional Registrations | 0.36% |
| Leadership | Communication leadership | 2.40% |
| Leadership | Direct/influential | 2.35% |

| | | |
|--|--|-------|
| Leadership | Build trust | 2.33% |
| Leadership | Build coalitions with team | 2.20% |
| Leadership | Timely decision making | 2.17% |
| Leadership | Team issue management | 1.98% |
| Leadership | Team builder | 1.96% |
| Leadership | Build consensus | 1.96% |
| Leadership | Develop and mentor others | 1.85% |
| Leadership | Innovation | 1.66% |
| Leadership | Cultural and ethnic sensitivity/leverages diverse thinking | 1.62% |
| Project Management Knowledge and Experience | Communication management | 2.44% |
| Project Management Knowledge and Experience | Understand project management concepts (FDM Chapter 2) | 2.41% |
| Project Management Knowledge and Experience | Budget management | 2.35% |
| Project Management Knowledge and Experience | Scope management | 2.29% |
| Project Management Knowledge and Experience | Risk and Issues management | 2.24% |
| Project Management Knowledge and Experience | Stakeholder Management | 2.23% |
| Project Management Knowledge and Experience | Quality management | 2.22% |
| Project Management Knowledge and Experience | Change management | 2.20% |
| Project Management Knowledge and Experience | Project Controls | 2.18% |
| Project Management Knowledge and Experience | Schedule management | 2.18% |
| DOT Operational Knowledge and Experience | Policy and Procedures | 1.74% |
| DOT Operational Knowledge and Experience | Knowledge Networks | 1.39% |
| DOT Operational Knowledge and Experience | Performance Measures | 1.38% |
| DOT Operational Knowledge and Experience | Technology and Software | 1.32% |
| DOT Operational Knowledge and Experience | Legal Issues | 1.12% |
| DOT Operational Knowledge and Experience | Standards and Specifications | 1.02% |

Table 10 shows an important demonstration of the specific competencies within each category that have the highest impact on the performance of PMs. The table also shows that some categories have higher weights per competency than others. These categories are the ones that have a bigger impact on differentiating the performance of “exceptional” and “average” PMs.

For the Cognitive/Personal Effectiveness category, the most important competencies are accountability and reliability, vision, and initiative. They are followed by the PM’s ability to be organized, have an impact on the project team, and be decisive.

The next category shown on this list is the Industry Knowledge and Experience category. Even though this category had a small number of competencies, the highest weight, problem solving, was in mid-range compared to other competencies.

The following category is Leadership, which is one of the three categories that had the highest presence in the top competencies. In this category, the most important competencies are communication leadership, being direct and influential, and building trust. These are followed by several competencies related to team building such as building trust, building coalitions with teams, and team issue management.

Project Management Knowledge and Experience comes next. This is the last category with heavy presence in the top competencies. Similar to Leadership, the highest competency in this category is communication related. It is followed by the PM understanding of management issues. The following competencies are job-related competencies such as budget, schedule, quality, and change management.

The final category is DOT Operational Knowledge and Experience, where the top competencies were policy and procedure and knowledge networks.

Overall, Industry Knowledge and Experience, DOT Operational Knowledge, and Experience had lower weights than Project Management Knowledge and Experience, Leadership and Cognitive/Personal Effectiveness categories.

Table 11 shows the weight of each category. These weights represent the relative importance of the category in differentiating the performance of “exceptional” PMs versus “average” PMs.

Table 11: Category Overall Weights

| Category | Percentage |
|--|-------------------|
| Cognitive/Personal Effectiveness | 21% |
| Industry Knowledge and Experience | 13% |
| Leadership | 24% |
| Project Management Knowledge and Experience | 27% |
| DOT Operational Knowledge and Experience | 16% |

It can be observed from the table that Project Management and Experience ranks highest (27%) then Leadership (24%) followed by Cognitive/Personal Effectiveness (21%) then DOT Operational Knowledge and Experience (16%) and finally Industry Knowledge and Experience (13%).

PMX Benchmark Calculations: Overall

One of the main outputs of the assessment is the comparative score of the PM to industry benchmarks, the Project Manager Index (PMX). Therefore, the researcher calculated a benchmark score based on the PM data collected and the competency weights calculated. This was done by multiplying the ratings given to each question by the calculated weights for each PM. The scores for all PMs were plotted in the form of a box and whiskers plot. A cut-off score was calculated based to differentiate between “average” and “exceptional” PMs using the solver function in Excel. This ad-in works by minimizing the misclassification of the category of each PM with different cutoff scores.

Figure 5 shows the graphical display, in the form of a box and whiskers plot, of the score of all PMs in the assessment.

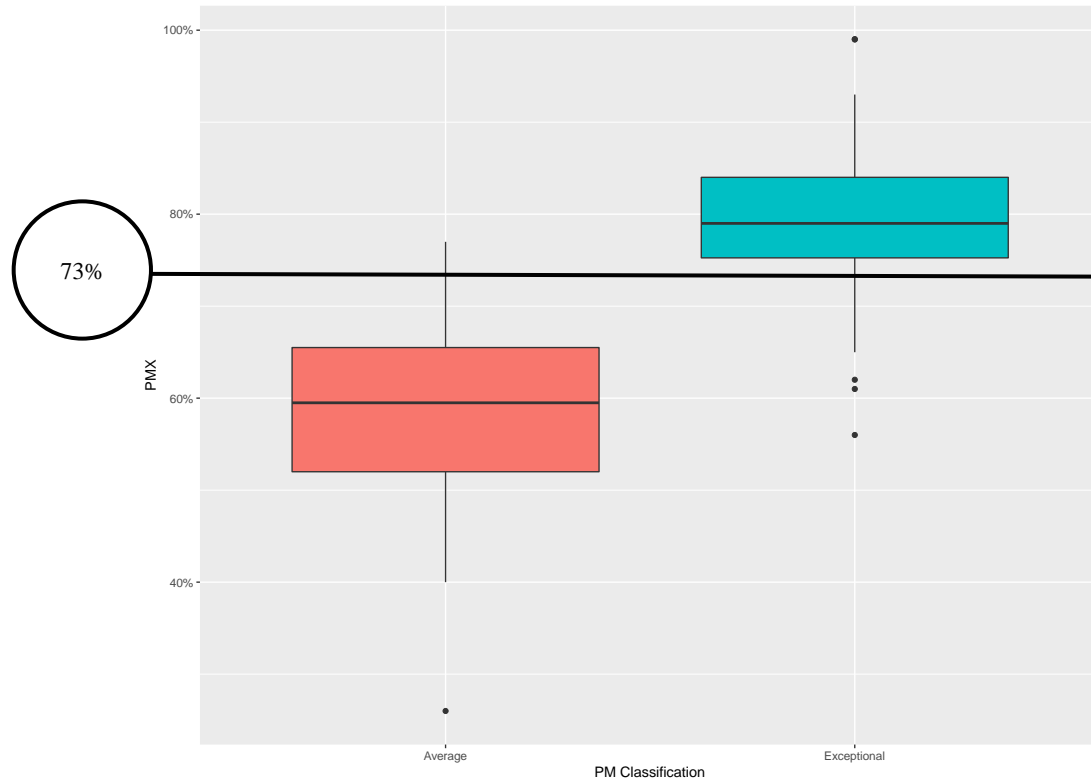


Figure 5: Box and Whiskers Plot of PMX Scores

The cut-off score for the combined data set was found to be 73% with an accuracy of 92%. This means that the PMs who scored 73% or more were usually classified as “exceptional” while the PMs who scored less than 73% were classified as “average”.

Outputs: WisDOT versus Other States

After ensuring that both data sets had an adequate number of data points, the researcher performed comparative analysis to show the difference, if any, between the data obtained from WisDOT PMs versus the data obtained from PMs in the 11 other states that were involve in the research.

The whole analysis process mentioned in this section was repeated two more times; once for the data points obtained from WisDOT alone and once for the data points obtained from all other states. This included calculating weights for each question, calculating weights for each competency and calculating a benchmark score for PMs in each group. This section will highlight the main similarities and differences between both data sets.

Table 12 shows the competencies, arranged by weight, for both data sets.

Table 12: Competencies Arranged in Descending Order of Weights of WisDOT vs. Other States

| Other States | | WisDOT | |
|---|--------|---|--------|
| Competency | Weight | Competency | Weight |
| The PM is accountable, responsible and Reliable | 2.605% | The PM is decisive | 2.778% |
| Understand project management concepts (FDM Chapter 2) | 2.429% | Communication management | 2.685% |
| Timely decision making | 2.408% | The PM is detail oriented and organized | 2.640% |
| Risk and Issues management | 2.408% | The PM is accountable, responsible and reliable | 2.632% |
| Direct/influential | 2.404% | Schedule management | 2.554% |
| Change management | 2.363% | Scope management | 2.537% |
| Build coalitions with team | 2.363% | The PM has initiative | 2.511% |
| Communication management | 2.348% | Budget management | 2.463% |
| Build trust | 2.331% | Understand project management concepts (FDM Chapter 2) | 2.434% |
| Quality management | 2.327% | Building trust | 2.365% |
| Communication leadership | 2.297% | The PM is assertive | 2.288% |
| The PM has initiative | 2.280% | Direct/influential | 2.282% |

| | | | |
|---|--------|---|--------|
| Budget management | 2.267% | Stakeholder Management | 2.281% |
| Stakeholder Management | 2.224% | The PM has impact and influence on project team members | 2.279% |
| Team issue management | 2.224% | Communication | 2.268% |
| The PM has vision | 2.213% | The PM is self-aware | 2.253% |
| Project Controls | 2.208% | Having a positive attitude | 2.193% |
| Scope management | 2.190% | The PM is approachable, listens and relates to others | 2.167% |
| Schedule management | 2.150% | Project Controls | 2.142% |
| The PM is personally effective | 2.096% | Building consensus | 2.099% |
| The PM values achievement and action | 2.056% | Quality management | 2.084% |
| Problem Solving | 2.053% | Develop and mentor others | 2.000% |
| Team builder | 2.041% | The PM is mature and professional | 1.978% |
| The PM has impact and influence on project team members | 2.016% | The PM values achievement and action | 1.961% |
| The PM is detail oriented and organized | 1.960% | Change management | 1.909% |
| The PM is adaptable | 1.952% | Build coalitions with team | 1.898% |
| Build consensus | 1.909% | Risk and Issues management | 1.896% |
| Innovation | 1.907% | The PM is credible and has integrity | 1.884% |
| Develop and mentor others | 1.784% | Team builder | 1.832% |
| The PM is courageous | 1.779% | having vision | 1.832% |
| The PM is approachable, listens and relates to others | 1.768% | The PM is energetic and enthusiastic | 1.806% |
| The PM is decisive | 1.712% | possesses adequate stress management | 1.772% |
| Policy and Procedures | 1.705% | The PM is adaptable | 1.737% |
| The PM is self-aware | 1.685% | Cultural and ethnic sensitivity/leverages diverse thinking | 1.720% |
| The PM is honest, ethical and trustworthy | 1.640% | Timely decision making | 1.703% |
| The PM has a positive attitude | 1.632% | The PM is personally effective | 1.703% |
| Application of relevant engineering principles | 1.597% | Problem Solving | 1.687% |
| The PM is assertive | 1.584% | Application of relevant engineering principles | 1.567% |
| Cultural and ethnic sensitivity/leverages diverse thinking | 1.576% | Knowledge Networks | 1.551% |
| The PM is energetic and enthusiastic | 1.552% | Technology and Software | 1.544% |

| | | | |
|---|--------|---|--------|
| The PM is credible and has integrity | 1.525% | The PM possesses analytical thinking skills | 1.496% |
| The PM is selfless | 1.488% | Team issue management | 1.491% |
| The PM possesses analytical thinking skills | 1.480% | Policy and Procedures | 1.459% |
| The PM possesses adequate stress management | 1.424% | The PM is selfless | 1.410% |
| Performance Measures | 1.414% | The PM is courageous | 1.402% |
| The PM is mature and professional | 1.296% | Performance Measures | 1.360% |
| Knowledge Networks | 1.253% | Awareness and use of Information Technology | 1.246% |
| Legal Issues | 1.224% | Innovation | 1.181% |
| Technology and Software | 1.213% | The PM is empathetic | 1.152% |
| The PM is loyal | 1.152% | The PM is loyal | 1.135% |
| Standards and Specifications | 1.106% | Legal Issues | 0.931% |
| The PM is empathetic | 1.056% | Standards and Specifications | 0.834% |
| Awareness of current research | 0.956% | The PM is honest, ethical and trustworthy | 0.697% |
| Awareness and use of Information Technology | 0.782% | Awareness of current research | 0.288% |
| Degrees, Certifications and Professional Registrations | 0.592% | Degrees, Certifications and Professional Registrations | 0.000% |

The observation that can be made based on the order of the competencies for both WisDOT as well as other states is that even though the top competencies are from the same categories (Project Management Knowledge and Experience, Leadership and Cognitive/Personal Effectiveness), the two groups value different competencies.

To assess the differences and similarities between the two groups, the researcher performed a comparative analysis that highlights the competencies with the largest difference in the order of the competencies.

For both Wisconsin and all the other states, the degrees, certifications and professional registration ranked last. Upon further investigation of the data, it was concluded that it ranked last

because it is not an important factor. Neither “exceptional” nor “average” project managers had degrees or certification. This is partially because they are not a requirement for SHA PMs.

Awareness of current research was a competency where “exceptional” and “average” PMs had similar scores, which is why the competency had a low importance in differentiating between both groups. These scores were neither high nor low, but rather around the midrange of the answer options.

Loyalty was another competency that had a low weight for both Wisconsin and other states. This is because all PMs, “exceptional” and “average”, had very high scores for this competency, which meant that it was not differentiating.

Table 13: Competency Ranking Difference Between WisDOT and Other States

| Competency | Rank Other States | Rank Wisconsin | Absolute Difference |
|---|-------------------|----------------|---------------------|
| Timely decision making | 3 | 35 | 32 |
| The PM is decisive | 32 | 1 | 31 |
| Team issue management | 15 | 42 | 27 |
| The PM is assertive | 38 | 11 | 27 |
| Risk and Issues management | 4 | 27 | 23 |
| The PM is mature and professional | 46 | 23 | 23 |
| The PM is detail oriented and organized | 25 | 3 | 22 |
| Innovation | 28 | 48 | 20 |
| Change management | 6 | 25 | 19 |
| Build coalitions with team | 7 | 26 | 19 |
| The PM has a positive attitude | 36 | 17 | 19 |
| The PM is self-aware | 34 | 16 | 18 |
| The PM is honest, ethical and trustworthy | 35 | 53 | 18 |
| The PM is personally effective | 20 | 36 | 16 |
| Problem Solving | 22 | 37 | 15 |
| The PM is courageous | 30 | 45 | 15 |
| Schedule management | 19 | 5 | 14 |
| The PM has vision | 16 | 29 | 13 |
| The PM is approachable, listens and relates to others | 31 | 18 | 13 |
| The PM is credible and has integrity | 41 | 28 | 13 |
| Scope management | 18 | 6 | 12 |
| The PM possesses adequate stress management | 44 | 32 | 12 |
| Quality management | 10 | 21 | 11 |
| The PM has impact and influence on project team members | 24 | 14 | 10 |
| Policy and Procedures | 33 | 43 | 10 |
| The PM is energetic and enthusiastic | 40 | 31 | 9 |
| Technology and Software | 49 | 40 | 9 |
| Knowledge Networks | 47 | 39 | 8 |
| Understand project management concepts (FDM Chapter 2) | 2 | 9 | 7 |
| Direct/influential | 5 | 12 | 7 |
| Team builder | 23 | 30 | 7 |
| The PM is adaptable | 26 | 33 | 7 |
| Build consensus | 27 | 20 | 7 |
| Develop and mentor others | 29 | 22 | 7 |
| Awareness and use of Information Technology | 54 | 47 | 7 |
| Communication management | 8 | 2 | 6 |

| | | | |
|---|-----------|-----------|---|
| The PM has initiative | 12 | 7 | 5 |
| Budget management | 13 | 8 | 5 |
| Cultural and ethnic sensitivity/leverages diverse thinking | 39 | 34 | 5 |
| Communication leadership | 11 | 15 | 4 |
| The PM is accountable, responsible and Reliable | 1 | 4 | 3 |
| The PM values achievement and action | 21 | 24 | 3 |
| Legal Issues | 48 | 51 | 3 |
| The PM is empathetic | 52 | 49 | 3 |
| Project Controls | 17 | 19 | 2 |
| The PM is selfless | 42 | 44 | 2 |
| The PM possesses analytical thinking skills | 43 | 41 | 2 |
| Build trust | 9 | 10 | 1 |
| Stakeholder Management | 14 | 13 | 1 |
| Application of relevant engineering principles | 37 | 38 | 1 |
| Performance Measures | 45 | 46 | 1 |
| Standards and Specifications | 51 | 52 | 1 |
| Awareness of current research | 53 | 54 | 1 |
| The PM is loyal | 50 | 50 | 0 |
| Degrees, Certifications and Professional Registrations | 55 | 55 | 0 |

Table 13 shows the different ranking of each competency for other states as well as Wisconsin. The last column shows the absolute difference between these rankings. The table is arranged in descending order of the difference between both rankings. The higher rankings are colored red. The competencies that have the same rankings for both are colored in green.

Although there is a large difference between the rankings of some of the competencies, some of the competencies seek similar attributes. For example, timely decision making was ranked 3 for other states and 35 for Wisconsin, while decisiveness was ranked 32 for other states and 1 for Wisconsin. Moreover, it is worth mentioning that the competencies that ranked low for either of the two groups could mean that they are abundant for all PMs and, therefore, do not differentiate the PMs. An example of this is loyalty, which is ranked 50 for both groups. Its ranking may make it seem unimportant, but in fact, all PMs, “exceptional” and “average” were loyal. On the other

hand, degrees and certification, for example, are not a requirement for PMs in most SHAs, therefore, almost no PMs had higher degrees and thus the competency is ranked last in all cases.

Benchmarks: Wisconsin versus Other States

The weights that were calculated for each of the two groups were used to calculate the PMX for the PMs of the respective group. The results were plotted on comparative box and whiskers plot charts.

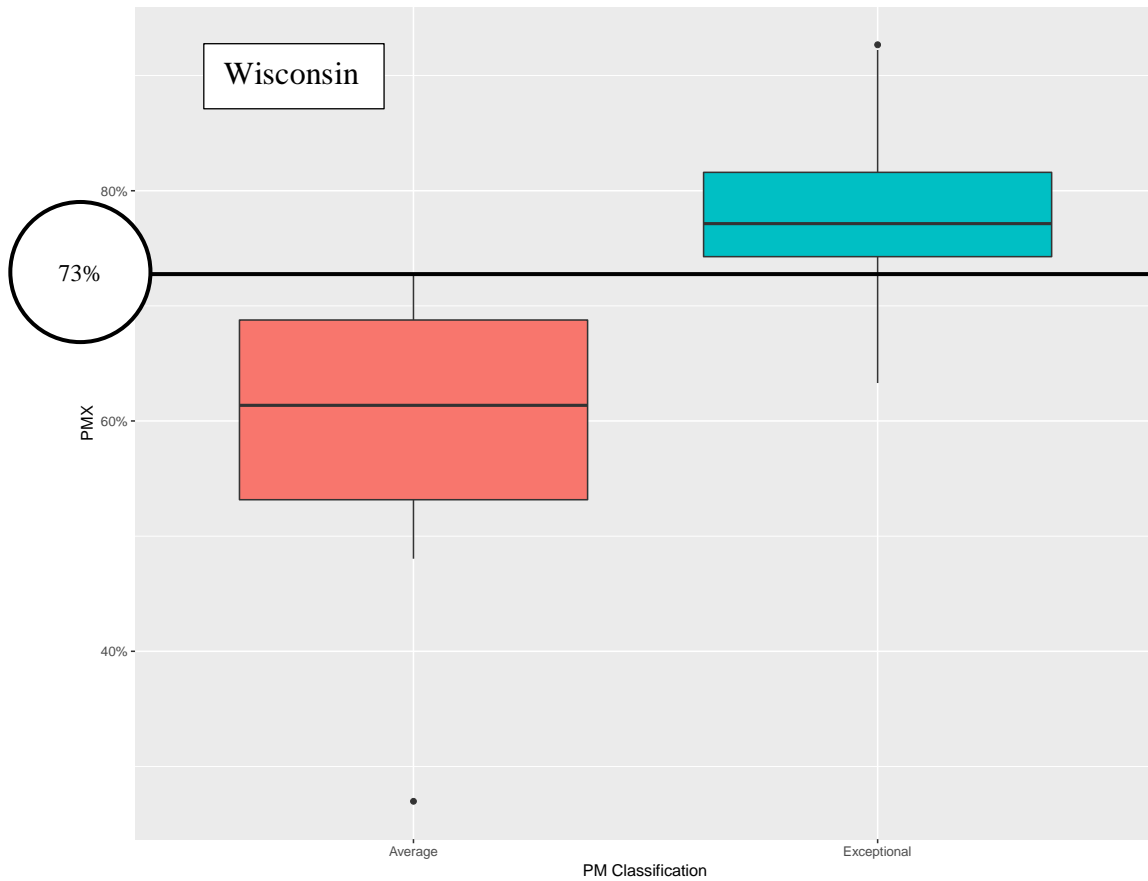


Figure 6: Box and Whiskers Plot of PMX for WisDOT PMs

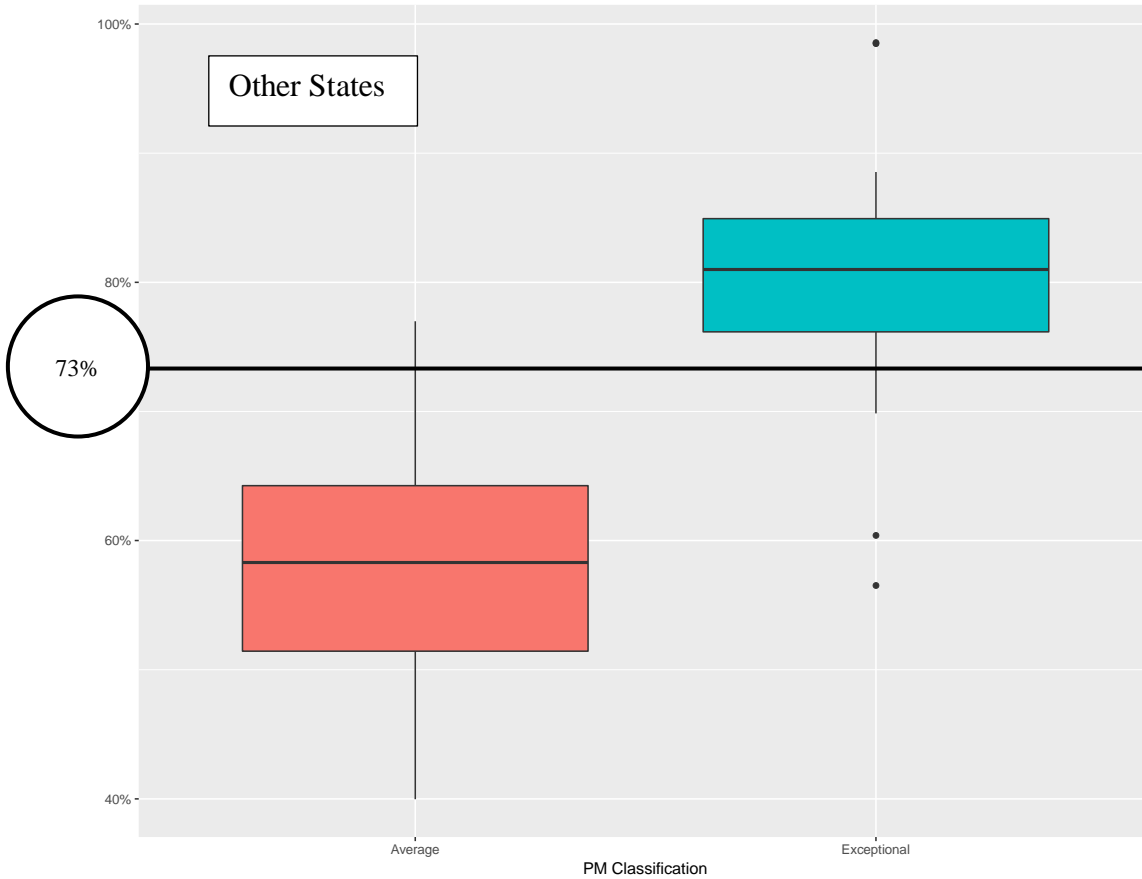


Figure 7: Box and Whiskers Plot of PMX for Other State PMs

These box plots show the distribution of the PMX for “average” and “exceptional” PMs while showing the median as well as the upper and lower quartiles. After performing optimization analysis on the results from both groups, it was interesting to see that the cut-off score, which is used as a benchmark, is 73% for both with an accuracy of 90%. Even though the weights of the competencies are different, the input for the PMs is different and the scores are different, the cut-off score is exactly the same in all three cases.

Cluster Analysis: Overall

As some of the weights of the competencies were very close to each other, the researcher performed cluster analysis to show the possible grouping of the competencies into 10 clusters. This shows the importance of each of the clusters rather than individual competencies. Although the weights are close, there are clear separations between the competencies in each cluster. This analysis was performed based on the weights from all 90 data points.

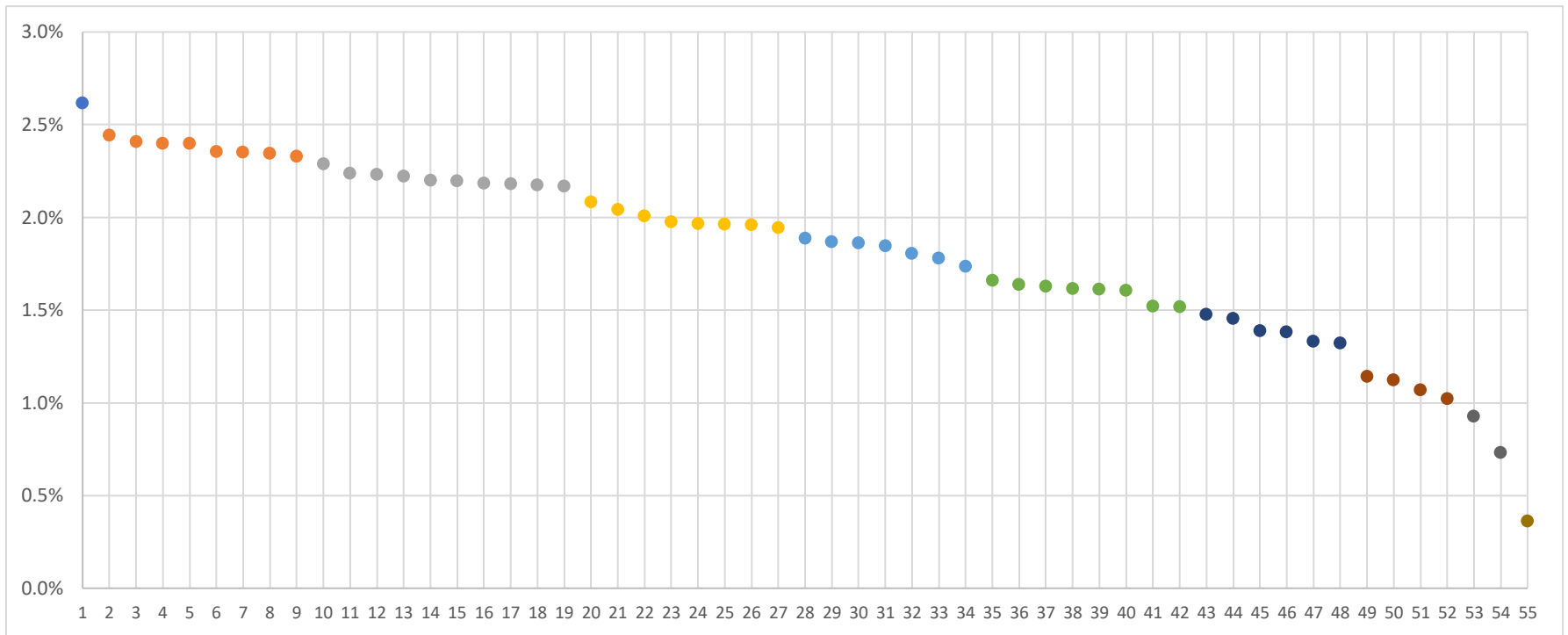


Figure 8: Graph Showing Cluster Analysis of Competency Weights

Table 14 shows the name of each competency and the cluster that it belongs to.

Table 14: Clusters Distribution

| Competency | Cluster |
|--|----------------|
| The PM is accountable, responsible and Reliable | 1 |
| Communication management | 2 |
| Understand project management concepts (FDM Chapter 2) | 2 |
| Communication leadership | 2 |
| The PM has vision | 2 |
| Budget management | 2 |
| Direct/influential | 2 |
| The PM has initiative | 2 |
| Build trust | 2 |
| Scope management | 3 |
| Risk and Issues management | 3 |
| Stakeholder Management | 3 |
| Quality management | 3 |
| Change management | 3 |
| Build coalitions with team | 3 |
| Project Controls | 3 |
| Schedule management | 3 |
| The PM is detail oriented and organized | 3 |
| Timely decision making | 3 |
| The PM has impact and influence on project team members | 4 |
| The PM is decisive | 4 |
| The PM values achievement and action | 4 |
| Team issue management | 4 |
| Team builder | 4 |
| Build consensus | 4 |
| The PM is personally effective | 4 |
| Problem Solving | 4 |
| The PM is approachable, listens and relates to others | 5 |
| The PM is adaptable | 5 |
| The PM is self-aware | 5 |
| Develop and mentor others | 5 |
| The PM is assertive | 5 |
| The PM has a positive attitude | 5 |
| Policy and Procedures | 5 |
| Innovation | 6 |

| | |
|---|----|
| The PM is courageous | 6 |
| The PM is credible and has integrity | 6 |
| Cultural and ethnic sensitivity/leverages diverse thinking | 6 |
| The PM is energetic and enthusiastic | 6 |
| Application of relevant engineering principles | 6 |
| The PM possesses adequate stress management | 6 |
| The PM is mature and professional | 6 |
| The PM possesses analytical thinking skills | 7 |
| The PM is selfless | 7 |
| Knowledge Networks | 7 |
| Performance Measures | 7 |
| The PM is honest, ethical and trustworthy | 7 |
| Technology and Software | 7 |
| The PM is loyal | 8 |
| Legal Issues | 8 |
| The PM is empathetic | 8 |
| Standards and Specifications | 8 |
| Awareness and use of Information Technology | 9 |
| Awareness of current research | 9 |
| Degrees, Certifications and Professional Registrations | 10 |

Category Benchmark: Overall

Using the data collected, a benchmark was calculated for each category of the assessment separately. This allowed the researcher to provide data-supported targets that can be used by the organization as a target for its PMs. To calculate the benchmarks, a box and whiskers plot was developed for each of the categories where the scores of the “exceptional” PMs were compared with the scores of “average” PMs.

Within the categories, it was more difficult to find a benchmark because of two main reasons: firstly, there were a lot of outliers and secondly, there were large overlaps between “average” and “exceptional” PMs. Moreover, scoring above the cut-off between “exceptional” and “average” in each category does not guarantee that the PM would have a good performance overall (high PMX). Therefore, the recommended benchmark in this case is not an optimized line between the two different classifications but rather, the mean of the “exceptional” category, which would insure higher performance for the PMs.

The box and whiskers plot for each of the categories is shown below while highlighting the mean of the “exceptional” PMs as ‘M’. The ‘M’ represents the score which is recommended as a target for organizations who seek a higher performance level from their PMs.

Figure 9 shows the plot for the Project Management Knowledge and Experience category.

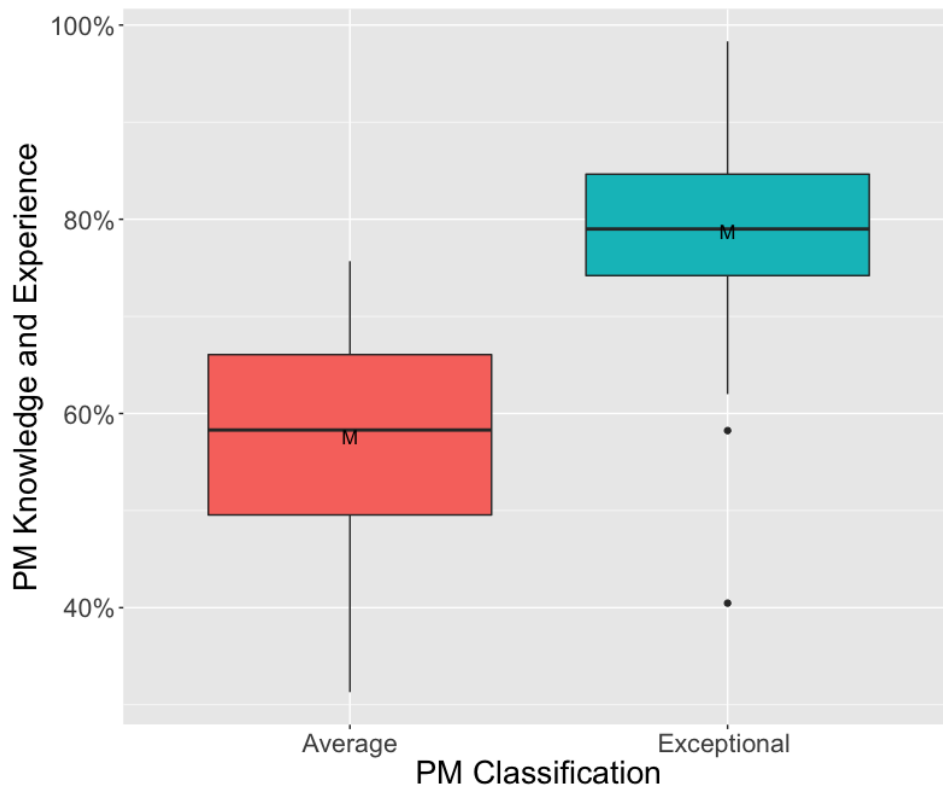


Figure 9: PM Knowledge and Experience Category Benchmark Box and Whiskers Plot

For the Project Management Knowledge and Experience category, the research recommended target score is 79%. This represents the mean of the scores of “exceptional” PMs from the data set collected.

Figure 10 shows the plot for the Leadership category.

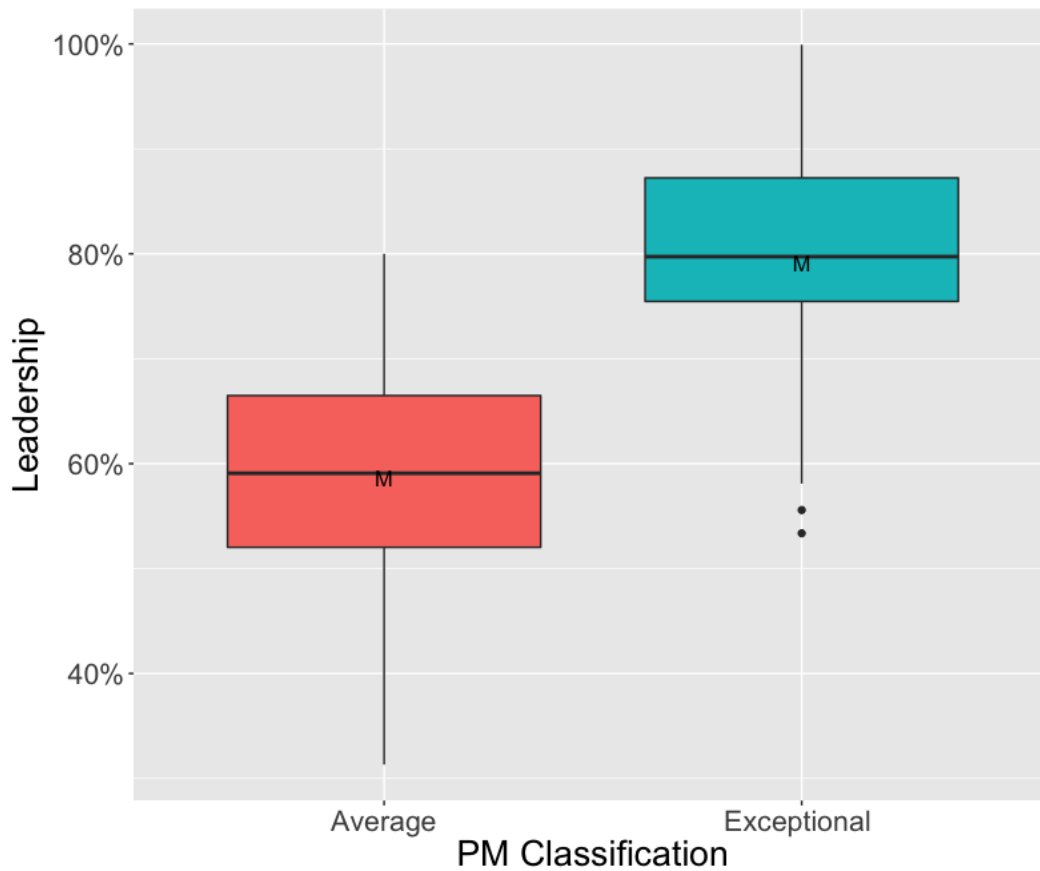


Figure 10: Leadership Category Benchmark Box and Whiskers Plot

For the Leadership category, similar to Project Management Knowledge and Experience, the research recommended target score is 79%. This represents the mean of the scores of “exceptional” PMs from the data set collected. Both of these categories have high benchmarks as compared to the overall benchmarks. They also have the highest overall weights as compared to the other categories in the assessment.

Figure 11 shows the box and whisker plot for the DOT Operational Knowledge and Experience category.

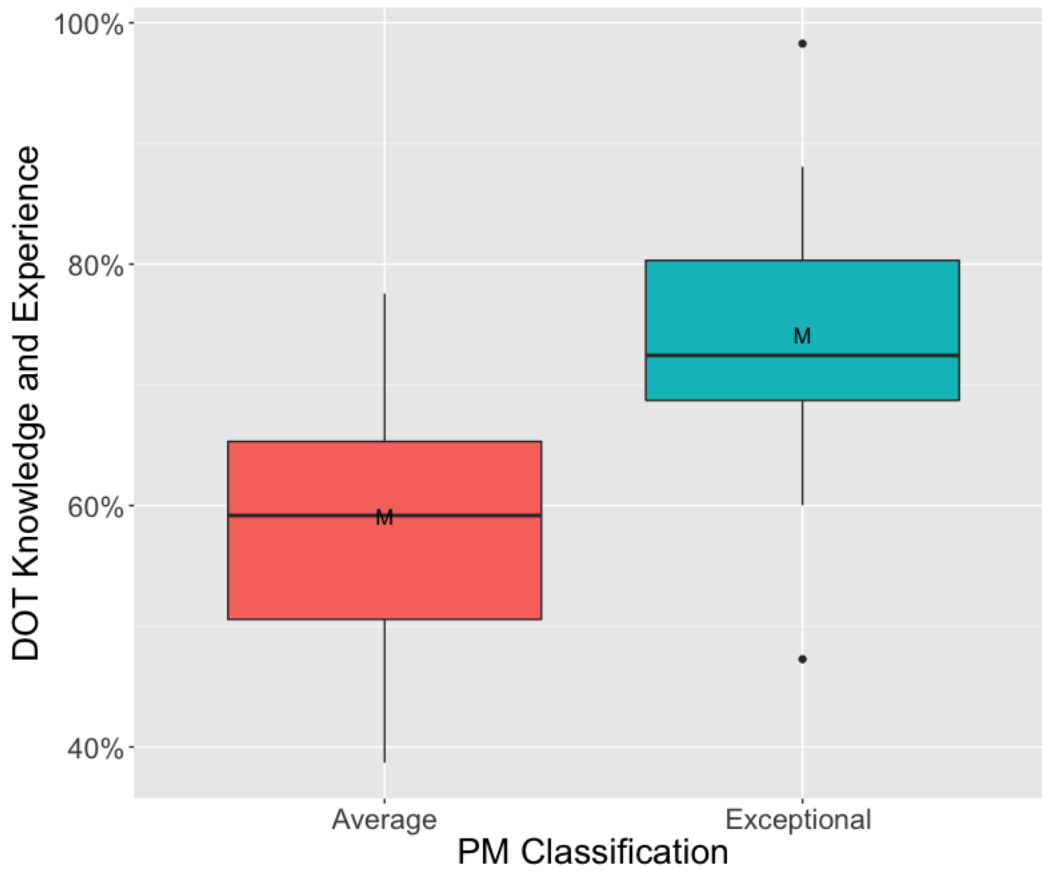


Figure 11: DOT Knowledge and Experience Category Benchmark Box and Whiskers Plot

For the DOT Operational Knowledge and Experience category the research recommended target score is 73%. This represents the mean of the scores of “exceptional” PMs from the data set collected.

Figure 12 shows the box and whisker plot for the Industry Knowledge and Experience category.

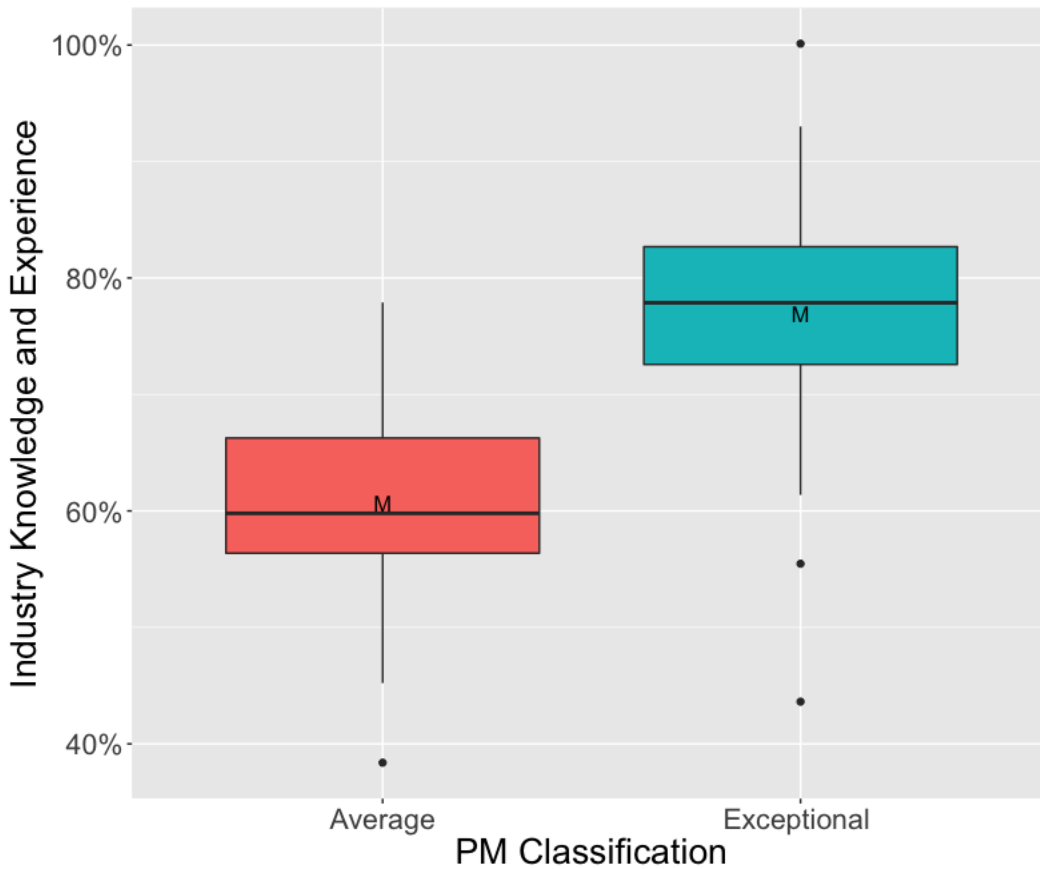


Figure 12: Industry Knowledge and Experience Category Benchmark Box and Whiskers Plot

For the Industry Knowledge and Experience category the research recommended target score is 77%. This represents the mean of the scores of “exceptional” PMs from the data set collected. Industry Knowledge and Experience, as well as DOT Operational Knowledge and Experience, have the lowest recommended benchmarks within the assessment.

Figure 13 shows the box and whisker plot for the Cognitive/Personal Effectiveness category.

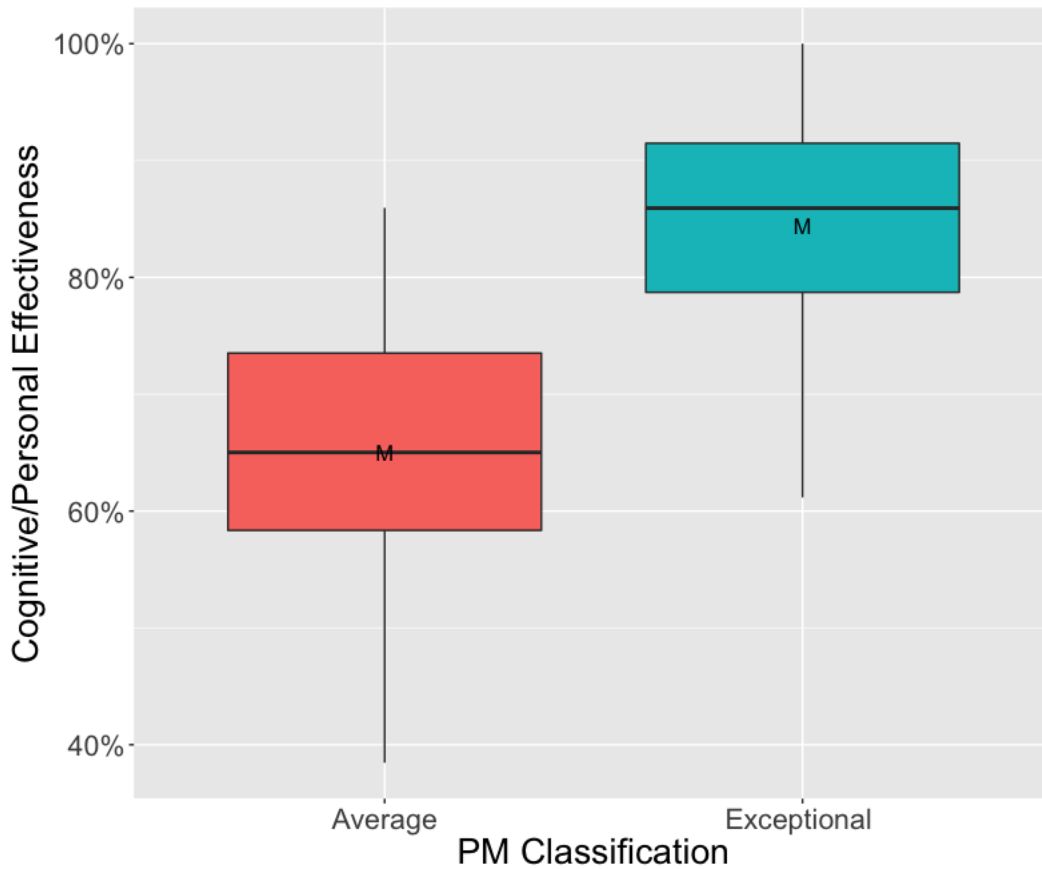


Figure 13: Cognitive/Personal Effectiveness Category Benchmark Box and Whiskers Plot

The Cognitive/Personal Effectiveness category has the highest recommended target score at 86%, which is the highest category within the assessment. This category also shows the largest difference between “exceptional” and “average” PMs. Therefore, SHAs should increase their focus on this category to improve the performance of their PMs. This is especially important because, based on the calculated weights, this category had a high overall importance within the assessment.

Category Benchmark: WisDOT versus Other States

Another interesting comparison is that of the benchmark differences between WisDOT and other states for each category.

Figures 14 and 15 show the comparative box and whisker plots for the Project Management Knowledge and Experience category for WisDOT and other states respectively.

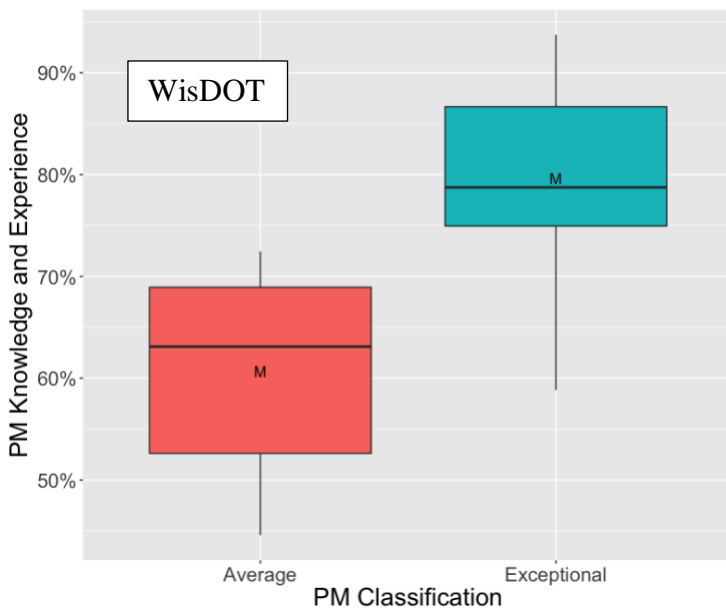


Figure 14: PM Knowledge and Experience Benchmark - WisDOT

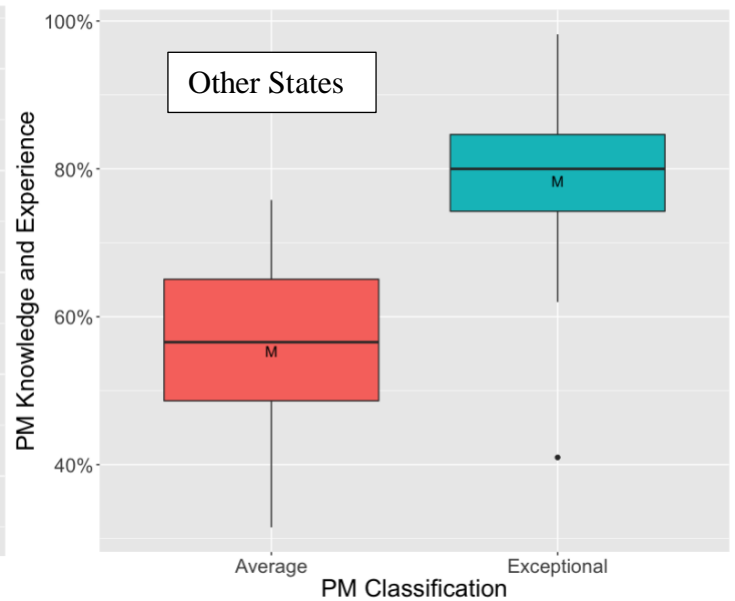


Figure 15: PM Knowledge and Experience Benchmark - Other States

These figures show that the means for the “exceptional” PM in both cases are very close, both being around 79%. However, it can be observed that the results for WisDOT PMs has a wider distribution and, therefore, a smaller gap while the distribution for the other state PMs has less variation and, therefore, has a larger gap between “average” and “exceptional” PMs.

Figures 16 and 17 show the comparative box and whisker plots for the Leadership Experience category for WisDOT and other states respectively.

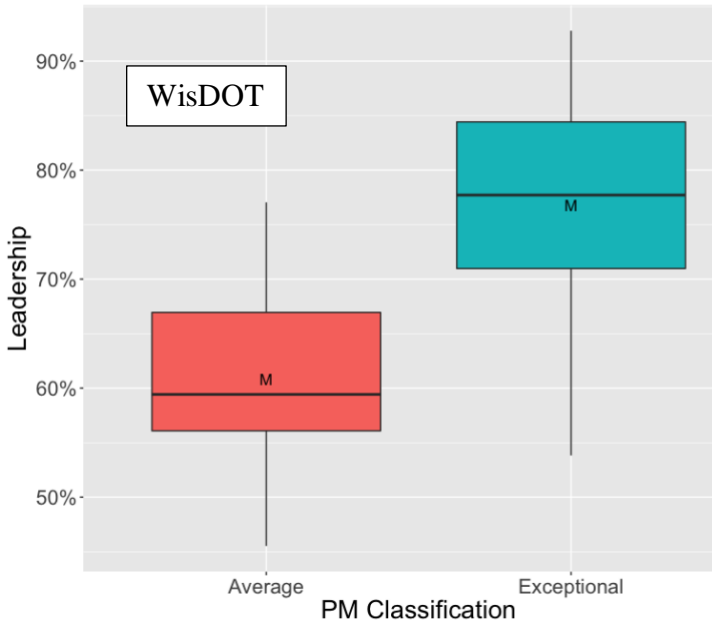


Figure 16: Leadership Benchmark - WisDOT

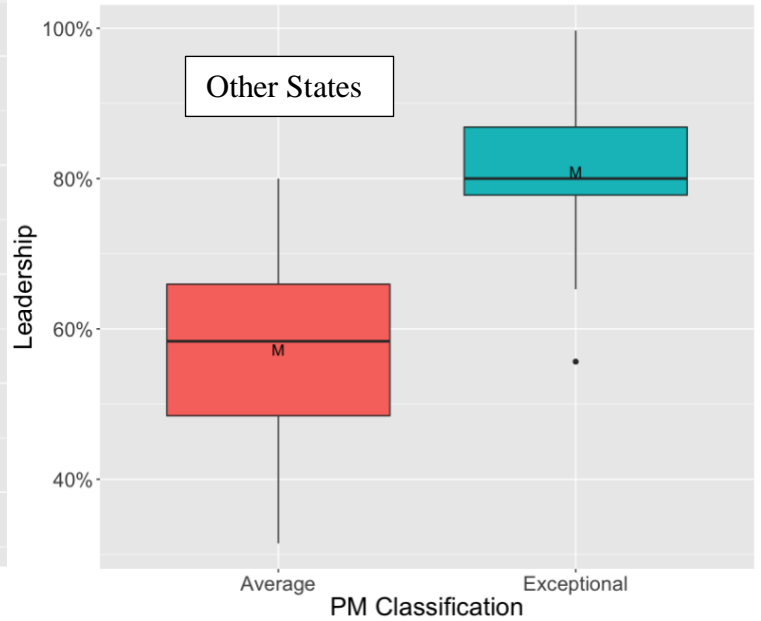


Figure 17: Leadership Benchmark - Other States

For the Leadership category, WisDOT has a lower recommended target at 77% while the other states have a recommended target of 80%. This category also has a lot of variation when it comes to “average” PMs in both categories while WisDOT “exceptional” PMs have higher variability than other states “exceptional” PMs.

Figures 18 and 19 show the comparative box and whiskers plots for the DOT Operational Knowledge and Experience category for WisDOT and other states respectively.

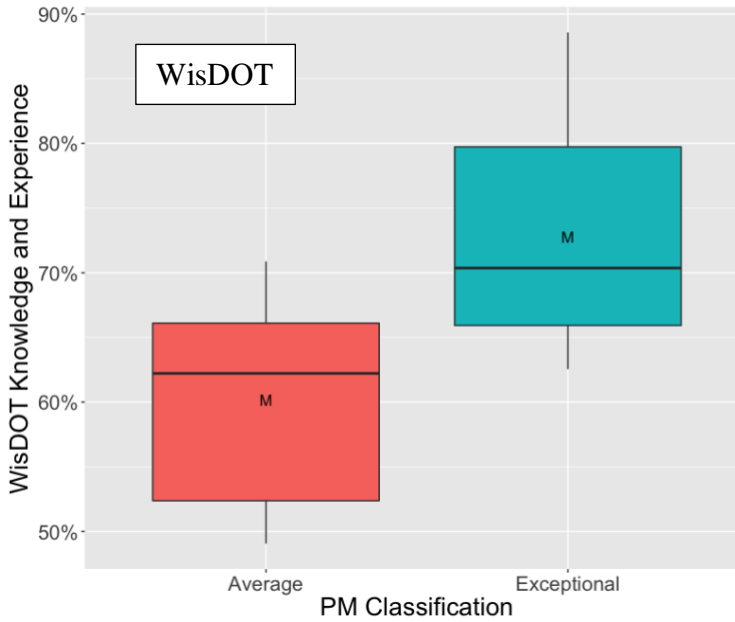


Figure 18: WisDOT Operational Knowledge and Experience Benchmark

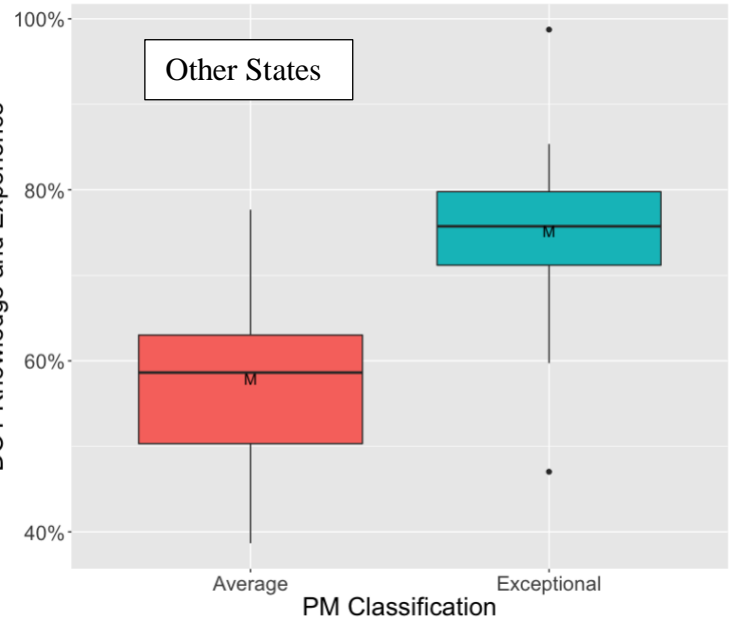


Figure 19: DOT Operational Knowledge and Experience Benchmark

The DOT Operational Knowledge and Experience has a lot of variation between WisDOT and other states. WisDOT has large variability between the results of the PMs in both the “exceptional” and the “average” classification. This large variation has led to a small overlap between the results of both sections. The recommended target for WisDOT is 73%. For the other states there is much less variation between the PM scores and the benchmark is at 76%.

Figures 20 and 21 show the comparative box and whiskers plots for the Industry Knowledge and Experience category for WisDOT and other states respectively.

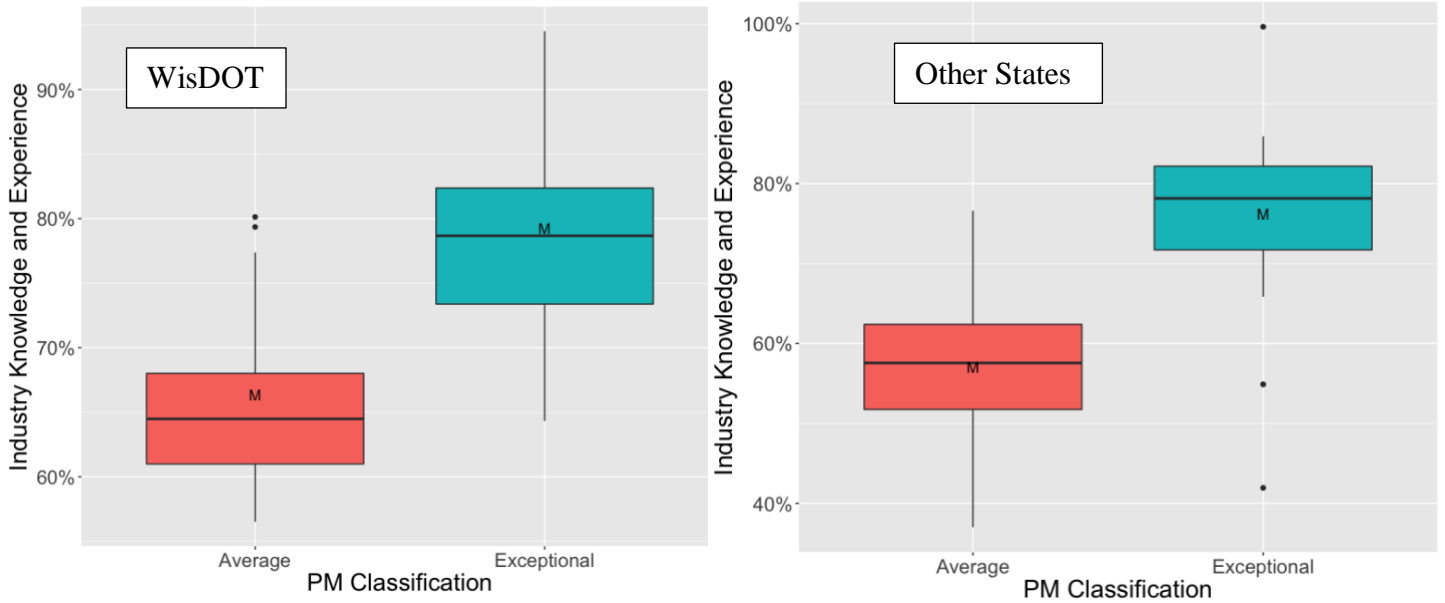


Figure 21: Industry Knowledge and Experience Benchmark - WisDOT Figure 20: Industry Knowledge and Experience Benchmark - Other States

For the Industry Knowledge and Experience category both WisDOT and other state PMs have similar results. The recommended target in this case is 79% for WisDOT and 78% for other states.

Figures 22 and 23 show the comparative box and whiskers plots for the Cognitive/Personal Effectiveness category for WisDOT and other states respectively.

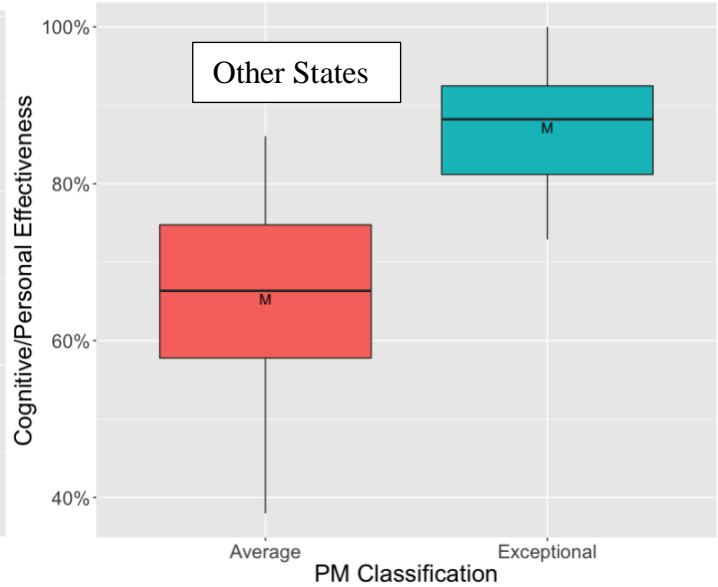
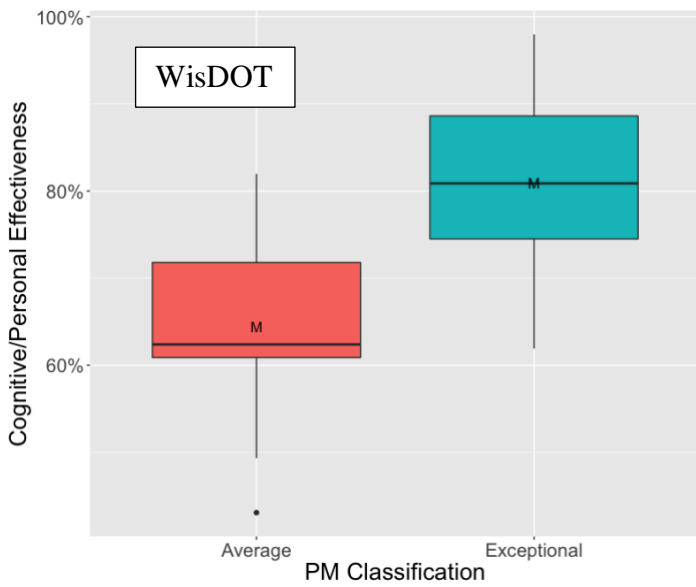


Figure 22: Cognitive/ Personal Effectiveness Benchmark - WisDOT

Figure 23: Cognitive/ Personal Effectiveness Benchmark - Other States

The Cognitive/Personal Effectiveness category has similar variation in both cases, however, WisDOT has a lower target than other states. WisDOT target is 80% while other states are 88%. This is the largest difference between recommended targets in the assessment.

Tool Development

One of the most important parts of this research was to make it applicable to industry practitioners, in this case WisDOT specifically and SHA generally. To achieve this goal the researcher created a user-friendly excel tool that allows the organization to create a file for each PM, fill in the assessment electronically, get instant feedback, and compare the results from previous periods.

The tool was developed with the help of two coding professionals who created the functionalities of the tool and made sure that the user interface was easy to use. To avoid any problems with allowable software on the computer devices of different SHAs, the tool was developed on Excel, which is a basic software that is available for all professionals. The user interface of the tool as well as the coding was done using Visual Basic for Applications (VBA). This allowed the coding professionals to create an interface that is user-friendly, allowing SHA professionals to use it easily. The tool created appears as a separate program when the Excel file is opened. This also means that the SHA professionals do not have to interact with different Excel sheets or face issues with changing the formulas used by mistake.

There were various functionalities that were important for the SHAs that the researcher made sure to include in the tool:

1. Each PM in the organization would have a separate file that contains all his/her assessments. This was achieved through creating a Master File which automatically creates a separate file for every new PM as needed. The file for the PM is saved and can be accessed to fill in future assessments or to reference old results.

2. The ability to set different targets for the PMs. Since not all PMs are at the same stage of their career, it is preferable to have the ability to set different performance targets for each PM, which would be specified in the PM's file. The research recommended targets are also displayed in each target window for reference.
3. The ability to have a 360° evaluation system for the PM where the assessment can be filled by a supervisor, by the PM his/herself or by a subordinate that works with the PM. Therefore, there is a separate window where the evaluator(s)' is written and is then shown on the results report.
4. The consistency and fairness of results is a crucial aspect for SHAs. Therefore, all assessment questions need to be filled in before the results report is generated. To ensure the completion of the assessment, when all category questions are complete, the color of its button changes from red to grey on the Home Page.

Deciding what outputs to display at the end of the tool was a critical task for the researcher as each of the outputs had to be relevant and useful to the individual or the organization. Moreover, it was important to show outputs that make the best use of the available data.

Tool Outputs

1. The overall score of the PM which is called the Project Manager Index (PMX). This output shows the overall score of the PM in the assessment as compared to the target set at the beginning of the assessment. If the research recommended targets are used, the PMX reflects the performance of the PM as compared to industry benchmarks. The second output of the tool is the score per category.
2. The score for each category is calculated separately to demonstrate the PM's abilities in different areas. This information is displayed in two ways; a bar chart and a spider chart.

Both charts show the target set at the beginning of the assessment, the score of the current assessment and the score of the two previous assessments. This not only helps the PM in comparing his/her performance to the targets but also allows the PM to monitor their progress between different assessments.

3. The PM's strengths are shown in a separate window. While setting the targets, the number of strengths to be displayed in this section can be set according to preference. These strengths highlight the competencies with the highest weight where the PM scored highest. This shows where the PM performs best and helps him/her and the organization in better utilizing his/her skills and capabilities.
4. The PM's training needs is the most important output of the tool. This highlights the most important competencies where the PM had a low score. These show the specific areas where the PM needs work and where s/he could focus on training and personal development. It provides a highly detailed and personalized recommendations list which allows the PM and the organization to make the most of all the knowledge accumulated in terms of competencies and categories.
5. The final step is to relate the training needs to separate training programs that would tackle these needs and help the PM improve his/her overall performance. As most SHAs have hundreds of training programs available and these programs change regularly, it would be impractical to have automatically generated recommendations for training programs. Therefore, the tool has a section where specific training programs can be added to each of the training needs. This allows for high flexibility of the tool.

To best demonstrate the tool functionalities, interface and outputs, the tool manual is included in the next section.

Project Manager Competency Training Needs Assessment Tool: User Manual

Introduction

Welcome to the Project Manager Competency Training Needs Assessment Tool User Manual. This tool is the result of an extensive research project performed by the Construction Materials Support Center (CMSC) at the University of Wisconsin-Madison (UW-Madison) in collaboration with the Wisconsin Department of Transportation (WisDOT). It is also a part of the master's thesis of graduate student Sarah Rezk, supervised by Professor Awad S. Hanna and Engineer Gary Whited.

This tool is designed to help Project Managers (PMs) of State Highway Agencies (SHAs) identify their strengths as well as the areas where further training is needed. It also helps the organization in identifying organization-wide training gaps.

The tool evaluates the competence of PMs in five categories; Industry Knowledge and Experience, WisDOT Operational Knowledge and Experience, Leadership, Project Management Knowledge and Experience and Cognitive/Personal Effectiveness.

In this document, you will find step-by-step instructions on using the functionalities of the tool as well as a description of its main outputs.

Note: This tool will only work on Microsoft Windows operated Personal Computers using Microsoft Excel 2013 or later versions.

Getting Started

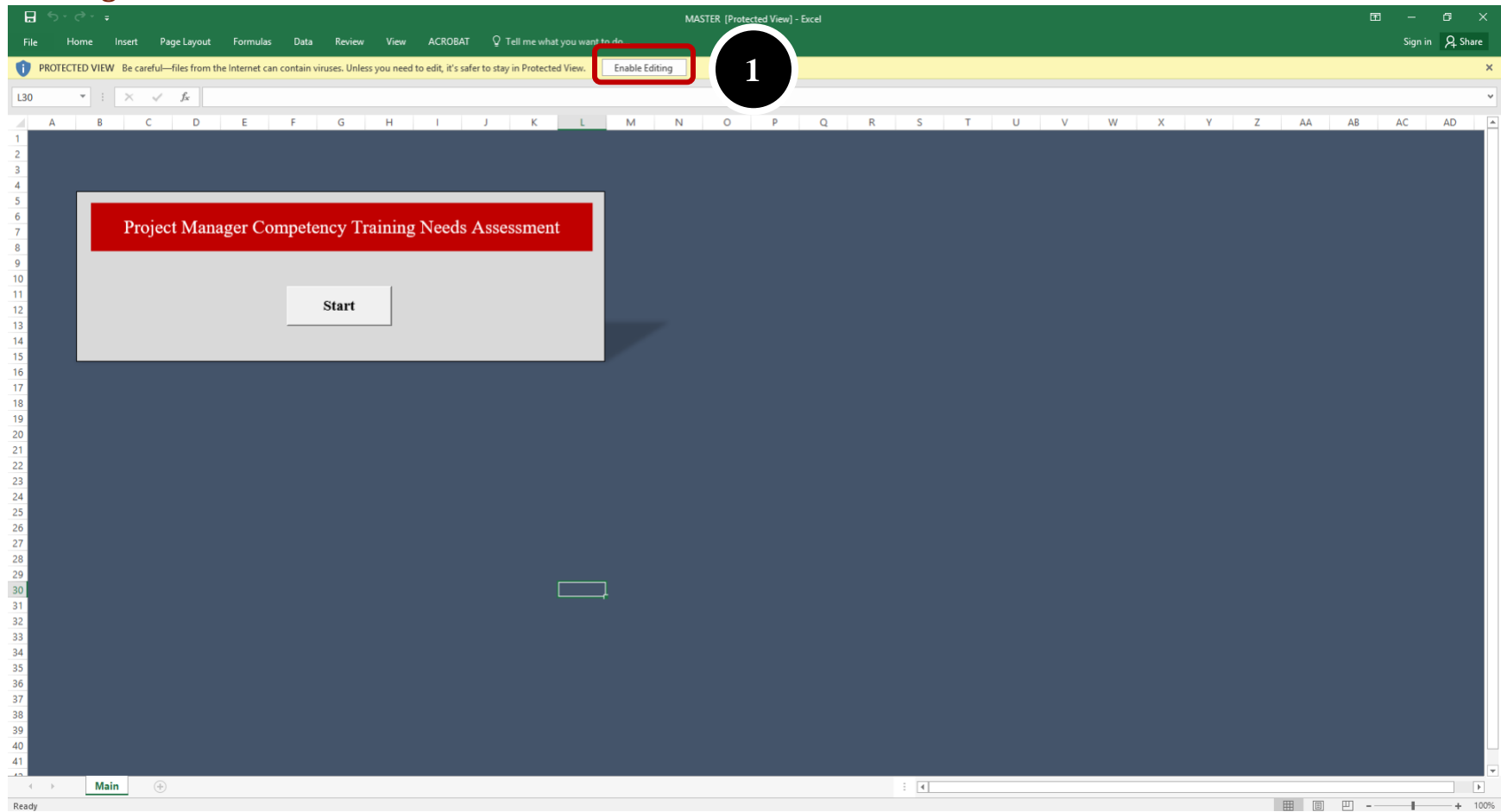


Figure 24: Tool Master File

After opening the Excel file called MASTER FILE:

1. Click "Enable Editing"

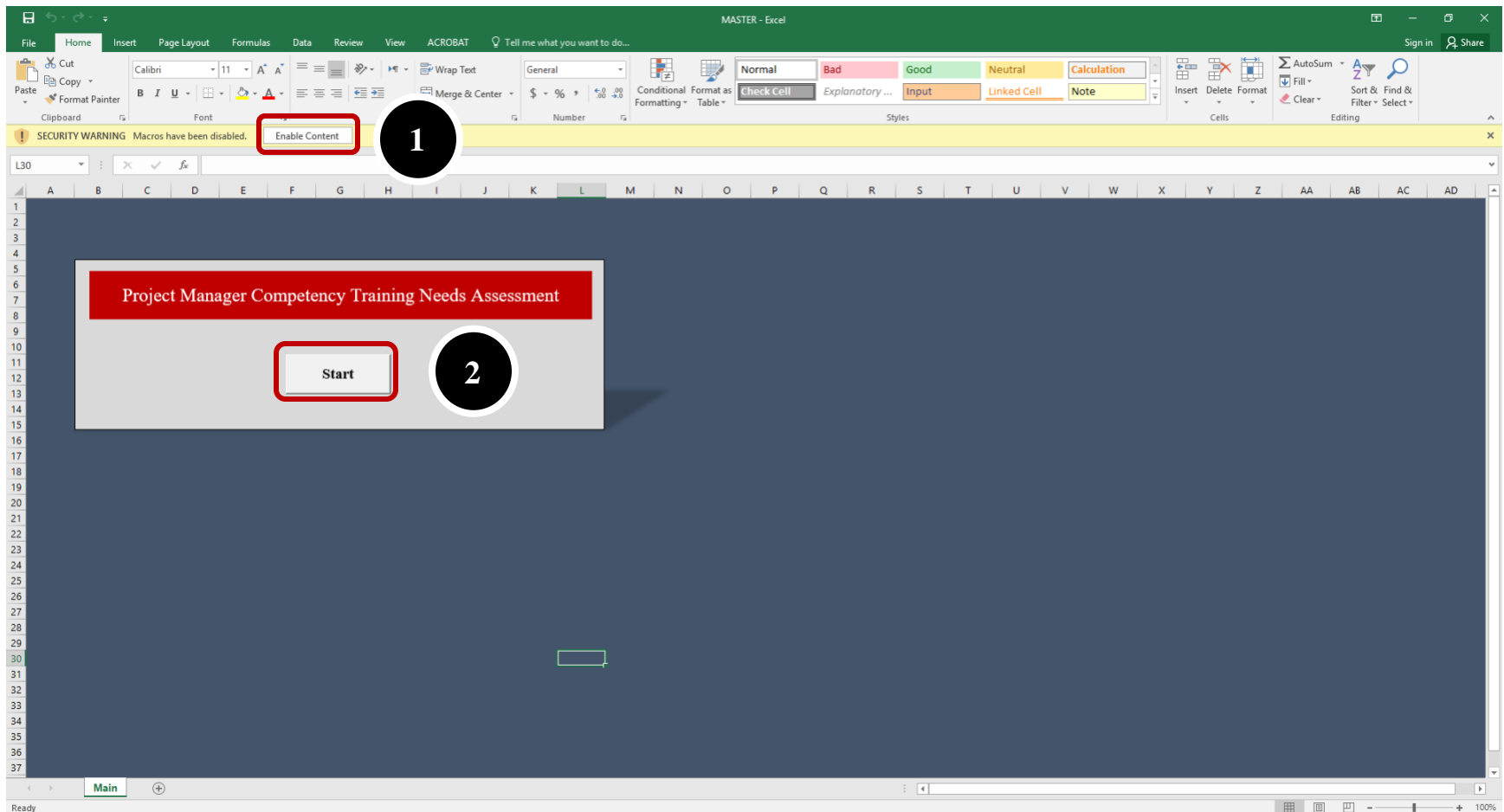




Figure 25: Tool Master File

1. Click "Enable Content"
2. Click "Start"

Creating a New User File

Sign up ×

 **Please Enter Project Manager Name** 

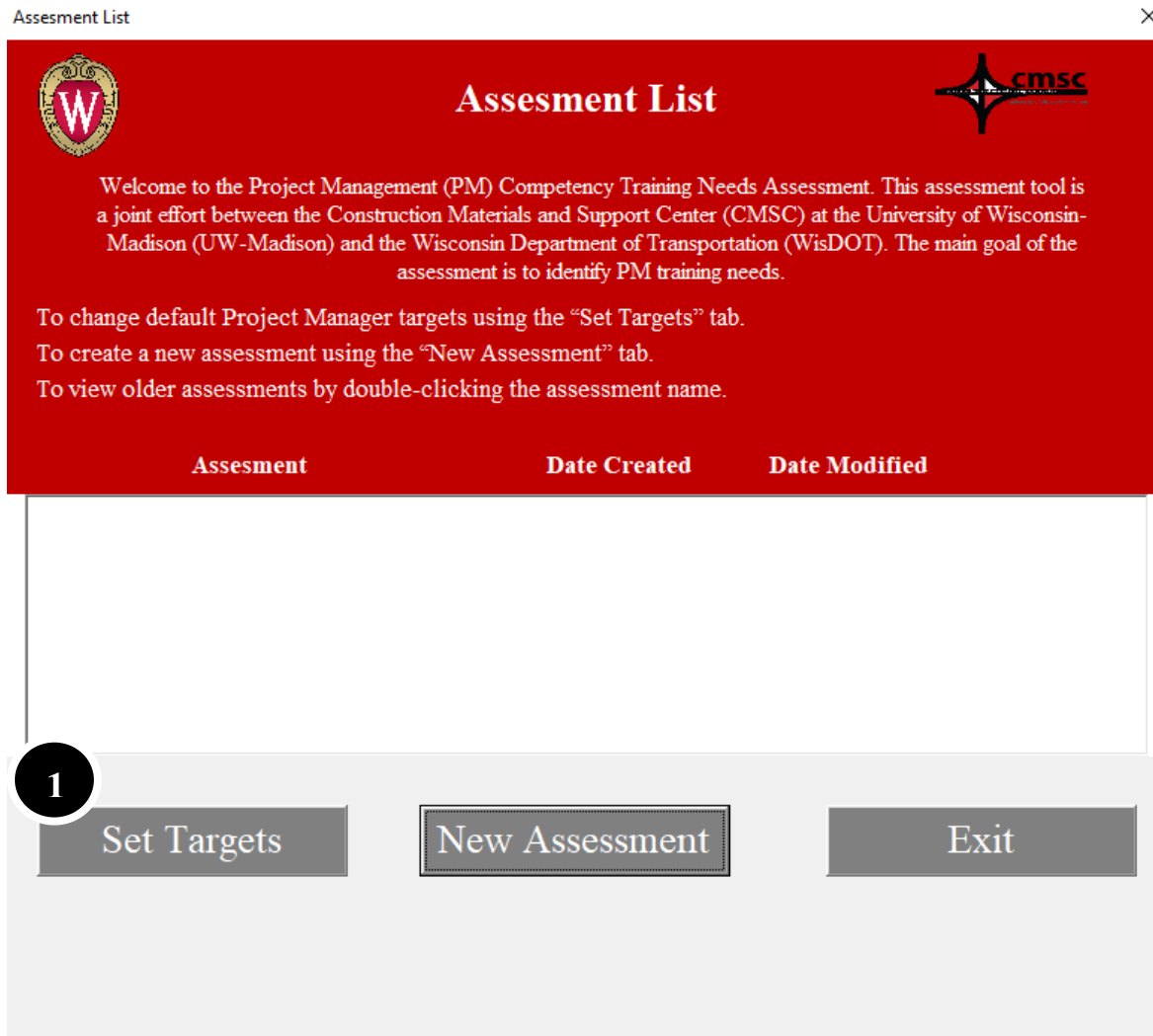
1 PM Name

Exit Save

Figure 26: Creating New PM File

1. Write the name of the PM being assessed then click “Save”
This will create a new file, saved in the same location of the MASTER FILE and titled: PMCA_*PMname*
This is the file that should be accessed when performing assessment for the same PM in future periods

Setting Targets



While displaying the tool outputs, there are research suggested targets for the different aspects of the assessment. These values are derived from data collected through the research phase. However, the tool offers the flexibility to change these targets for each PM.

1. Click the “Set Targets” button to change the targets
2. Click the “New Assessment” button to start a new assessment

Figure 27: Assessment List Window



There are three components that have changeable targets:

1. Overall PM score:
“Project Manager Index (PMX)”
2. PM score per category:
“Spider and Bar Charts”
3. Number of “strengths and Training Needs” to be displayed

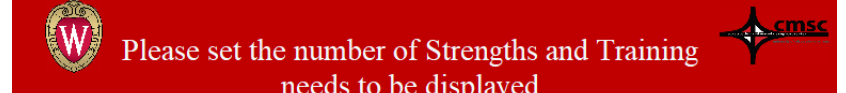
Change the values as desired, then click “Save” as shown in the following figures

Figure 28: Setting Targets Window



1 Project Manager Index

Figure 29: Setting PMX Target



3 Strengths

Training Needs

Figure 30: Setting Number of Strengths and Training Needs

Category Targets



2

Project Management Knowledge and Experience
(Research recommended value = 0.90)

WisDOT Operational Knowledge and Experience
(Research recommended value = 0.90)

Leadership
(Research recommended value = 0.90)

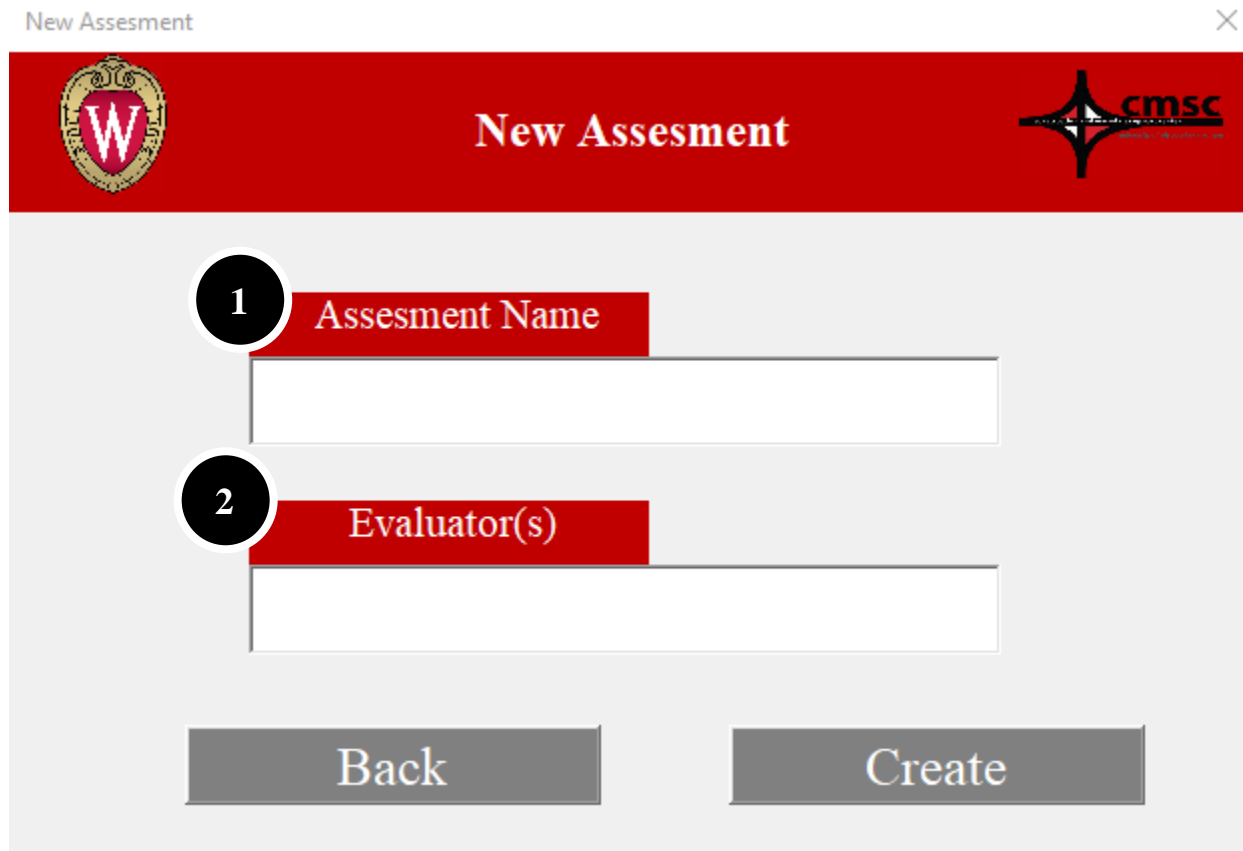
Industry Knowledge and Experience
(Research recommended value = 0.90)

Cognitive/Personal Effectiveness
(Research recommended value = 0.90)

Figure 31: Setting Targets for Each Category

Creating a New Assessment

New Assesment ×



1 Assesment Name

2 Evaluator(s)

Back Create

Figure 32: Creating New Assessment Window

After clicking “New Assessment” on the Assessment List page:

1. Write the name of the new assessment (ex. 2018 Assessment)
2. Write the name of the evaluator(s) participating in the assessment then click “Create”

Starting the Assessment

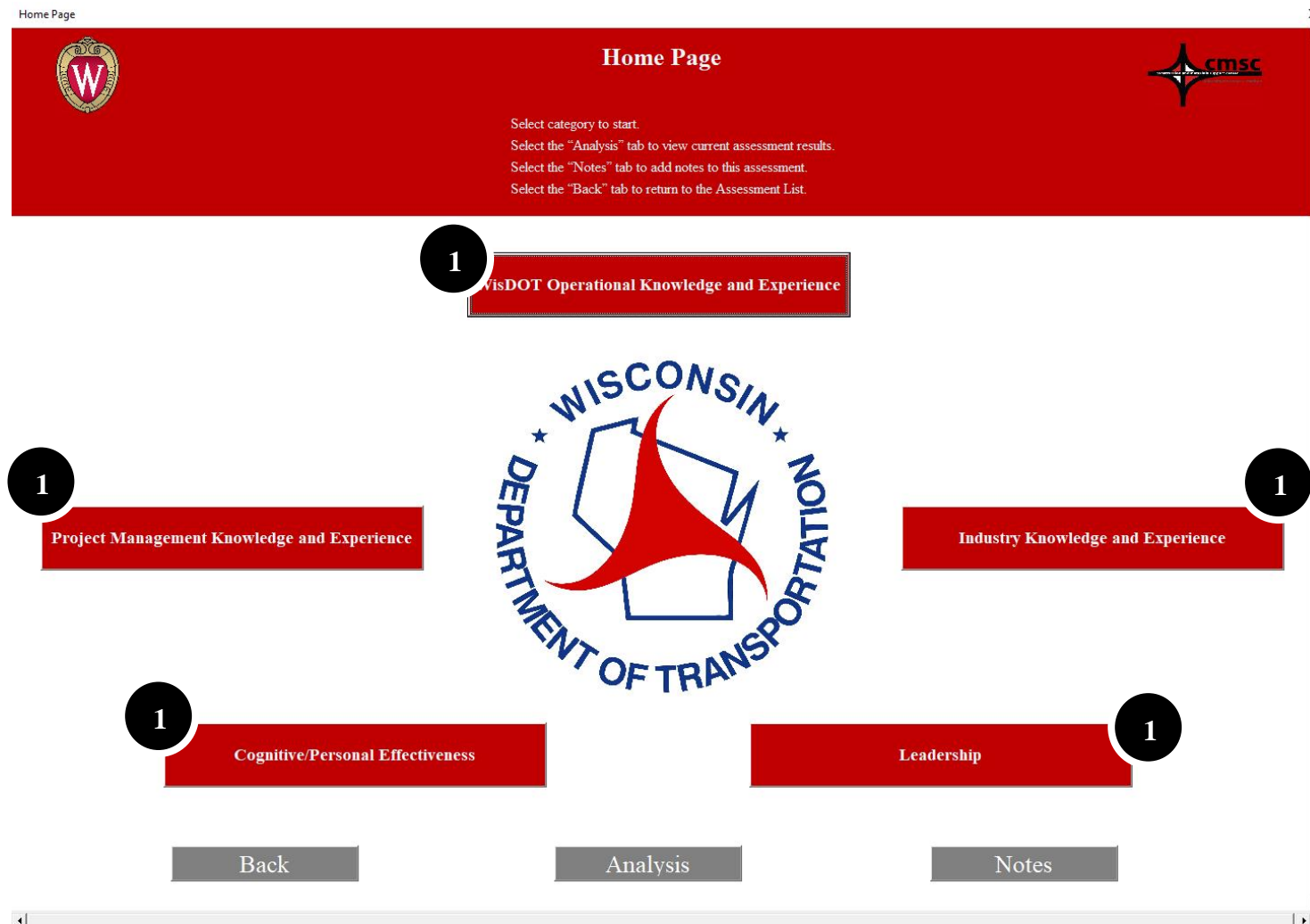


Figure 33: Tool Home Page

1. Select any of the five categories to start filling the assessment

Viewing Definitions

The screenshot shows a window titled 'Leadership' with a logo on the left. The main content area has a dark background with white text defining the category. Below the definition is a table with a red header row containing the competency name and five rating options: 'Not At All', 'Slightly', 'Somewhat', 'Very', and 'Extremely'. The table contains three rows of questions. A callout box titled 'UserForm1' is overlaid on the table, showing the definition for the competency 'Build coalitions with team'.

Leadership

This category evaluates the individual's ability to lead a team, set team performance expectations and organize team members to work collaboratively and effectively to accomplish project goals. The category relates to the project delivery team and how effective the PM is in engaging diverse team members; recognizing and dealing with individual team member's personal styles, capabilities and preferences, resolving conflict, celebrating achievements and creating an environment that ensures the success of the project while maintaining team effectiveness. It also assesses the PM's organizational leadership ability to be innovative, possess strategic insight and influence others both internal and external to the organization. These capabilities are difficult to develop but they are essential for an exceptional PM.

Build coalitions with team:

| | Not At All | Slightly | Somewhat | Very | Extremely |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. How well does the PM foster team work to achieve project objectives? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. How effective is the PM in maintaining a collaborative work environment between project team members? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. How well does the PM develop positive relationships with project stakeholders? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Build coalitions with team:

| | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. How well does the PM manage conflicting interests on the project team? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. How well does the PM manage critical issues between the project team members? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. How well does the PM manage critical issues within the project team? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. How effective is the PM in reaching general agreement between all stakeholders? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

UserForm1

Creating positive relationships between all project stakeholders to ensure the overall success of the project

Close

Figure 34: Typical Category Window

1. At the top of each category page, there is a definition that details the content of the category and ensure its relevance to SHA PMs
2. Each competency has a definition that provides an elaborate explanation of the competency title. To view this definition, click the question mark next to the competency name

| Team issue management: | ? | Not At All | Slightly | Somewhat | Very | Extremely |
|--|---|--------------------------|--------------------------|--------------------------|-------------------------------------|-------------------------------------|
| 1. How well does the PM evaluate issues that arise within the project team? | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. How well does the PM resolve conflicts between team members? | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Communication: | ? | Not At All | Slightly | Somewhat | Very | Extremely |
| 1. How well does the PM ensure that efficient communication takes place between team members? | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. How effective is the PM in communicating technical and business information to relevant team members? | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. How well does the PM demonstrate active listening? | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Timely decision making: | ? | Not At All | Slightly | Somewhat | Very | Extremely |
| 1. How effective is the PM in making timely decisions that ensure project success? | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

5
Previous

2
Save

3
Back

4
Next

Figure 35: Category Window Functionality

1. Fill in the assessment by ticking the boxes in response to the question
2. The “Save” button saves current progress and returns to Home Page
3. The “Back” button returns to Home Page without saving current progress
4. The “Next” button saves progress and moves to the next category
5. The “Previous” button saves progress and moves to the previous category

Reviewing Assessment Results

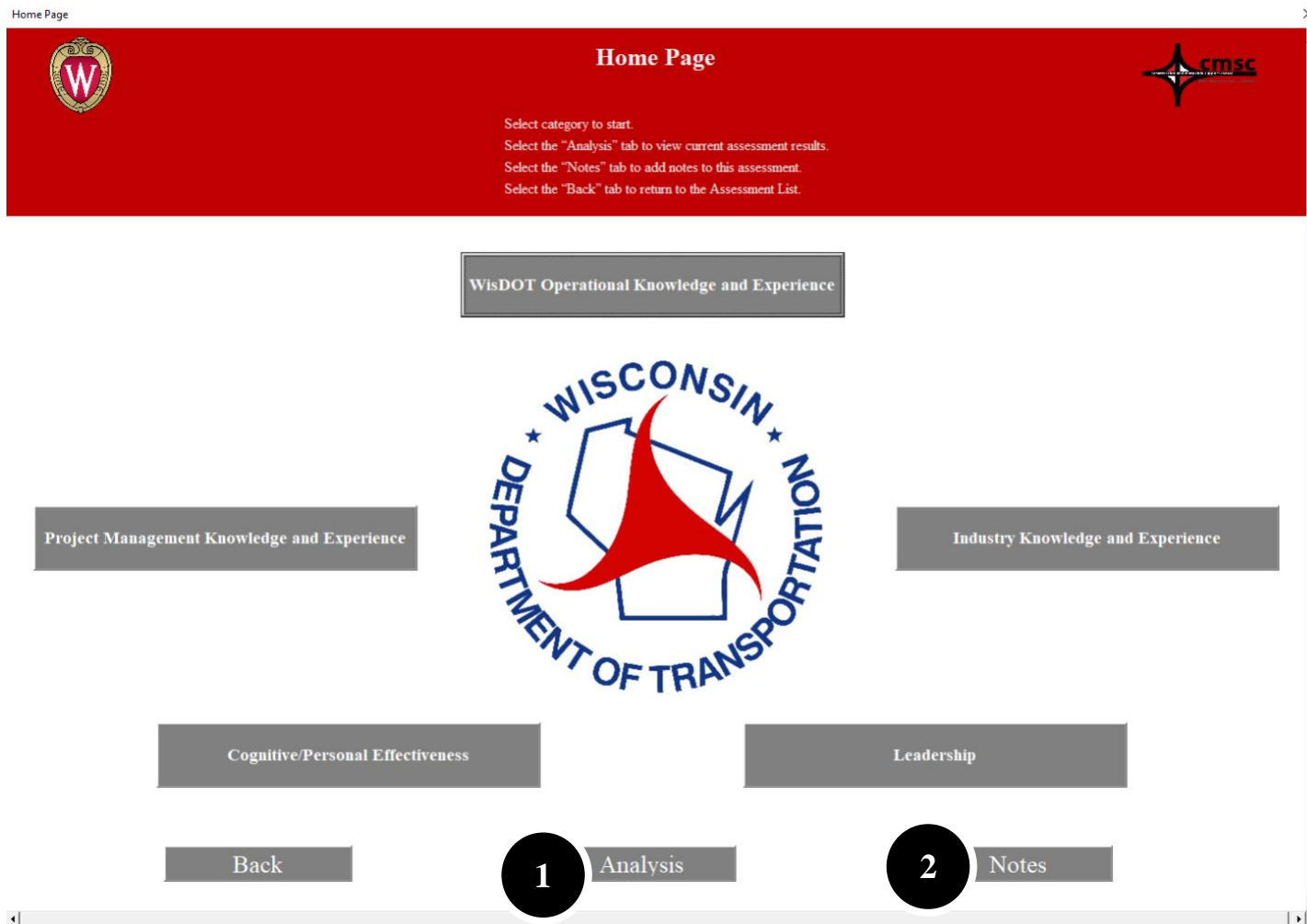
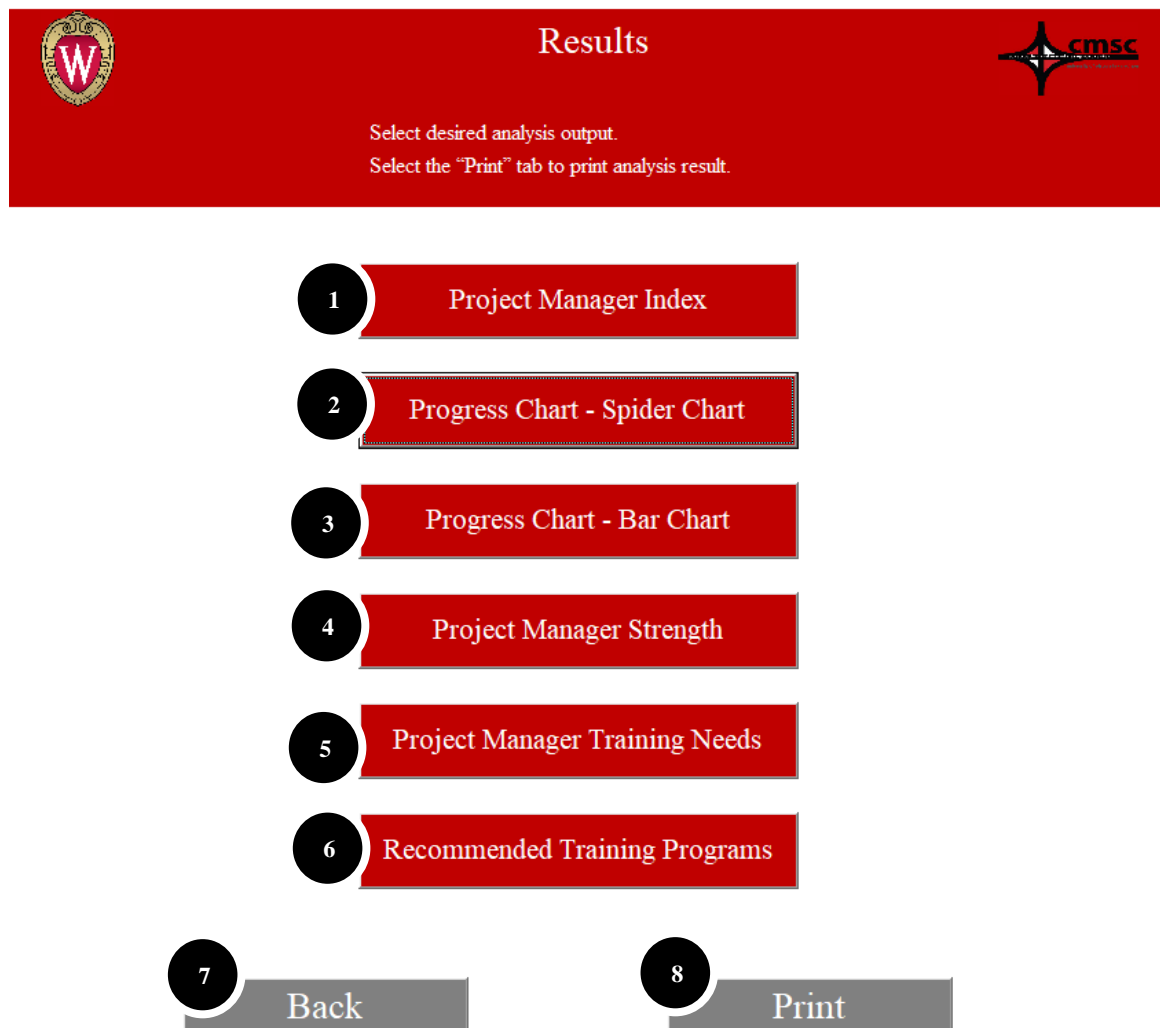


Figure 36: Home Page After Filling The Assessment

After filling in all the question within a category, the color of its button on the Home Page will change to grey to indicate its completion

1. After all categories are complete, click the "Analysis" button to review the results of the assessment
2. The "Notes" button takes you to a window where notes for this assessment can be added



The assessment tool has five main outputs:

1. Project Manager Index (PMX)
2. Spider Chart
3. Bar Chart
4. Project Manager Strengths
5. Project Manager Training Needs

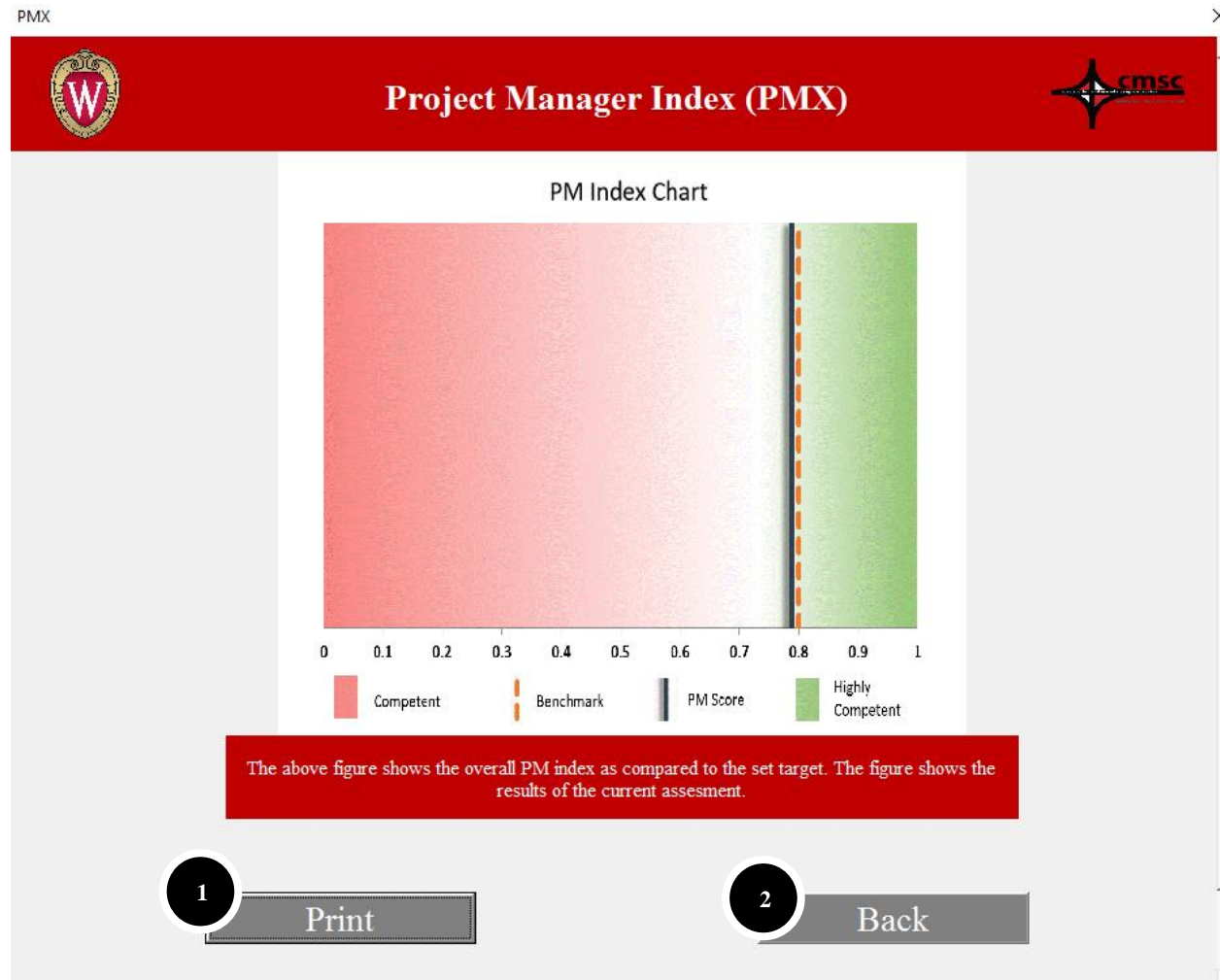
Each of these can be accessed by clicking one of the buttons 1-5

Each output will be explained in detail in the following section

6. Recommended Training Needs: allows evaluator(s) to insert specific training programs in response to every training need
7. The "Back" button returns to Home Page
8. The "Print" button prints all assessment results into a word document for future review

Figure 37: Results Window

1. Project Manager Index



The Project Manager Index (PMX) is the output that reflects the PM's total score.

The black line reflects the score of the PM while the dashed, red line reflect the targets set at the beginning of the assessment. If the PM score is greater than the target, the PM is highly competency. If it is below the red line, s/he is competent.

1. Click "Print" to print the individual chart
2. Click "Back" to go back to results list

Figure 38: Project Manager Index (PMX) Output Chart

2. Progress Chart: Spider Chart

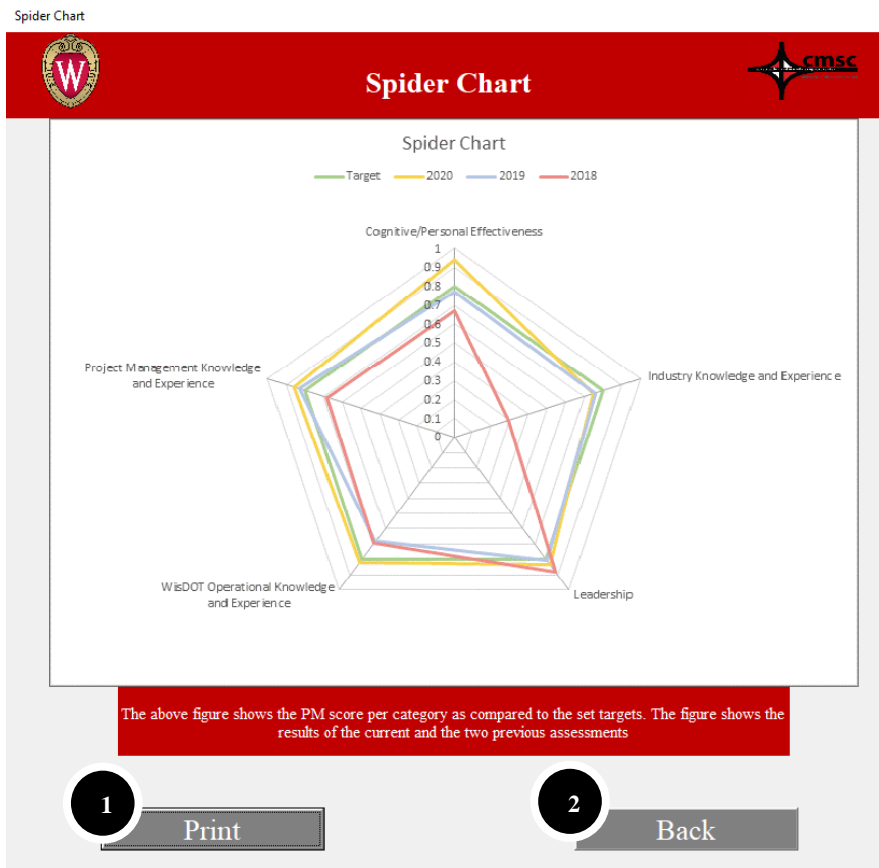


Figure 40: Spider Chart Output - 2020

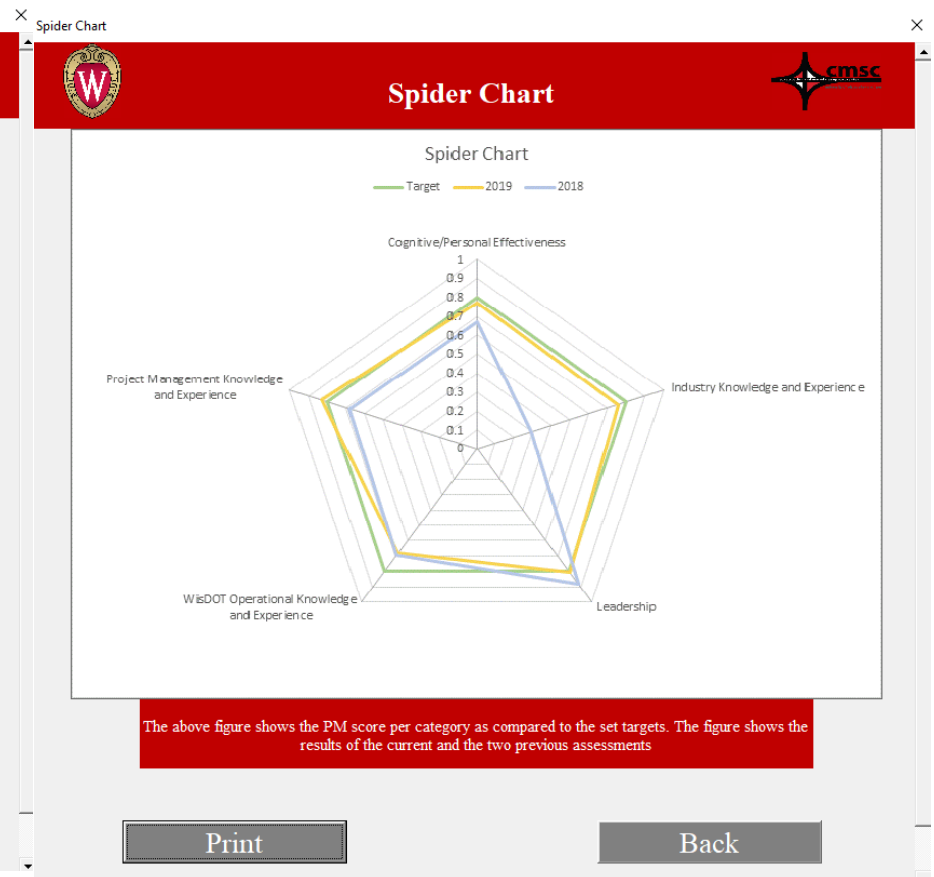


Figure 39: Spider Chart Output - 2019

The Spider Chart shows the PM's score for each category of the assessment. This helps the PM and the organization identify the PM's strongest categories. The chart shows the PM's current score as well as the set targets and the score of the previous two assessments. This helps the PM and the organization in tracking his/her progress over the years.

1. Click "Print" to print the individual chart
2. Click "Back" to go back to results list

3. Progress Chart: Bar Chart

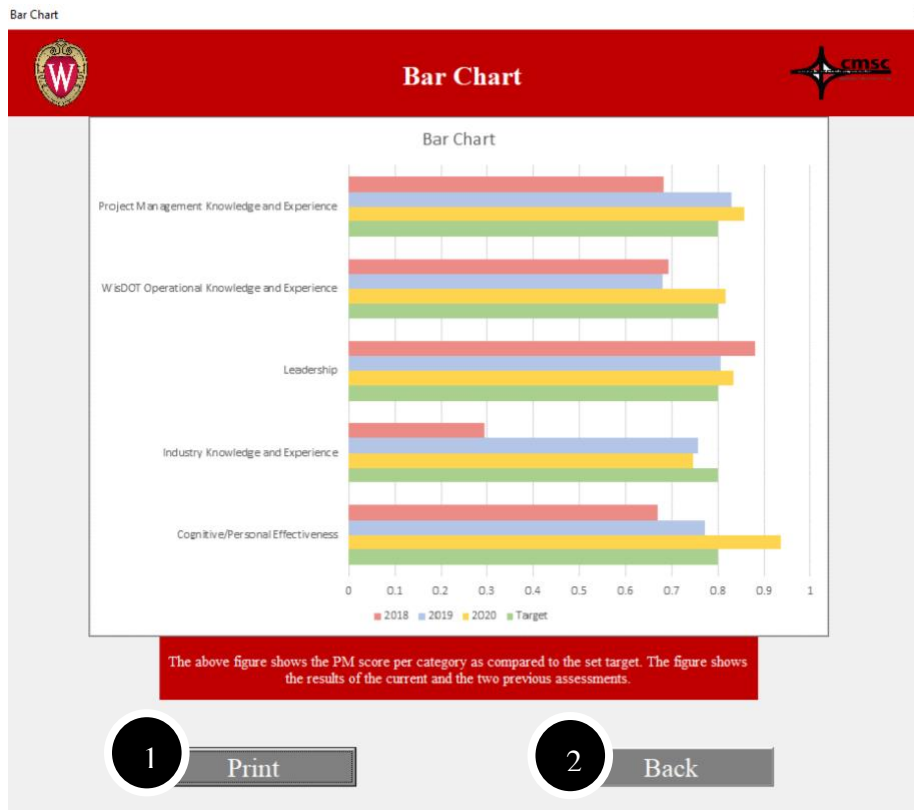


Figure 42: Bar Chart Output - 2020

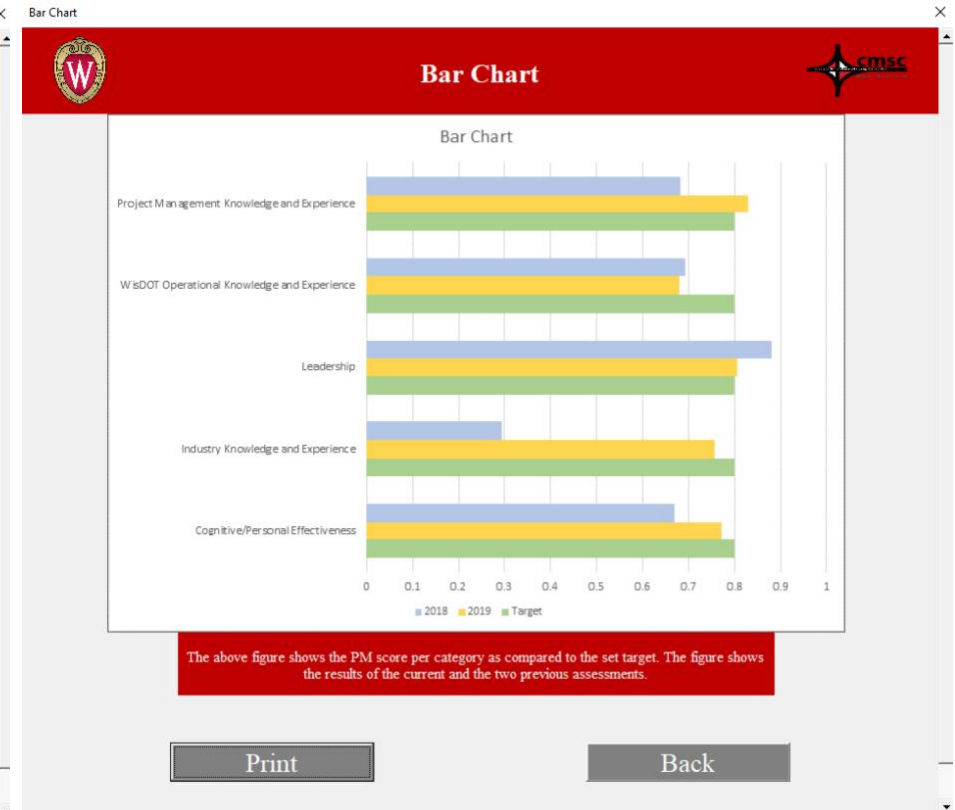


Figure 41: Bar Chart Output 2019

Similar to the Spider Chart, the Bar Chart shows the PM’s score for each category of the assessment. This helps the PM and the organization identify the PM’s strongest categories. The chart shows the PM’s current score as well as the set targets and the score of the previous two assessments. This helps the PM and the organization in tracking his/her progress over the years.

1. Click “Print” to print the individual chart
2. Click “Back” to go back to results list

4. Project Manager Strengths

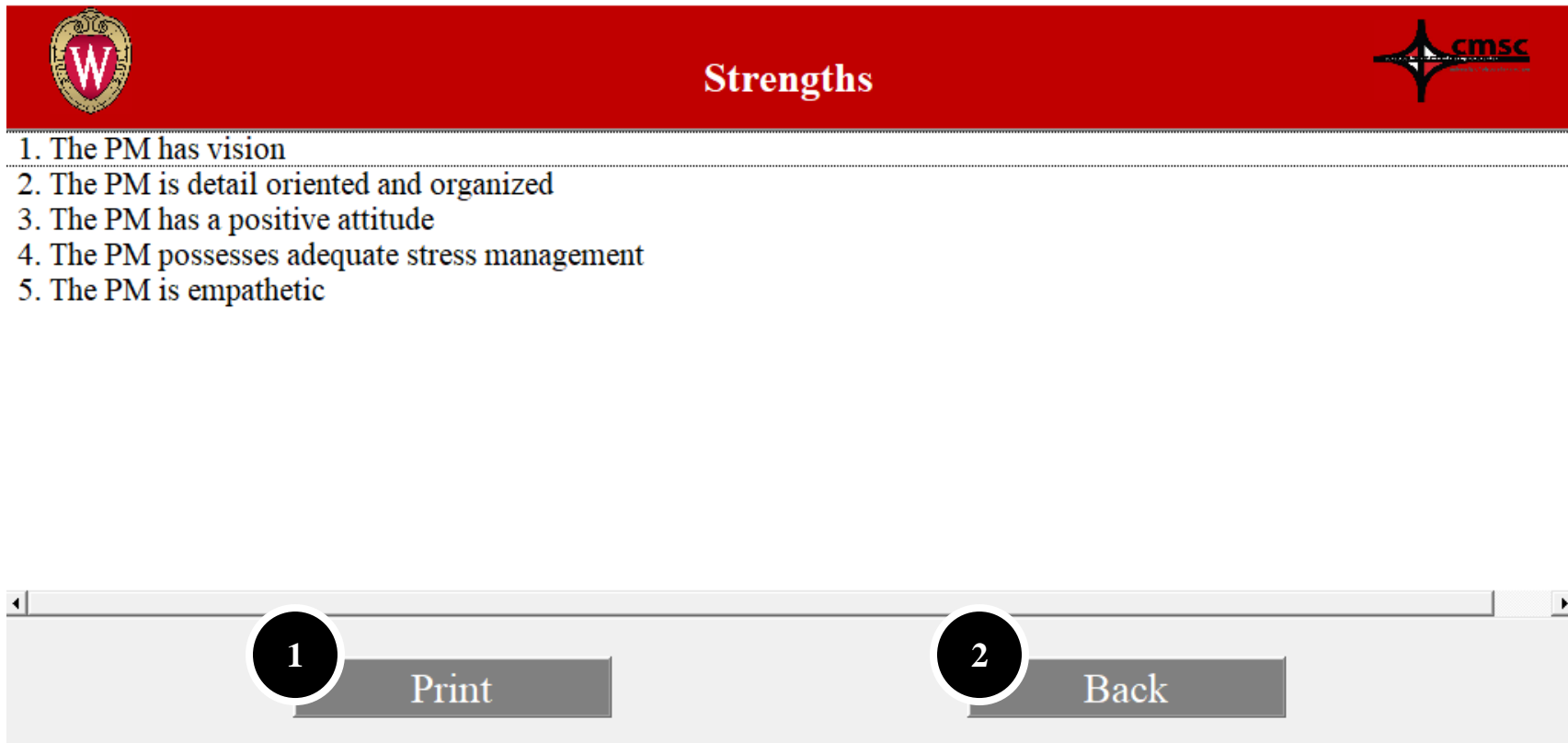


Figure 43: PM Strengths Window

The Project Manager Strengths shows the competencies that the PM excels at. This helps the PM and organization and the PM direct his/her career to a direction where s/he would add most value.

1. Click "Print" to print the individual chart
2. Click "Back" to go back to results list

5. Project Manager Training Needs

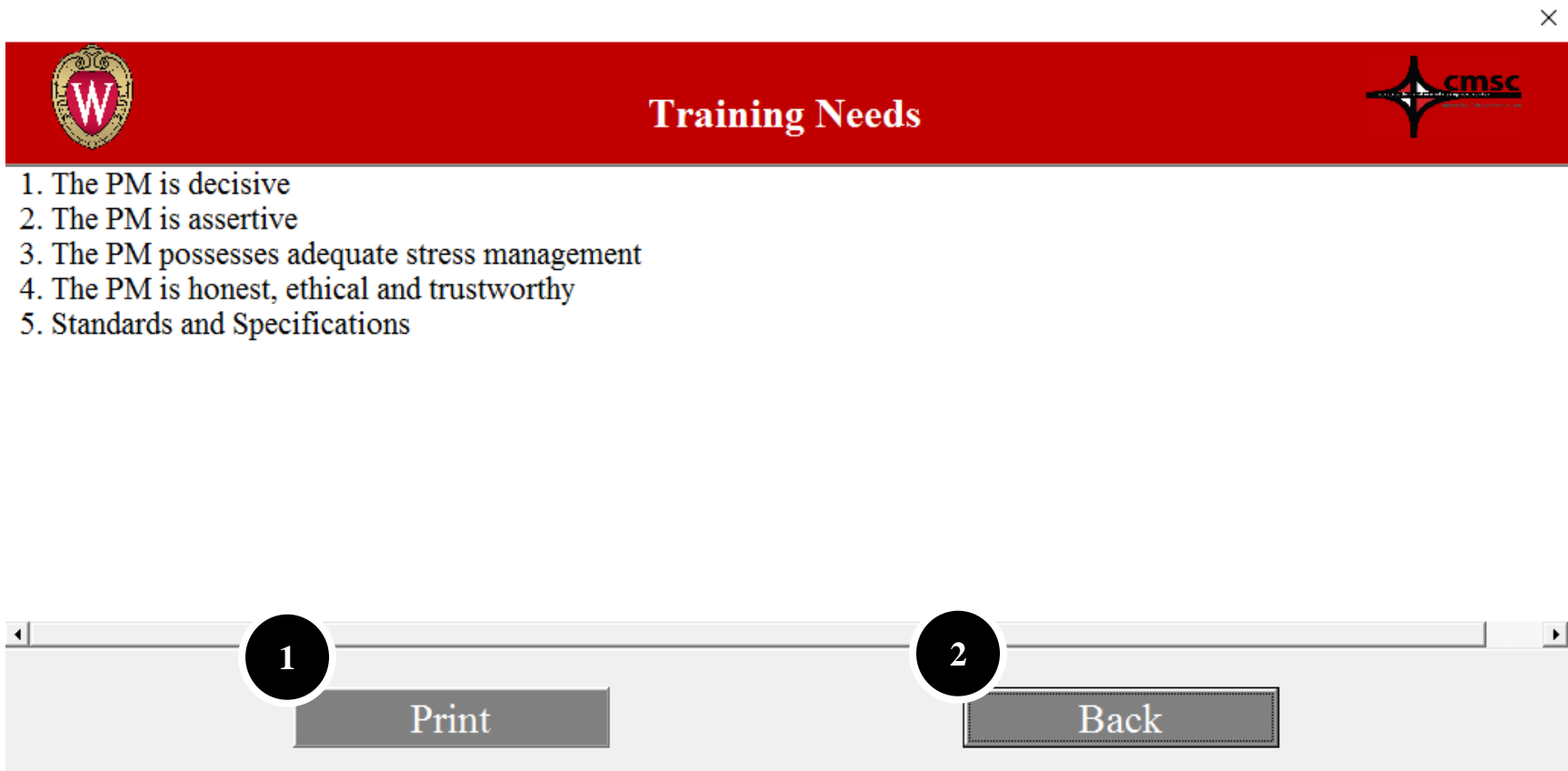


Figure 44: PM Training Needs Window

The Project Manager Training Needs point out the areas where the PM needs most work and improvement. As this is specific to each PM, it helps him/her in developing these skills to enhance their overall competence.

1. Click "Print" to print the individual chart
2. Click "Back" to go back to results list

Recommended Training Programs

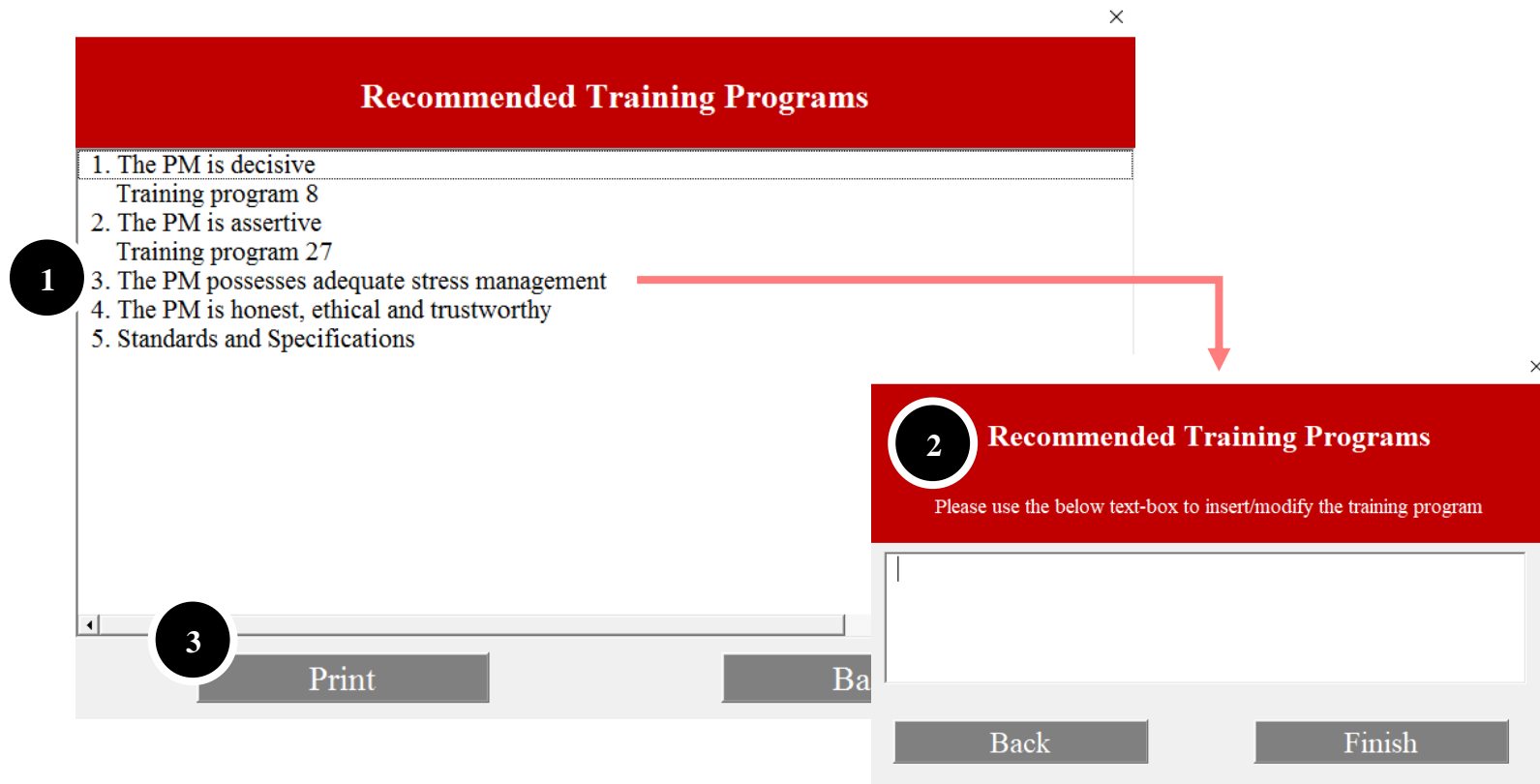



Figure 45: Recommended Training Programs Window

This window allows the evaluator(s) to input specific Training Programs to tackle each Training need that the PM has.


1. Double-click the Training Need that you would like to add a Training Program to
2. Type the name of the Training Program(s) and click "Finish" or click "Back" to return without saving
3. When all desired Training Program(s) are entered, click "Print" to

Exiting the Tool

Assesment List ×



Assesment List



Welcome to the Project Management (PM) Competency Training Needs Assessment. This assessment tool is a joint effort between the Construction Materials and Support Center (CMSC) at the University of Wisconsin-Madison (UW-Madison) and the Wisconsin Department of Transportation (WisDOT). The main goal of the assessment is to identify PM training needs.

To change default Project Manager targets using the “Set Targets” tab.
To create a new assessment using the “New Assessment” tab.
To view older assessments by double-clicking the assessment name.

| Assesment | Date Created | Date Modified |
|-----------|--------------|---------------|
| 2018 | 4/26/2018 | 4/26/2018 |
| 2019 | 4/26/2018 | 4/26/2018 |
| 2020 | 4/26/2018 | 4/26/2018 |

Set TargetsNew AssessmentExit

1. After finishing the assessment, return to the Assessment List page and click the “Exit” button

Then close the Excel file. Click the “Save” button in the pop-up window to save the changes made to the file.

Figure 46: Assessment List Window

Sample Output

Project Manager Competency Training Needs Assessment - Report

Project Manager Name: John

Assessment Name: 2019

Evaluator(s): Jane

Date Created: 4/27/2018

Date Modified: 4/29/2018

Project**Manager****Strengths**

1. Risk and Issues management
2. Project Controls
3. The PM is adaptable
4. Develop and mentor others
5. Policy and Procedures

Project Manager Training Needs

1. The PM is decisive
2. The PM is assertive
3. The PM possesses adequate stress management
4. The PM is honest, ethical and trustworthy
5. Standards and Specifications

Recommended Training Programs

| Project Manager Training Need | Recommended Training Program |
|--|-------------------------------------|
| 1. The PM is decisive | Training program 8 |
| 2. The PM is assertive | Training program 27 |
| 3. The PM possesses adequate stress management | |
| 4. The PM is honest, ethical and trustworthy | |
| 5. Standards and Specifications | |

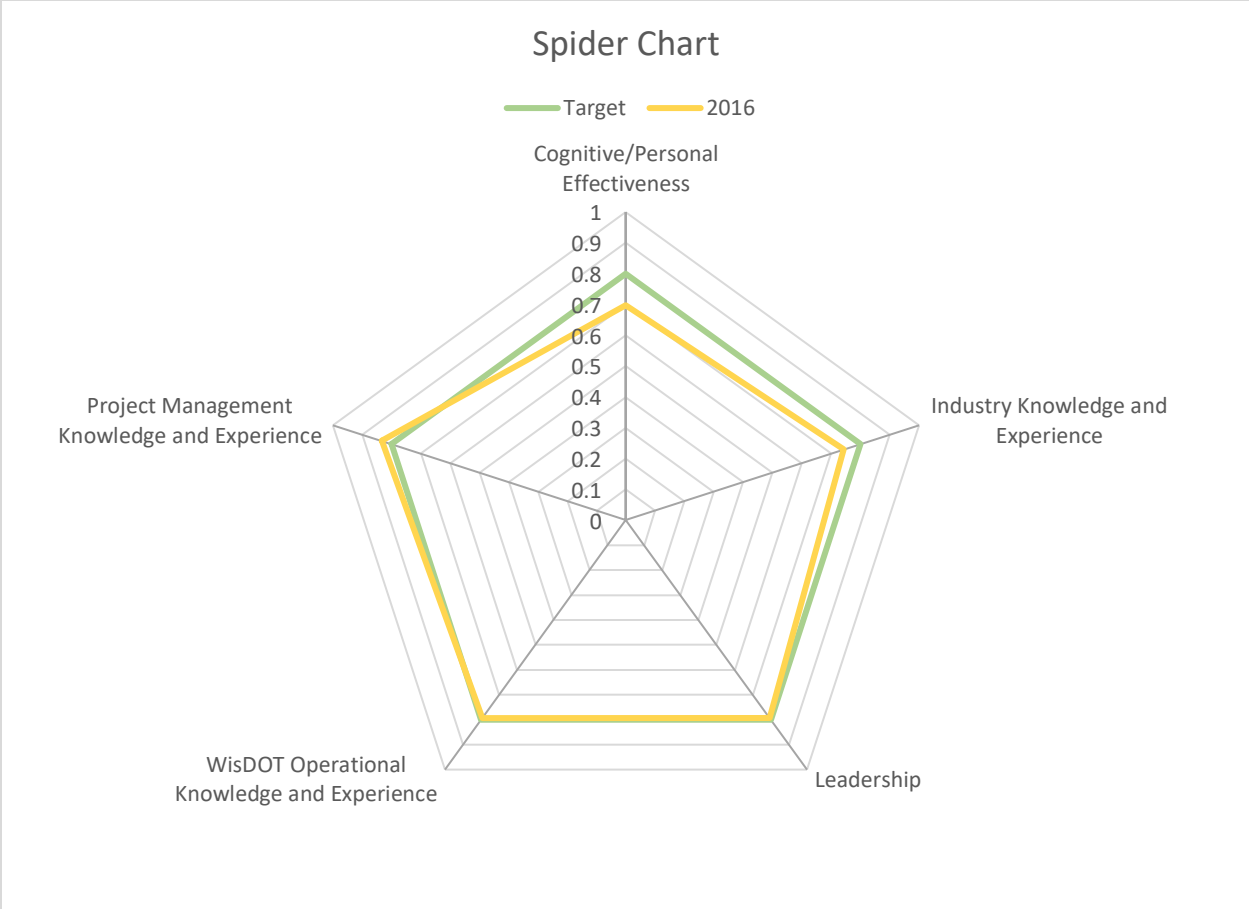


Figure 47: Sample Tool Output - Spider Chart

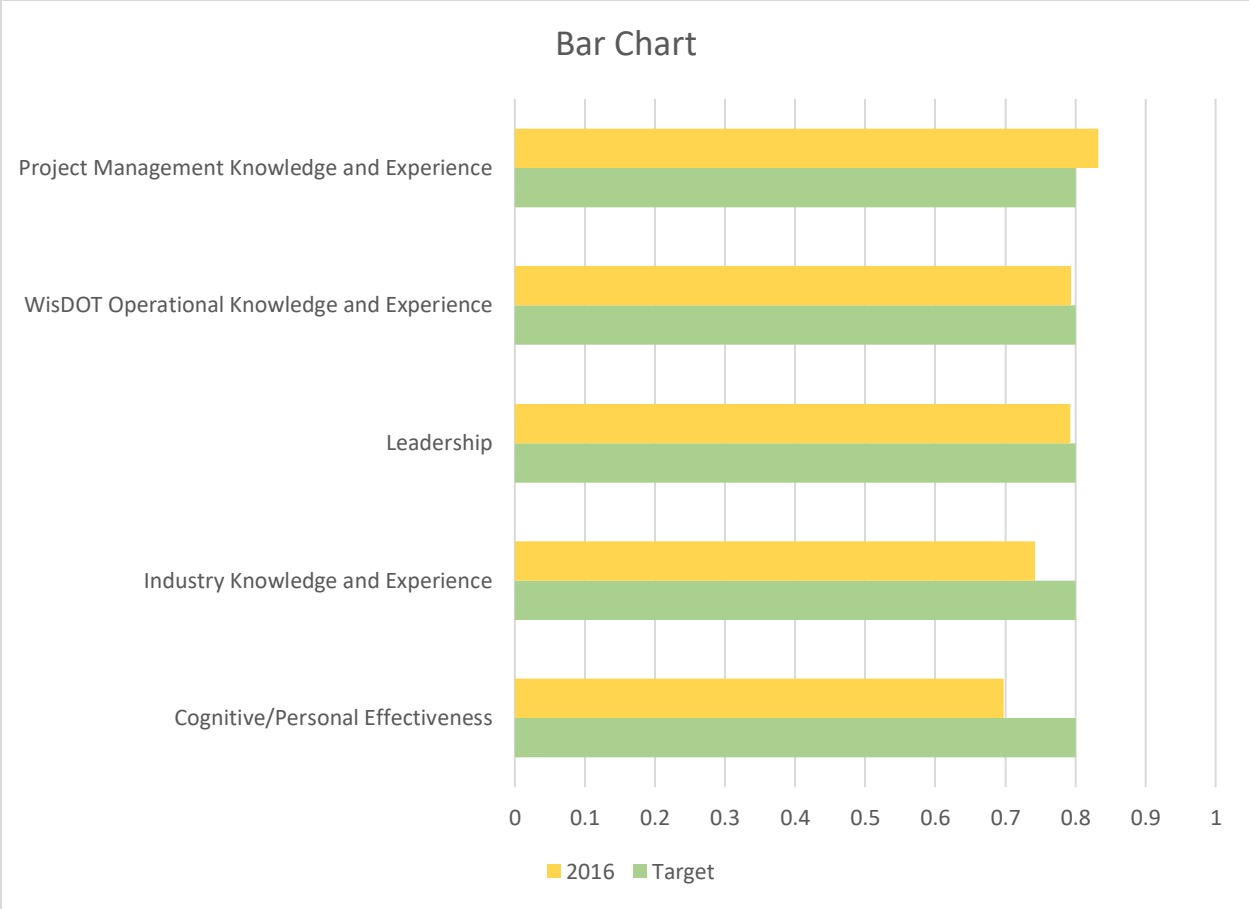


Figure 48: Sample Tool Output - Bar Chart

PM Index Chart

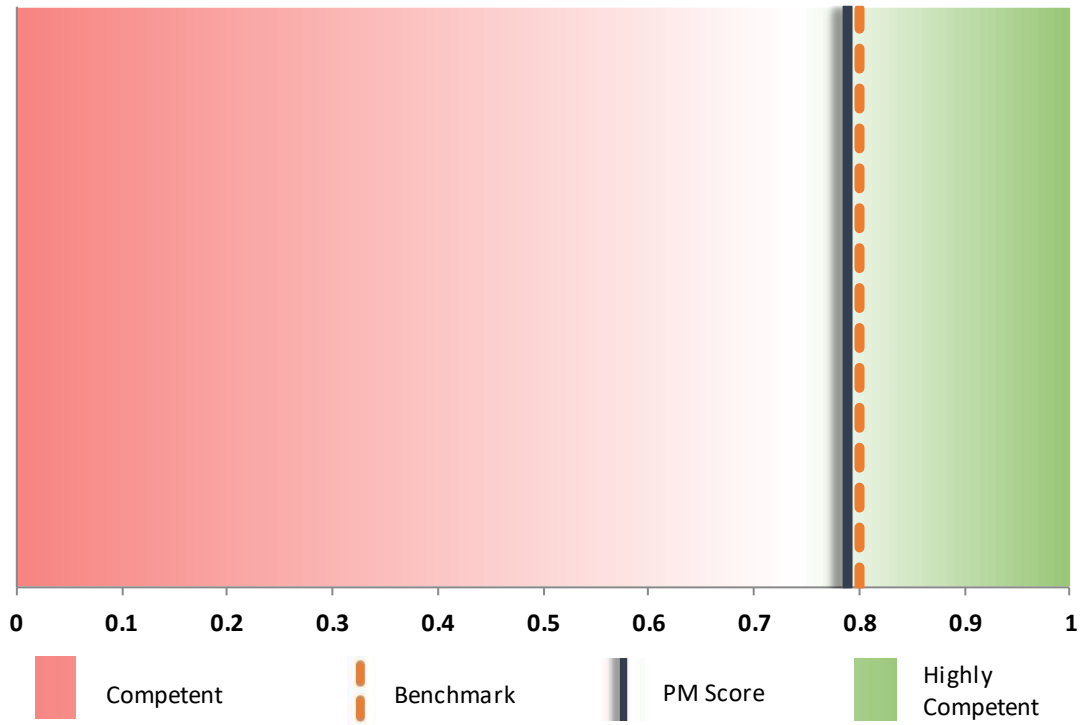


Figure 49: Sample Tool Output - Project Manager Index (PMX)

Tool Testing and Validation

The tool was tested by the WisDOT professional committee who provided feedback regarding the tool functionality and usability for WisDOT.

100% of the participants said that:

- a) The tool is useful for WisDOT PMs
- b) The tool is easy to use
- c) The tool manual is useful
- d) The tool outputs are useful
- e) The tool should be used annually to monitor PM progress

The researcher hopes that this positive feedback would mean that the tool would be put to application as soon as possible as part of WisDOT's annual assessments.

In a follow up survey, the tool will be tested by participants from the 11 states that participated in the data collection period.

Conclusion

In a labor-intensive industry like the construction industry, adequate management is essential for a project's success. Project Managers (PM) have a role that can ensure a project's success or failure. Therefore, the capabilities and skills of PMs have been heavily researched in recent years. This research has focused on two main categories: hard skills and soft skills, both of which are crucial for the performance of PMs. Several entities have used this body of knowledge to create a more applicable way for PMs of different entities to make use of the research outcomes. These efforts have resulted in several frameworks and assessments for PMs that work in the construction industry. However, there was a clear gap in the literature in the area of transportation construction. This research effort tackled this gap by identifying and defining the main competencies needed for State Highway Agency (SHA) PMs, creating an objective and quantitative assessment and developing an Excel-based tool that allows the assessment to be easily used and provides personalized and useful feedback to the PMs.

The researcher worked with a team of academicians, two professionals from the University of Wisconsin-Madison (UW-Madison), as well as industry professionals, six professionals from the Wisconsin Department of Transportation (WisDOT), to identify 55 competencies spanning five categories; Project Management Knowledge and Experience, Leadership, Department of Transportation Operational Knowledge and Experience, Industry Knowledge and Experience and Cognitive/Personal Effectiveness. For each category and competency, a definition was created to reduce the room for interpretation and make each of them specific to SHA PMs. A set of questions was then developed for each competency to make the assessment process objective and quantitative. In total, the assessment consists of 145 questions.

To identify the relative importance of the competencies, 90 data points were collected from 12 states. This data reflected that the most important categories for SHA PMs are Project Management Knowledge and Experience and Leadership. In terms of the calculations performed, this shows that these two categories are the ones that have the highest impact on the difference in performance between “exceptional” and “average” PMs. The category with the least impact on performance was identified to be Industry Knowledge and Experience. This is due to the fact that most PMs, “average” and “exceptional”, had high scores when it came to this category and, therefore, its impact on the score was low.

The data collected was divided into two sections where 35 data points were collected from WisDOT and the other 55 points were collected from 11 different states. This allowed the researcher to perform comparative analysis between both data groups. In most cases, the data showed similar results between the two groups and, therefore, the researcher used the overall calculations for the tool and to draw conclusions.

The final step of the research was developing a user-friendly tool that would allow for this research effort to be useful for industry professional. The tool developed is Excel-based and has a user-friendly interface. The researcher also focused on providing output that would be most useful for SHA PMs and would allow them to enhance their capabilities and be able to track their progress over time. The tool was tested and validated by WisDOT professionals who believed that the tool would be very useful for their PMs and the organization as a whole.

Future Research

This research effort focused on the competencies needed for the basic job description of a SHA PM. It provides a comprehensive list of leadership and cognitive competencies that SHA PMs should have, however, there is room for more in depth research regarding more complex project delivery methods that needs different competencies. These involve projects that are developed under lean and integrated project delivery systems. These systems require different competencies which allow that PM to work in different conditions of a collaborative environment that has different requirements and restrictions. Therefore, this research effort can be expanded to include competencies needed for these cooperative delivery systems.

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