

Project Management Skills of the Future

by

Cynthia Joyce King

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Graduate Supervisory Committee:

Avi Wiezel, Chair  
William Badger  
Kenneth Sullivan

ARIZONA STATE UNIVERSITY

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## ABSTRACT

The goal of this research study was to identify the competencies the Project Manager (PM) will need to respond to the challenges the construction industry faces in 2022 and beyond.

The study revealed twenty-one emerging challenges for construction PMs grouped into four primary disruptive forces: workforce demographics, globalization, rapidly evolving technology, and changing organizational structures. The future PM will respond to these emerging challenges using a combination of fourteen competencies. The competencies are grouped into four categories: technical (multi-disciplined, practical understanding of technology), management (keen business insight, understanding of project management, knowledge network building, continuous risk monitoring), cognitive (complex decisions making, emotional maturity, effective communication), and leadership (leveraging diverse thinking, building relationships, engaging others, mentoring, building trust).

Popular data collection methods used in project management research, such as surveys and interviews, have received criticism about the differences between stated responses to questions, what respondents say they will do, and revealed preferences, what they actually practice in the workplace. Rather than relying on surveys, this research study utilized information generated from games and exercises bundled into one-day training seminars conducted by Construction Industry Institute (CII) companies for current and upcoming generations of PMs. Educational games and exercises provide participants with the opportunity to

apply classroom learning and workplace experience to resolve issues presented in real-world scenarios, providing responses that are more closely aligned with the actual decisions and activities occurring on projects. The future competencies were identified by combining results of the literature review with information from the games and exercises through an iterative cycle of data mining, analysis, and consolidation review sessions with CII members.

This competency forecast will be used as a basis for company recruiting and to create tools for professional development programs and project management education at the university level. In addition to the competency forecast, the research identified simulation games and exercises as components of a project management development program in a classroom setting. An instrument that links the emerging challenges with the fourteen competencies and learning tools that facilitate the mastering of these competencies has also been developed.

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# 1 INTRODUCTION

## Background

The Construction Industry Institute (CII) is a consortium of owner, engineer-contractor and supplier firms in the public and private sectors. This consortium partners CII member companies with university academics to conduct various research initiatives committed to improving industry performance.

CII, like a number of other professional industry organizations, has developed a strategy to help prepare the Engineering and Construction (E&C) industry for the challenges coming in the next decade. In 2008, the CII Strategic Planning Committee conducted a broad-based study and prepared an “Emerging Trends and Blue Sky” report. This study revealed that the construction industry was already developing new ways of delivering capital projects and rethinking corporate strategies to incorporate collaborative approaches. The results awakened greater interest in the role Project Managers (PM) will play, particularly for the new competencies that will be demanded.

In 2010, CII chartered Research Team 281 (RT-281) to predict the competencies successful PMs will need in the coming decade. Industry representatives from more than a dozen CII member companies guided, participated in, and provided data for research, while academic members brought knowledge of the latest advances in project management development and provided guidance for the research analysis.

RT-281 set out to answer this question: “What skill set will be required for the PM of the future?”

The primary goal of the research was to identify and define specific attributes and competencies required for PMs to successfully respond to the changes already being experienced within the industry.

### Research Hypothesis

By the year 2022, a PM's competencies will expand from the current primary focus on technical and management proficiency to include an emphasis on leadership (i.e., "soft skills").

### Organization of the report

This research report is organized as follows:

- The Introduction provides a brief explanation of the background, the research objectives, hypothesis, and organization of the report.
- The Literature Review presents the results of a literature search. The literature review was one of the key resources used in this research to determine the competencies for PMs in 2022 and beyond.
- The Methodology chapter provides an in-depth discussion of the forecasting approach that was used.
- The Discussion of Data Analysis, Findings, and Applications provides the results of the study. This discussion includes an overview of the attributes and competencies of future PMs plus identifying tools, games, and exercises that will support the development and growth of future PMs.

- The Conclusions and Recommendations chapter includes an assessment of the research study objectives and hypothesis, as well as the potential application of the results. A brief discussion of follow-on research is also included in this section.

## 2 LITERATURE REVIEW

Literature review is one of the key resources used in this research to determine the competencies for engineering and construction PMs in 2022 and beyond.

The literature review effort included an extensive search of two primary areas:

- futures studies, including macro level forecasts and trends and their industry specific impacts
- PM competency research studies

The purpose of the literature search was two-fold:

- to perform a critical review of the methodologies behind previous PM competency research studies and industry-specific futures studies in order to determine not only what has been done but also how it was done
- to seek insight regarding:
  - a) the findings relative to forces and trends that will pose challenges for the industry in ten years
  - b) the findings relative to current PMs, and what competencies are forecast for PMs in ten years

## Research Methods

### *Futures Forecasting Research*

In an attempt to prepare the E&C industry for the uncertainties and challenges to come in the next decade, a number of industry professional and research organizations prepared studies forecasting the future.

Examples of professional organizations that developed strategies for the industry, which are focused on the next decade, include: the Construction Research and Innovation Strategy Panel (nCRISP), the Construction Industry Research and Information Association (CIRIA) from the UK, the Construction Industry Institute (CII) and American Society of Civil Engineers (ASCE) from the US, and the Australian Cooperative Research Centre for Construction Innovation (CRC) from Australia.

In 2007, Harty et al. (2007) published a critical review of thirteen construction-related forecasting studies, which incorporated the themes, commonalities and differences of opinion as a basis for developing two future scenarios occurring in 2025. This critical review provided an overview of the methodologies used to develop these reports, published between 1998 and 2005, that included workshops interviews, questionnaires, individual and organization speculation, and reviews of past work.

Recent books published on industry strategies include The Project Management Institute's (PMI) *Project Management Circa 2025* in 2009. This book featured a collection of project management based scenarios "circa 2025" from current project management practitioners in different industries and

countries. In their book, *Constructing Futures*, published in 2011, Professors Chan and Cooper provided a critique of ten industry specific futures studies from around the globe. Chan and Cooper's assessment is that industry-specific futures studies tend to offer extensions of present-day thinking. Hardy et al. agrees that these studies tend to predict a positive outlook for the industry, especially regarding the possibilities of technology for improving productivity and reducing requirements for physical labor. The studies were based on interviews with industry professionals and academics, as well as reviews of published reports. The studies tend to offer a high-level view rather than providing specific guidance on what actions are required to meet future challenges. Hardy et al. found that these studies primarily represent the views and speculation of small groups of experts, many of whom are detached from the front-line working level (Chan and Cooper 2011; Harty et al. 2007).

High level, or "macro-level," forecasts are good resources for "blue-sky" thinking. Two recognized examples include the forecasts from Toffler Associates (2010) and the TechCast Project. Toffler Associates, founded by renowned futurists and authors Alvin and Heidi Toffler, recently published the study *40 for the Next 40*. This study provides a sample of drivers (in the areas of culture, technology, politics, environment and economics) predicted to change the future - between now and 2050. Likewise, The TechCast Project, a joint venture between George Washington University and TechCast LLC, employs an online research model to assemble the knowledge of high-tech executives, scientists, engineers, academics, futurists and other leading experts from around the world to develop a

forecast on how technology will transform life over the next twenty to thirty years (Halal 2006).

### *PM Competencies Research*

Traditionally the construction industry has focused on the technical and managerial features of construction projects (Toor and Ofori 2008b). In reviewing the evolution of topics in project management research, Thomas et al. (2009) took an extensive look at how project management research has been evolving. Early research focused on technical and management techniques, tools and processes. In the 1990s, research began to include more focus on people in relation to projects, e.g., communications, partnering and the importance of the team.

To collect this data, the construction management industry has long relied on quantitative research methodologies, such as surveys. When more qualitative methods are employed, researchers tend to rely on interviews. However, this reliance on surveys and interviews has received some criticism (Dainty 2008; Toor and Ofori 2008a, Toor and Ofori 2008c) due to concerns about the truthfulness of interviewees and “the differences between what people say and what they actually do” (Dainty 2008, p.7).

Steven Levitt and Stephen Dubner (2009) concur by stating in their book, *Super Freakonomics*, there is “good reason” to be skeptical of information gathered from surveys because of the difference between what people say and what they actually do.” Researchers in the area of economics describe these different behaviors as ‘stated preferences’ (what people say in a survey or interview about how they behave) and ‘revealed preferences’ (how people



actually behave). For example, in 2007, the majority of respondents to a *Washington Post-ABC* news poll (Anonymous 2007c) indicated that global warming was a concern and, as a result, the respondents had made an effort to reduce energy consumption in their homes. Seventy percent claimed they used energy efficient compact fluorescent light bulbs (CFLs). However, a 2007 review of the United States CFL market share did not reflect anywhere near that level of consumer support; reporting the market share had only increased five percent above the 2001 levels, to about six percent (Harden 2007).

In a study of construction management research methods, Dainty (2008) argues that construction management researchers involved in social sciences research indicated that no single method is best for collecting data. Dainty (2008) states that adopting a strategy that combines parts of different methodologies may provide the most “complete picture” (p.11).

The critiques of future forecasting reports’ reliance on small groups of experts, construction management industry’s reliance on a single method approach, and recognition of the differences between stated and revealed behaviors, highlight why alternative methodologies need to be considered (to obtain more accurate conclusions)when researching future project management competencies.

Notably absent from previous studies is the use of information generated in simulation games and exercises. Using such information is one viable option in obtaining accurate data concerning E&C industry practices. By playing a game or doing an exercise, construction management students are provided with real life

scenarios where they must apply the theories and techniques, i.e., their revealed preferences, learned in the classroom and experienced in the workplace. In the E&C industry, there are a number of educational simulation games and exercises covering a wide variety of topics from estimating to resource management (Nassar 2002).

### Key Forces and Trends

In the book *Project Management Circa 2025*, the author of the scenario “The Future of Team Leadership in Complex Project Environments,” Hans J. Thamhain (2009) states “Globalization, privatization, digitization, and rapidly changing technologies have transformed our economies into a hyper-competitive enterprise system where virtually every organization is under pressure to do more things faster, better, and cheaper.” The study “Future Work Skills 2020,” labels the drivers of change as “disruptive forces” (Davies et al. 2011). An extensive review of future forecast studies, at both the macro-level and the industry specific level, found agreement on the forces and trends that will significantly impact the PM environment. Many trends are simply extensions of those already present in today’s environment. The studies concur that the most significant differences will be the exponential speed at which technology will advance in the next decade, the vast amounts of information that will be generated, and the (type of) changes that will take place in the workforce. Presented in this section is an overview of the forces and trends most likely to have the greatest impact on how PMs will manage and lead in the next decade.

The four, primary disruptive forces PMs will face are:

- workforce demographics
- globalization
- technology
- new and changing organizations

#### *Workforce demographics*

There are a number of changes in workforce demographics predicted for the E&C industry in the near future. As the industry is highly labor-intensive (Experian-SAMI 2008) and the majority of PMs spend more than one-half of their time interacting with other people (Sunindijo et al. 2007), future PMs will be challenged to lead diverse teams with widely varying experience, vision, values, and backgrounds.

Numerous factors influence the changing dynamics of the construction industry workplace. To begin with, the industry has consistently struggled to overcome reductions in its workforce due to image problems such as being seen as labor intensive, requiring work in difficult areas and conditions, and experiencing cyclical ups and downs. These challenges have made it difficult to attract and retain talent. In addition, the industry is expected to experience a workforce shortage due to the retirement of the Baby Boomer Generation; a shortage that is predicted to continue at all levels, including management (CII 2008). It is interesting to note, however, that in the 2009 National Vital Statistics Report, life expectancies were forecasted to increase, making extended careers a possibility in the future (Xu et al. 2009).

Over the course of the next decade, forecasters predict the workforce will be drawn from three distinct generations, each of which presents different visions, values, preferences, and experiences. The Baby Boomer Generation, consisting of those born between the years 1946 and 1964, was the first generation to be raised with technologies, such as radio and television. However, this generation lacks the communications and information technology savvy of younger cohorts. Baby Boomers will be in demand for their industry knowledge and experience but will be challenged to adapt to changing times. By 2022, the youngest of the Baby Boomers will be in his/her late 50s with sights set on retirement. These individuals will take years of valuable knowledge and experience with them. The majority of the workforce at that time will consist of members of Generation X, those born between 1965 and 1982, and Generation Y, those born between 1983 and 1997.

Generation X is often described as an entrepreneurial generation that values the freedom to work alone over working in teams. Generation Y is described by those who have studied it as innovative and creative, likely to come up with new solutions to problems. Both Generation X and Generation Y have been raised with computers and are technology savvy. Both generations value work-life balance and expect more non-cash compensation options such as additional vacation and flexible work schedules. However, Generation Y is accustomed to working in teams and, therefore, will not tolerate being excluded from decision-making (Jugdev 2009; Puente 2010; Hammill 2005; Kane, n.d. b; Experian-SAMI 2008; Mitchell and Learmond 2010).

In addition to being multi-generational, the future workforce will also be multicultural. Many predicted vacancies probably will be filled by immigrants and residents from developing countries who range from unskilled to well-educated. Additionally, women and other minorities are likely to continue to step up to fill many leadership and skilled job vacancies (Jugdev et al. 2009; Coates 2008; CII 2008).

### *Globalization*

There are a number of macro level changes predicted for the global landscape in the next ten years. By 2025, the global population is expected to grow to 8.3 billion, twice what it was in 1975 (Mitchell and Learmond 2010). This global population growth will exceed available resources and strain existing infrastructures. In addition, it will result in increased demands for natural resources, energy, and new infrastructure (Toffler Associates 2010). According to Jugdev et al. (2009), energy, climate, and environmental issues will become a greater focus for many countries around the globe.

The macro-level and industry-specific studies reviewed for this study also predict the following:

- increase in the number of female leaders and religious groups in governments (Toffler Associates 2010)
- continued geopolitical unrest - including the United States' "War on Terrorism"(Jugdev et al. 2009)
- increased government and industry oversight and regulation - expected to grow in all regions around the globe (Mitchell and Learmond 2010)

- increased global integration - information and communication technology advances will knock down the commercial boundaries between nations
- greater influence of mega corporations (e.g., Walmart), and “philanthro-capitalists” (e.g., Bill Gates) – these corporations will exert greater influence within the U.S. and internationally
- shift in investments from developed countries in the West to developing countries in the East (CII 2008; Toffler Associates 2010)

Changes in the global landscape will lead to increased complexity and the probability of unexpected risks at the project level. With investments shifting to new areas, future PMs will find themselves working on projects located in countries with difficult working conditions. PMs will need to develop knowledge in new areas of project specialization, such as security-oriented and defense projects as well as new and alternate energy projects. Safety issues and training beyond traditional areas, such as preventive security, will also increase (IHS CERA 2011; CII 2008; Jugdev et al. 2009).

Under pressure to deal with increases in government and industry oversight, as well as demands to reduce the carbon footprint of the construction process, future PMs will be challenged to balance the traditional success factors, such as cost, schedule, and quality with sustainability objectives and new rules and regulations (Mitchell and Learmond 2010; National Research Council 2008).

The skill levels of resources located in low cost execution centers are expected to improve, making them available to support more difficult projects.

The future PM will be challenged to build and maintain relationships with project teams dispersed around the globe (CII 2008). This increased demand for resources will lead to increased competition for equipment and materials resulting in price and schedule pressures. The future PM will be forced to manage the logistics of complex global supply chains – determining who has the best capacity to do the job - as well as meet schedule and price competitiveness (John Voeller, report to RT-281, February 13, 2011).

### *Technology*

The rapid development of information and communications technologies (ICT) in recent decades has created numerous changes with respect to how and where work gets done. Moreover, futures studies that were reviewed showed that ICT will continue to develop and change at an exponential rate. Radically enhanced communications technology using audio (e.g., voice activation) and visual media will become increasingly influential (Toffler Associates 2010). Future network communications are expected to become more “photocentric,” reflecting Generation Y’s communication preferences (Guynn 2010).

The TechCast Project predicts 2020 will be the year for “breakthroughs” in technologies relating to smart robots, speech recognition, and intelligent agents - driving advances in many areas. It is forecasted that these advances will change existing markets and alter the way people work (Halal 2006).

While the engineering and construction industry has a reputation for lagging behind other industries, with respect to technical innovation, its use of new technologies and methods is expected to increase in the decade leading up to

2022 and beyond (Experian-SAMI 2008), changing where, when, and how work gets done as well as by whom.

For the future PM, business will be conducted at a faster pace. Due to the advances in ICT, with 24/7/365 access and demands for PMs to provide instant responses (Mitchell and Learmond 2010), work will expand to fill all available time (Toffler Associates 2010). Information will be collected faster than it can be analyzed (Toffler Associates 2010) and the increased speed of information exchanged means that factors influencing decision-making may change within minutes (Mitchell and Learmond 2010).

Future PMs, therefore, will have to work in two environments: leading teams and building relationships both virtually and face-to-face. Virtual construction will become the standard, with project teams working anywhere in the world to identify and solve problems before physical construction begins. Activities across all phases of the project will become more integrated through the use of collaborative technologies, such as social networks and interactive project management software. This will enable scenario and role playing as well as verbal data entry (Lojeski 2009; CII 2008; Thomas et al. 2009). The use of robotics in pre-fabrication and off-site manufacturing will be common, but by 2022, use of robots on-site will most likely be speculative (CII 2008; Experian-SAMI 2008).

#### *New and Changing Organizations*

The current organizational model is a hierarchal formal reporting structure with clear divisions of labor, specific job descriptions, and a scope of authority for each position in the organization. In this traditional hierarchy, information about



performance objectives and directions flow from the top down to the front-line working level. Over the next decade, the traditional organizational boundaries will begin to disappear and the flow of information will be reversed - flowing from the front-line up the hierarchy (Anonymous 2006; Hamel and Breen 2007; Ju 2007; Mitchell and Learmond 2010).

Because younger workers, such as those from Generation Y, do not respond as well to command and control, and because the advance of social media has created a new era of openness and transparency, the manager role will change to better reflect facilitating team decisions and developing innovative ideas from workers on the frontline. Future PMs will need to include team members on decisions throughout the entire project lifecycle (Anonymous 2006; Hamel and Breen 2007; Ju 2007; Mitchell and Learmond 2010; CII 2008).

In addition, future leaders will have access to a wide network of stakeholders that extends beyond the boundaries of their own organizations. Project leaders will no longer be limited to finding answers from team members located in their immediate vicinity. These leaders will be able to seek out solutions from experts no matter where the experts may physically be located. Knowledge will come from both inside and outside the organization, with subject matter networks replacing individual subject matter experts. Key talent may no longer be full employees of a company but rather contract employees not physically located at the project office or jobsite (Mitchell and Learmond 2010; CII 2008). Hamel and Breen (2007) highlight the example of Proctor & Gamble's management innovation. That company's development pipeline has been opened

up to ideas and technologies from outside the firm, and the company's chairman, A.G. Lafley, stated that he "expects 50 percent of the company's future products to be based on concepts and technologies acquired from third parties."

The continued development in integrated information sharing technology will have an impact on future leaders as well. Future PMs will have to deal with, and reconcile, the competing agendas of multiple stakeholders, such as customers and suppliers who share real-time access to project information. The advances in technology, such as virtual modeling and video conferencing, will allow managers to spend more time away from their offices and jobsites plus develop and maintain relationships with their extended network of stakeholders while still maintaining a close eye on the work at the project (Mitchell and Learmond 2010; CII 2008).

Larger and more complex projects in difficult locations will drive changes in project organizations with more joint ventures and public/private partnerships where the parties share expertise, knowledge and risk (CII 2008).

## PM Competencies

### *PM Impact on Project Success*

In order to improve future project success rates, it is necessary for organizations to recognize a PM's impact on the project - understand the complexity of the industry, the drivers of change, and correctly identify the competencies needed (Harty et al. 2007; Hartman 2008).

The PM is recognized as the person with the ultimate responsibility for a project's outcome. Research has shown that site managers have an impact on the

overall qualification and cost of a project and may affect project cost as much as 10 percent (Toor and Ofori 2008b). In the article, *What Great Projects Have in Common*, authors Dvir and Shenhar identified the managerial characteristics common to successful projects, including the competitive advantage of the project, the approach to project planning, the innovative culture, and the team structure. When Dvir and Shenhar looked at project leadership, they found that great projects have “superior leadership.” The successful project leader “should have high personal skills, excellent communication qualifications, and connections to upper management (Dvir and Shenhar 2011).”

In *Project Management Circa 2025*, Boyatzis et al. (2009), authors of the scenario titled “Emotional and Social Intelligence of Effective Project Managers,” describe three groups of competencies that distinguish outstanding performers from average performers:

- cognitive intelligence
- emotional intelligence
- social intelligence

Frances Hartman (2008) identified a PM’s three best traits as

- being able to identify problems and issues quickly and make decisions to deal with them effectively
- displaying good relationship building and communication skills
- enjoying high trust levels with stakeholders

While general management literature considers a manager’s leadership style to have an impact on a business’ performance, in a review of literature on

project success factors in the E&C industry, Turner and Muller (2005) stated that “it has largely ignored the leadership style and competence of the PM on project success.”

### *Current PM Competencies*

Traditionally, the construction industry has directed its focus on a project’s management and technical aspects. In a study of career development in construction management, Barbara Young (1989) assumed that a construction manager was able to determine what skills and knowledge were required for the current job, and for five years in the future. The study surveyed construction managers across three levels of responsibility (senior, mid-level, and junior level) rank ordering, in order of importance, the skills and knowledge required in their current position and how they anticipated their job changing in the next five years (i.e., mid-1990s). Young (1989) concluded that in the 1990s, there would not be significant changes in the construction manager’s role. Education programs in organization, human relations, communications, personnel management, and operational planning would continue to be required with greater emphasis on computer technology going forward as well as the expansion of the human resource component, which would be especially important for managers at the middle level.

Today’s PMs are generally more production-oriented than relationship-oriented, concentrating on daily tasks and compliance with requirements in standards and codes, and budget and time limits (Toor and Ofori 2008b). The most frequently described PM competencies include: project-specific expertise,

problem solving capabilities, leadership and social competencies, and entrepreneurial and project management know-how (Hölzle 2010). Many of today's PMs have been drawn from the technical ranks of their organizations, thereby possessing a technically focused education. In addition to their technical education and experience, PMs acquire competencies through qualification programs in combination with experience gained in the workplace. PM toolkits, such as the Project Management Institute's Project Management Body of Knowledge (PMBOK), provide PMs with a framework of methodologies for managing cost and schedule, having some business and accounting know-how, and having some understanding of human behavior (Hartman 2008). In research on project management education and development, Frances Hartman (2008) found that PM education is focused on prescriptive processes, procedures, tools, and techniques associated with traditional project performance metrics such as time, cost, and quality with a primary missing component of dealing with behaviors.

### *Shifting PM Competencies*

PMs stand out from the general category of managers because they must function successfully in the complex and unique construction project environment (Thomas et al. 2009).

The project environment can be described as a complex system made up of many interconnected parts in combination with external forces that are continually developing and changing (Thomas and Mengel 2008). The PM does not have to wait for 2022 to face complex challenges. For example, in 2012 PMs

face the challenges of diverse teams located out of sight in low cost engineering centers, manufacture of project components off-site, international sources for materials and equipment, virtual modeling, and integrated project management software. The complexity is compounded by the uniqueness of each construction project. In manufacturing, the processes used to produce products are typically repetitive, but in the construction industry each project is unique and temporary in nature. Even for projects built using the same design, there are a number of factors that make each project unique, such as the specific design conditions and the makeup of the project team (CII 2008). There is growing industry recognition of the trends in project complexity, both in research and practice (Thomas and Mengel 2008). To be effective, it is important that PMs understand this complexity.

One feature that all construction projects have in common is that they involve people. According to research, the majority of PMs (about 88 percent) spend more than half of their working time interacting with others (Sunindijo et al. 2007). Today's PMs are under pressure to do more with fewer people and resources, so the people side of project management has become increasingly important for successful project delivery (Toor and Ofori 2008b). In recent research on the future of team leadership in complex project environments, Dr. Hans J. Thamhain (2009) highlights that the performance problems on complex projects involve "largely management, behavior, and organizational issues rather than technical problems." Given the unique and temporary environment of construction projects, the literature indicates that PMs will need both technical

and social competencies in order to build project teams across functional organizational lines (Thomas and Mengel 2008).

According to Hodgson et al (2011), a certain amount of technical knowledge is needed to oversee the technical aspects of projects and to manage the technical staff. However, Toor and Ofori state that with the increased emphasis of PM systems, more companies are changing the emphasis of their PM searches from technical to leadership and management competencies (Toor and Ofori 2008b). In *Project Management Circa 2025*, Belle Collins Brown (2009), author of “The Coming Evolution of the Research and Development Project Manager” scenario, states that in the future many technical requirements will become automated. These advances in the computer systems’ development will allow PMs to delegate many of the technical requirements to others while shifting their focus to team building, facilitating communications, and removing the barriers to success. In their study of future leadership essentials for 2020, Mitchell and Learmond suggest that future leaders will be “T-shaped thinkers” with “deep subject expertise in one or more areas plus knowledge about functions and issues important to the organization and the business/social environment.” They also state, “single subject expertise will be less relevant (Mitchell and Learmond 2010 p14).”

The changing environment facing the industry calls for the addition of leadership skills to the current technical and management competencies (Toor and Ofori 2008b p 308). Mitchell and Learmond suggest that future leaders will be spending more time outside of their organizations, so they will need to learn how

to better delegate. Future leaders will need to understand their teams' composition, be sensitive to other cultures, genders and generations, and establish embraced ideas from non-traditional resources (Mitchell and Learmond 2010).

According to Ray Ju (2007), the shift from management to leadership will require trust, openness, and intuitive behaviors that foster relationships. Soft skills, also known as people skills, are important to successfully build and lead project teams as well as build relationships. According to Riley et al (2008), "in the last ten years the concept of emotional intelligence (EI) has emerged as the science behind leadership and a much more accurate predictor of success than other forms of measurement." EI is comprised of two competencies:

- The first is personal self-management. A PM needs to be aware of his/her own strengths and weaknesses, be open to feedback, and able to learn from experience. Attributes of this competency include self-control, being trustworthy and conscientiousness, having initiative, and being flexible.
- The second competency is social and relationship management, which is critical for working with people (Sunindijo et al. 2007). EI can be developed through motivation, extended practice, and feedback (Riley et al. 2008).

Skipper and Bacon state in their research on the future of leadership in the construction industry that today's PMs may not be ready to deal with this complex and unpredictable nature of future projects – though they do recognize the importance of leadership skills (Skipper and Bell 2006a; Skipper and Bell



2006b). In their research, Toor and Ofori (2008b) contend “that there is a need for leadership development in PMs in the construction industry.” They propose that the industry needs to develop future PMs as “authentic leaders to successfully operate in the increasingly complex working environment.”

As the demand for project management grows, there is an increasing interest in the PM’s people skills and the standards for development and assessment of a PM’s competence (Fisher 2011). Toor and Ofori found that industry research is paying more attention to leadership competencies whereas the traditional academic curricula do not cover people skills development (Toor and Ofori 2008b).

In their review of recent research on project management education and development and training programs, Thomas and Mengel (2008) found the development of leadership ability, in addition to the traditional management skills, were an emerging key trend for PMs. The traditional project management education model that emphasizes instruction and training in the standards’ tools and techniques and problem-solving know-how may be the appropriate approach for developing the junior level PM. However, Thomas and Mengel propose that “more emphasis on educational models, supporting and fostering continuous change, creative and critical reflection, self-organized networking, virtual and cross-cultural communication, ability to cope with various frames of reference, increased self-knowledge, and the ability to build and contribute to high-performance teams” is required to prepare “master” PMs to deal with a complex project environment. According to Riley et al. (2008), “research has shown that

through a process of personal awareness, feedback, and skill development, leadership skills can be cultivated at every level of an organization.” A leadership development program should place an emphasis on situational learning as well as provide students with feedback and assessments on their development.

In the study, “2020 Vision – The Future of UK Construction,” the authors stated “investing in lifelong learning, knowledge management, and welfare of people will enhance industry standards, improve profitability, and attract better people to the industry” (Experian-SAMI 2008).

### 3 METHODOLOGY

#### Defining Key Terms for the Research Study

The researcher team members recognized the importance of being precise in the use of terms to promote clarity in communicating their insights and findings. Since there are a number of definitions for terms such as “skill” and “project manager (PM),” a dictionary of key terms was developed specifically for this research project.<sup>1</sup>

The “future” timeframe referred to throughout the report describes the window “2022 and beyond,” the period ten years out from the presentation of these research findings.

In this study the umbrella term “competency” is used to describe the behaviors, knowledge, and combination of skills that make the PM qualified to bring about successful realization of project goals. Specifically, a skill is the term used to describe someone’s capability to perform a specific action or task. Skills are learned more quickly than competencies, generally over days to months. Competencies are developed and honed over an extended period of time, usually several years.

An “attribute” is a person’s fundamental quality or characteristic. The future may demand new skills and behaviors, but it will not change the

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<sup>1</sup> In some cases these terms can be found in dictionary references, such as the *ESI International Project Management Terms Dictionary*, *Webster’s*, etc., but the use of the term for this research project differs from such standard definitions and therefore is included. In general, these definitions are a blend of input from dictionaries, literature search references, thought leaders, individual team members, consultants, academics, and Generation Y members, purposely tailored to provide the meaning of a word, acronym, or phrase within the context of this research project and the construction industry. The complete list of terms is included in APPENDIX A: PM Dictionary.

fundamental attributes associated with PMs today. For the purpose of this research, character-related components (values and attributes) were considered constant. The research study addressed the attributes that need special emphasis in the next decade.

“Project management” is the discipline of planning, organizing, and allocating resources to bring about successful completion of project goals and objectives while honoring project constraints. For the purposes of this study, a PM is defined as “one who is trained and practices the principles of project management; the individual responsible for leading and allocating resources to bring about successful realization of project goals while honoring project constraints.”

“Project success” is the satisfaction of stakeholder needs; it is measured by the success criteria being identified and agreed upon at the start of the project. Stakeholders will have differing viewpoints for project success that must be taken into account. However, success criteria generally include project completion according to the following parameters:

- within a specified time frame
- within budget
- at specified performance levels
- at specified quality levels under safe conditions

A successful PM leads projects in a way that fully engages the spirit and energy of both the project team and the stakeholders as well as creates, in everyone involved, the desire to work together on future challenges.

Substantiation is the term used to describe the process in this research study that assures the results are tested and worthy of confidence by exposing the insights and conclusions to individuals with independent experience.

### The Research Approach

This research study presented a unique challenge: to predict successful PM skill sets for the year 2022. Thus, the need for innovative and distinct research methodologies became apparent. As shown graphically in figure 3.1., the research approach had three key phases: information gathering, synthesis, and developing deliverables. (For a discussion of the challenges presented by this approach refer to the section “Discussion of the Features and Challenges of the Research Approach” in this chapter.)

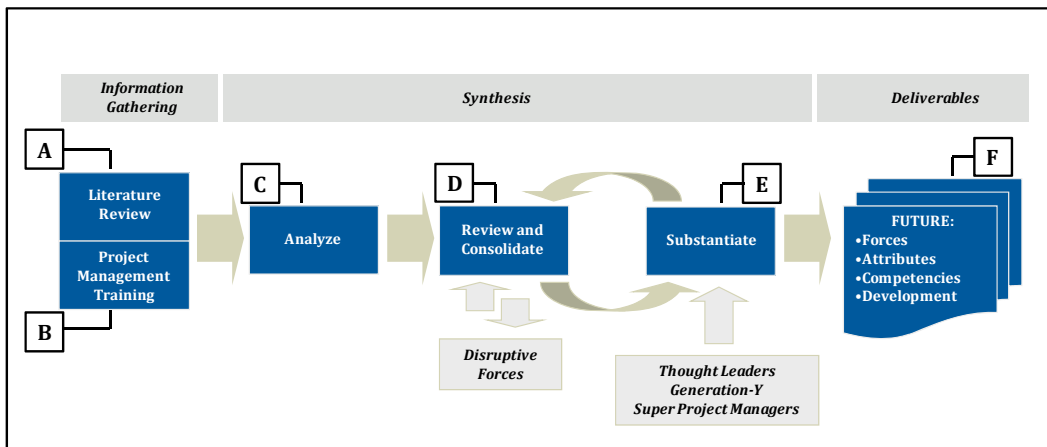


Figure 3.1. Research Approach

#### *Phase 1: Information Gathering*

The research study used two primary information resources to build the foundation for the competencies forecast: an extensive literature review combined

with the information generated in the project management training seminars provided by industry member companies.

#### Literature review

The literature review (shown in box A, figure 3.1) involved a search of futures studies, to include macro-level forecasts and industry-specific trends as well as PM competency research studies. To ensure that the search was extensive and incorporated multiple views of the future, the research adopted a team approach. The research team formed a sub-team of six members dedicated to executing the literature review. The sub-team search plan consisted of three primary steps:

- Open scouting: After establishing a list of suggested search perspectives and questions, each sub-team member began the search for a minimum of three published sources relevant to the research objectives. As the search progressed, the sub-team members were assigned to focus their search on a specific information resource – periodicals (such as magazines and newspapers), peer review journals (e.g., *Journal of Management in Engineering*, *Journal of Construction Education*), professional organization websites, or books.
- Coordination: The objective of the coordination step was to avoid redundancies, identify gaps, and point out related and useful references to others. Typically, on a bi-weekly basis, each sub-team member shared with the entire sub-team the sources found, search perspectives

used, and all possibly applicable articles, papers and books. A comprehensive list of references was then prepared.

- Summarization: For each resource reviewed, a summary was prepared that identified the reference for the bibliography and identified the key wisdoms from the article. The summaries provided a guide for developing the literature review detailed findings for this study.

This literature search provided a critical review of the methodologies behind previous PM competency research and industry-specific studies. It also provided findings and insights on the forces and trends that current PMs find challenging and those that will pose challenges for the industry in ten years.

From the literature review, a summary was developed that provided predictions for key future forces and trends. This summary throughout the review process to test the relevance of the forecasted competencies and to ensure that the competencies addressed PMs' future issues and challenges.

#### Project management training seminars

In previous research, as outlined in the literature review findings, the primary methods for collecting data of construction management and strategy forecasts were surveys and interviews. As stated before, these techniques have been criticized due to concerns about interviewees' truthfulness and the differences between their stated responses and what they actually practice. Additionally, industry-specific futures forecasts tended to rely on small groups of experts, neglecting to include the views of the PMs on the front-line. The omission of front-line viewpoints, together with the differences observed between

declared and revealed preferences, highlight why alternative resources need to be considered to obtain more accurate conclusions. Additionally, when reviewing previous research of PM leadership competencies, analysis of information generated in simulation games and exercises, a potential resource, was notably absent. For this research project, research team member companies departed from the traditional use of surveys to gain knowledge from their practicing project management professionals (box B, figure 3.1). CII companies organized an eight-hour professional development seminar for their practicing project professionals that focused on four key learning objectives:

- developing facilitating skills to be an effective problem solver
- establishing relationships with key stakeholders to be an effective leader
- finding the appropriate balance between management and leadership that would drive the most successful project performance
- recognizing the attributes and competencies essential for project professionals' future career success.

The seminar combined four individual and team exercises and simulation games. Three of the project management development exercises and games were developed from extensive, long-term academic research. Plus, the exercises/games had been previously tested and used in many corporate and professional environments. The exercises/games selected for the seminar were rooted in self-diagnosis and introspection; they encouraged participants to reflect



on their own activities, outlook, and preferences from different points of view.

The exercises/games did not provide data to measure a PM's performance.

The exercise forms built into each game or exercise are included in APPENDIX B: PM Seminar Exercise Forms. The seminar curriculum included:

- Experience Review.

Participants began the seminar with a review of their career and recent project experience by completing a questionnaire.

- Magic Deck of PM Action Card Game (PM Game) Entry Level Selection.

The PM Game is an interactive activity that profiles a PM's leadership/management style and educates and trains PMs in project management. The game includes an individual and a team exercise played in three rounds. Each player is presented with a deck of fifty-two "PM Magic Action Cards" - twenty-six leadership action cards and twenty-six management cards, grouped into the traditional four suits (hearts, diamonds, spades, and clubs). Hearts and diamonds are leadership action cards, and spades and clubs are management action cards. The action stated on each card, which was selected and tested through several years of research, represented PMs' essential elective activities. Elective activities are not mandated by rules and regulations; they are the means by which a PM can influence the project, thus distinguishing herself/himself from other PMs. In each of the three rounds, participants select ten action cards from the fifty-two card

deck in response to different project scenarios, e.g., an ideal project with no problems and a project plagued with hassles and problems, also known as the “Project from Hell” (Badger et al. 2009). For the Entry Level Selection, each participant selects ten action cards in response to a “new project” assignment and the “project from hell” scenario.

- Hassles in Construction Exercise.

In this exercise, PMs work together in teams, using a seven-step improvement model, to improve facilitation skills and find solutions to reducing job hassles (William Badger, leadership text, *DNA of Leadership*, 2011).

- Who’s on Your Molecule? (WOYM).

WOYM is a self-diagnostic tool that helps each PM understand how he or she fits into the organization. Using a six-step evaluation process, participants identify their key stakeholders, estimate the time spent with each, and measure the quality and importance of their relationships with the people they encounter daily. Participants also reflect on how they spend their time each week and what skills are needed to build positive relationships. This exercise helps them recognize where to best focus their time and efforts to become a more effective project leader (William Badger, leadership text, *DNA of Leadership*, 2011).

- PM Game Team Play.

In the PM Game, the PMs work in teams to propose, defend, and agree on ten action cards that address the issues plaguing a problem project known as the “project from hell.”

- PM Game Exit Level Selection.

At the end of the PM team game, each individual participant completes an exit selection of ten new action cards for the “project from hell” and records them. The two entry level and the exit level cards numbers are then posted on the spider chart to enable each individual to observe any movement in his or her leadership and management preferences.

(Badger et al. 2009)

- Capstone Exercise.

Recognizing that PMs plan for every contingency except their own skill development, the Capstone Exercise was included in the seminar curriculum to turn the spotlight on a PM’s own career – to help the PM become aware of the most important skills that he/she needs. In the Capstone Exercise, each PM is given a list of twenty-four suggested attributes and forty-four suggested competencies, from which each one selects a PM’s top five future attributes, top ten current, and top ten future competencies, knowledge and skills. Participants could also write-in their own suggestions to be included on the lists. This exercise ends with each participant identifying one future competency that he/she will work to develop over the next year.

The seminar leaders from each of the CII member companies, experts experienced in a number of different project management disciplines, were trained as subject experts on the professional development games and exercises. Overall, fourteen CII member companies led seminars for 338 practicing project professionals in their respective organizations. Industry members also recognized that Generation Y professionals (those born between 1983 and 1997) are the future PMs – in 2022. The Generation-Y research sub-team, formed by team members from the contractor companies, organized a seminar specifically for Generation-Y professionals – those more comfortable with today’s rapidly evolving information and communication techniques. The Generation-Y sub-team engaged twenty-four young individuals, currently active in project management and attending the seminar, to collect information that reflected their unique vantage point.

In addition to providing in-house development for project professionals, the training sessions introduced professional development and training as a new resource that companies could use to collect employee feedback and data for the research. As an alternative to traditional employee information collection methods, such as the employee survey, these sessions provided the companies with (a) more information about the hassles and barriers impacting project productivity, (b) a look into the complexity of their project management organization, (c) the management/leadership styles of their PMs, and (d) their PMs’ career development outlook.

## *Phase 2: Synthesis*

As shown in figure 3.1, the synthesis phase includes three key activities: analyze, review and consolidate, and substantiate. This section will explain the three key activities.

### Analyze

Each of the two information sources used for this research was initially analyzed (refer to box C, figure 3.1) and the results were merged through iterative consolidation reviews.

### Summarizing the future trends

From the literature review, a summary of key forces and trends that were predicted to impact the PM of the future was developed. This summary was presented twice to the full research team for review and comment. The final version of this table was used by the team through the synthesis process to test every identified competency for its relevance in addressing and responding to one or more of them. It also allowed the research team to identify competencies not previously identified but which the team needed to face specifically.

### Constructing the database

The information generated in the project management training sessions captured a significant amount of data on current project management professionals' viewpoints, which was used to build the competency forecast. The output was captured on the exercise forms built into the games and exercises. At the beginning of the seminar, each participant selected a unique alias from a list and recorded that alias on the exercise forms. The use of the alias provided

anonymity for participants and collating of the results captured throughout the games and exercises. The information collected included professional background and recent project experience, the action cards selected, the number of stakeholders, and how the PMs spent their time during a week. (Refer to the APPENDIX C: Output from the PM Seminar Games and Exercises for the complete list of variables captured for each seminar participant.) The host companies provided the completed forms to be combined and assembled into a database to facilitate analysis of the results. The individual and team responses were segregated into separate workbooks in the database with a line of information created for the responses of each individual participant and the responses of each team.

#### Database exploration

Once this large pool of training results, provided by CII member companies, was consolidated into the database, the challenge was to successfully extract useful information from the training results. The analysis began by using data mining software for an initial exploration of the individual participant's data, looking for patterns and trends in the results that were captured from the games and exercises. Where possible, statistics such as averages, distributions, and rankings were developed to provide experts with more in-depth views of current project management preferences and activities.

The software tool used for the data mining was SIPINA. SIPINA is a software tool which can extract knowledge from quantitative and qualitative data and produce decision trees. The SIPINA software, which is distributed free on the

web (since 1995) and runs on Windows Operating Systems, implements various supervised learning paradigms to build decision trees. For this research, the IMPROVED CHAID learning paradigm was selected because it builds short trees that are useful in an initial database exploration (Rakotomalala 2008).

This data mining software does not handle missing data, so prior to beginning the data mining runs it was necessary to review the data in the spreadsheet for missing information. If any line of data was incomplete, that line was eliminated from the final spreadsheet that would be used for analysis throughout the process. Of the original 338 lines of data, 233 (69 percent) sets of data, or observations, were comprehensive and complete so that a comparative analysis would yield valid conclusions. SIPINA software (Rakotomalala 2000) was used to build the 154 decision trees from the 233 observations.

Prior to beginning the initial data mining reviews, industry team members received instruction on the data mining process, the structure of the decision trees, and how to extract the relevant findings in each tree. Team members also reviewed and agreed on the criteria to be used to determine if the rule was relevant (having some sensible or logical connection with something else such as a matter being discussed or investigated) and warranted further discussion and interpretation.

The following criteria were used to extract the relevant findings or “rules” (i.e., the IF premise THEN conclusion) found in each of the 154 decision trees. For the purposes of this research effort, relevant is defined as having some

sensible or logical connection with something else such as a matter being discussed or investigated, (i.e., the Class Attribute).

- Step 1: Determine if a “rule” is interesting.

A “rule” was considered *interesting* if the calculated lift was greater than one (refer to figure 3.2).

Lift was defined as an increase in CONFIDENCE.

CONFIDENCE was the percentage of instances that the variable

occurs in a node (branch) of the tree. The CONFIDENCE percentage

was calculated by the data mining software.

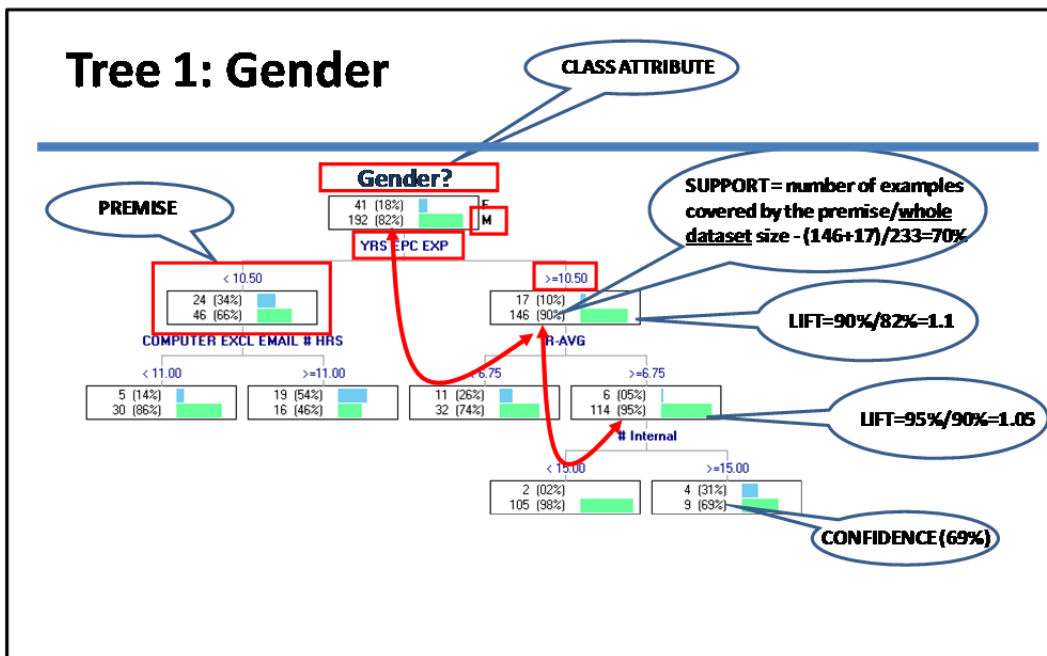


Figure 3.2. Data Mining Tree Example A

- Step 2: Determine if a “rule” is relevant (refer to figure 3.3).

A “rule” was considered *relevant* if it had a HIGH confidence and a HIGH support, calculated to be greater than 60 percent.



SUPPORT was calculated by dividing the number of examples covered by the premise by the whole dataset size.

RELEVANCE was calculated by averaging CONFIDENCE and SUPPORT.

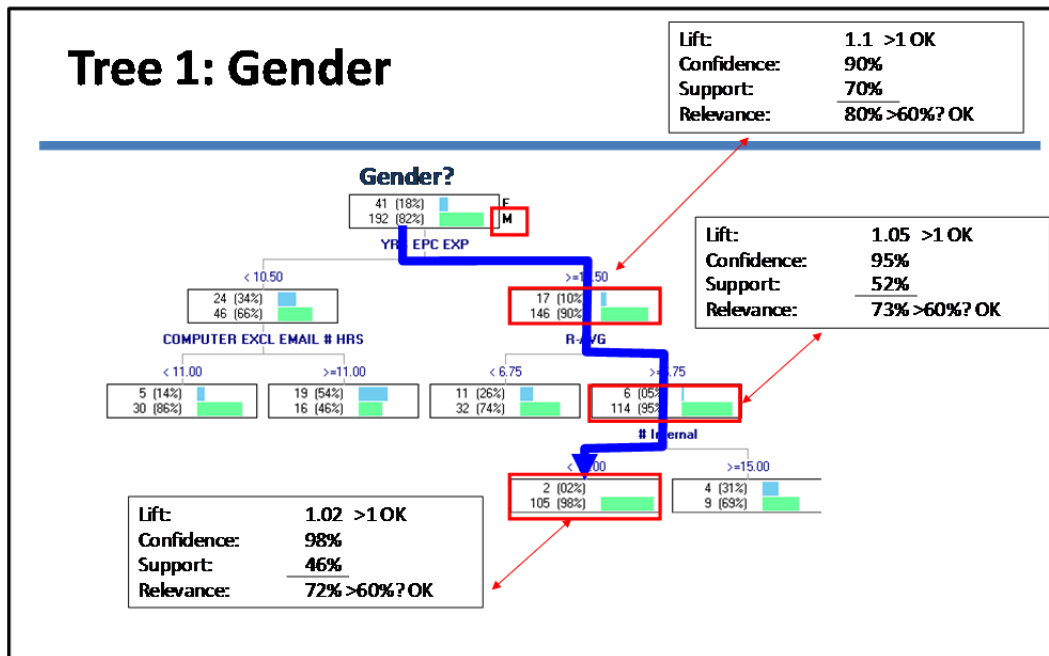


Figure 3.3. Data Mining Tree Example B

Following the path with LIFT > 1.0 shown in Tree 1: Gender (figure 3.3), the following is INTERESTING and RELEVANT:

- males AND
- more than ten years' experience ("later in their career") AND
- have  $R_{Average} > 6.75$  ("have better relationships with their stakeholders") AND
- have less than fifteen internal stakeholders ("have fewer internal stakeholders")

The “rule” was interpreted as follows. As expected, some hints of variability in PMs’ perceptions and activities - depending on their years of experience - emerged in the data mining. On Tree #1, the male PMs with more than 10.5 years of EPC experience perceive that the quality of their relationships with their stakeholders (also known as the  $R_{\text{average}}$  score in the WOYM Exercise) averaged greater than 6.75 (on a scale of one, least to ten, most) as compared to the overall average relationship quality score of 7.48 for the 233 session participants.

The expertise and experience of the research team industry members was fundamental to analyzing and interpreting the data mining output and statistics. The research team industry members established four sub-teams to review the large number of decision trees generated for the initial review. The decision trees were randomly distributed among the four sub-teams for review and interpretation of the rules found in each. Each sub-team presented a brief overview of its interpretations of the rules extracted from the decision trees for discussion with members of the full team. Parallel to the industry member review, the academic members conducted an independent review of the data mining results. The results of the two reviews were consolidated and summarized for follow-up reviews by the full team in subsequent consolidation steps.

The results from the database analysis fell into three primary categories:

- expected findings that supported generally held industry views of current project management profiles, activities, and practices

- unexpected findings that did not uphold the research team’s previous perceptions of the preferences and activities of current PMs
- additional findings by the PMs via their actions in the PM Game and Capstone Exercise

Review and consolidate and substantiate

The two stages in the synthesis phase (shown in box D and box E of figure 3.1) are intertwined, and there were a number of iterative reviews. The decision whether to include a competency on the final list was based on the researchers’ rigorous examination and review. Following the initial database review, the researchers conducted a series of consolidation and substantiation reviews.

Consolidation review #1

The initial consolidation review (shown in box D of figure 3.1) in the synthesis phase centered on reviewing the results from the Capstone Exercise. The research team members reviewed the ranked lists (organized by most votes to least) of current and future competencies identified by 233 current project practitioners and the twenty-four Generation Y seminar participants. The primary focus at this step was the “Top ten” competencies of each list.

Guidelines and key discussion points established by the research team members for determining whether a competency warranted further discussion and investigation included:

- Is the competency future focused?
- Is it critical to project management?

- Does it align with the forces and trends that will drive/impact the future PM?
- Is the competency: leadership, management, or technical?
- Does it respond to the Thought Leaders' wisdoms?
- Does it correspond with the research team's definition for success?

The researchers also determined that it was important that the review of future competencies incorporate the list of write-in competencies from the Capstone Exercise. In the Capstone Exercise, PM seminar participants could write-in their own suggestions to be included on the lists. The write-in competencies were summarized, combining the duplicate entries (e.g. multi-lingual, speaks more than one language, etc.) and eliminating write-ins that repeated competencies included on the list of forty-four competencies in the exercise. This summary generated fifty-seven additional competencies for consideration by the research team members. The list of write-in competencies reviewed by the researchers is included in Appendix E: List of "Write-in" Future Competencies.

As the research process unfolded, new competencies with a future focus were identified. This listing of "post capstone" competencies was developed by C.H. Dunn, retired industry consultant for CII RT-281. The list identified thirty-four future oriented skills, knowledge, and behaviors not included in the Capstone Exercise list of PM Skills, Knowledge, and Behaviors used in the PM seminars.<sup>2</sup>

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<sup>2</sup> The complete list of "post capstone" is included in Appendix D: List of Post Capstone Competencies of this report. Some of these competencies are pure in their source and the reference has been indicated with the competency. Others are blends from varied sources (e.g., dictionaries,

Each competencies list was reviewed by the researcher team members, and after discussion reduced into the short-list “Top ten” of each.

The final step in this initial competency consolidation review involved consolidating all of the “Top ten” competencies lists into one list. The lists were grouped together and like competencies were eliminated. The result was a list of twenty-one future competencies. Industry members then ranked this list of twenty-one competencies before proceeding to the next step. The results of the review are included in chapter 4.

The research team members also reviewed the ranked lists of future attributes from the Capstone Exercise. Like attributes were consolidated and the results were summarized to be incorporated into the research forecast. The results of this review are included in chapter 4.

Substantiation review: Generation Y and “Super” PMs

At the completion of the Consolidation Review #1 (box E of figure 3.1.), the research team performed a credibility check to demonstrate that the initial forecast results were worthy of confidence. Industry team members did this by reviewing the initial consolidated list of future competencies from two different and distinct points of view.

To obtain a further independent perspective, the industry team members formed two sub-teams and separately engaged two groups:

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literature search references, thought leaders, individual team members, consultants, academics, and Generation Y members). These proposed competencies are listed in alphabetical order and no effort was made to cluster them into like groupings (e.g. Leadership vs. Management vs. Technical or Thinking competencies, information overload management competencies, or communication competencies).

- twenty-nine “Generation Y” emerging project professionals
- thirty-eight established “Super PMs” with a proven track record of excellence and success in managing projects in their respective organizations

Each of these groups reviewed the ranked list of future competencies identified by the research team members in the initial consolidation step and selected the ‘Top ten’ competencies that would ensure the success of future PMs. The sub-teams’ ranked lists were consolidated and summarized for comparison with the ranked lists from the PM seminars and previous consolidation activities. The results of the review are included in chapter 4.

The Super PMs also reviewed the PM Magic Action Cards and selected their ‘Top ten’ action cards for the “new project assignment” and the “Project from Hell” scenarios. Comparisons of these results with those of the PM seminars and the Generation Y PM seminars are included chapter 4.

#### Consolidation review #2

A second review and consolidation cycle (box D of figure 3.1) was initiated that compared the lists of top ranked future competencies from the first consolidation review with the results from the substantiation reviews of the Generation Y and Super PM sub-teams and the initial database review. To prepare for the next step in the consolidation process, the research team members began with a review of the summary of interpretations and findings from the initial database exploration activities. The research team members also compared the lists of top ranked future competencies from the PM seminars and the initial

consolidation review with results from the substantiation reviews of the Generation Y and Super PM sub-teams. For this comparison, the research team members established guidelines/weightings (i.e., percentage of selection votes) and identified the “short-list” of competencies for further definition development and testing – testing of their correspondence to the anticipated forces and trends.

The research team members reviewed and agreed with the final revised summary of future disruptive forces, trends forecast, and PM challenges from the literature review. The summary was used by research team members throughout the review process to test the relevance of the forecast competencies and ensure the competencies would address the future issues and challenges a PM would face. The summary of these trends are included in chapter 4.0.

#### Consolidation review #3

Diversity in terminology, closely related concepts, and overlapping perspectives of the competencies necessitated a final consolidation review (box D of figure 3.1) with research team members. Each competency was confirmed once more with the knowledge gained from the PM seminars and literature review. Descriptions for each competency were refined into more focused wording, and expanded definitions and adjustments were made to strengthen the competencies’ future orientation and relevance. Additionally, the competencies were grouped into four key competency areas determined essential to overcome the forces and trends that lie ahead:

- technical/virtual
- management

- cognitive
- leadership

Throughout the consolidation and review sessions, the research team members were concerned about the relationship of the identified future competencies to the specific PM challenges derived from the anticipated shifts. The future competencies have to put the PM in a position to successfully respond to new and currently not dominating, or even existing, demands and circumstances. A repeated testing of this correspondence helped with the description and the condensation into the recommended competencies. Future PM challenges provided a reference point to test every identified competency for its relevance in addressing and responding to one or more of the challenges. Testing also allowed the research team to identify competencies not previously identified, but needed to face specific or a group of challenges.

### *Phase 3: Deliverables*

There will always be a wide range of competencies about which a PM should be literate. As shown in box F of figure 3.1, the research team identified competencies that should be emphasized over the next decade because of their implications on a PM's success in addressing future challenges. This list of competences, along with their definitions, aids in focusing future educational and on-the-job training efforts. In addition to the list of future attributes and competencies, the research study identified games, exercises, and tools as components of a project management development program in a classroom setting.



## Discussion of the Features and Challenges of the Research Approach

This research study presented a unique challenge: to predict successful PM skill sets for the year 2022. The need for an innovative and distinct research approach became apparent.

### *Research Resources*

A review of recently published studies of the industry's future, included in the literature review, noted a reliance on small groups of industry experts to develop these forecasts. The small groups essentially overlooked a broader view that included the view from those members on the front-line of project execution.

Multiple experienced resources were included in the development of this competency forecast. In 2010, CII chartered Research Team 281 (RT-281) to begin a research initiative directed to predict the competencies successful PMs would need in the coming decade. A team, consisting of nineteen members, conducted this initiative by partnering CII member companies with university academics. Thirteen CII member companies - seven owners and six engineer contractors - with interests in the public and private sectors joined the research team. Representatives from these member companies, with extensive Engineering, Procurement, and Construction (EPC) industry expertise (ranging from human resource management to project and corporate management) brought project management domain expertise to the study. Emerging PMs, belonging to "Generation Y," and experienced "Super PMs" with reputations for excellent performance in their respective organizations provided independent third-party credibility checks of the results.

Retired industry consultants with both industry and research experience, in conjunction with the academic research advisors, brought knowledge of the latest advances in project management development and provided guidance for the research approach.

Industry thought leaders with extensive and diverse experience in the Engineering, Procurement and Construction (EPC) industry as well as in research were consulted to further substantiate the research method. Secondly, “blue-sky” thinking discussions, with two of the thought leaders, served as a starting point for further literature review.

### *Information Gathering*

As outlined in the findings from the literature review, previous project management research relied heavily on the use of surveys and interviews for collecting data. However, the reliability of interviewee responses, specifically the differences between stated preferences (what people say they will do) and revealed preferences (what they actually do) raised concerns about the use of surveys and interviews.

Also noted in the literature review was the absence of using information generated in simulation games and exercises as a viable option for obtaining more accurate data. Playing educational games provides participants with real life scenarios where they must apply the theories and techniques, i.e., their revealed preferences, learned in the classroom and experienced in the workplace. The differences observed between declared and revealed preferences highlight why a research approach that incorporates alternative information resources is

considered necessary to ensure industry acceptance as well as confidence in the competencies forecast.

The research study employed innovative information resources to build the foundation for the competencies forecast. First, a team-based approach was used to ensure that the literature search was extensive and incorporated multiple views of the future. A six member sub-team, comprised of members with industry and research experience, was dedicated to executing a broad review of published studies on the future of the industry, as well as PM competencies research, in order to highlight the future forces, trends, and challenges. Second, instead of using classical surveys and interviews to collect stated opinions, the research team's industry member companies used results from specifically designed one-day project management training sessions to collect their project management professionals' preferences. In addition to providing in-house development and training for their project professionals, the companies established professional development and training to collect employee feedback; feedback regarding the hassles and barriers impacting project productivity, views of the project management organization's complexity, management/leadership styles of their PMs, and their PMs' career development outlook.

### *Synthesis of the Information*

Successfully extracting useful information from this large database of training results presented a challenge for the research study. Data mining software was needed for an initial exploration of the database in combination with the

development of quantitative statistics to provide reviewing experts with more in-depth views of current project management preferences and activities.

The information amassed from the literature review and the project management training was reviewed, consolidated, and substantiated through an iterative cycle of multiple reviews with research study team members. This was done in order to synthesize the findings and ultimately highlight the most important project management competencies required to respond to future demands and conditions identified in the published literature.

#### *Developing the Deliverables for Use by the Industry*

This competency forecast will be used as a basis to create tools that CII member companies can use for recruiting, professional development programs, and PM education at the university level. For this study, in addition to the list of future attributes and competencies, the research study has identified games, exercises, and tools as components of a project management development program in a classroom setting.

#### *Process Reviews and Future Thinking: Thought Leader Meetings*

The researchers recognized early on that this proposed method for building the competencies forecast needed to be exposed to independent scrutiny and challenge. To substantiate the research approach, researchers identified and consulted with five recognized industry thought leaders; leaders with long and diverse experience in the E&C industry as well as in research. The five thought leaders consulted by the team included:

- Joseph A. “Bud” Ahearn, Retired Commander of the Air Force Civil Engineering Corps, served as Vice Chairman of the Board for CM2H CH2M Hill, member of the National Academy of Construction (NAC) and National Academy of Engineering (NAE).
- Dr. Richard Tucker, retired director of CII, member of NAC and NAE.
- Emerson Johns, President of CII (2009) and retired DuPont Executive who managed the finances for over 6,000 projects worldwide.
- John Voeller, Senior Vice President for New Technologies at Black and Veatch who was charged with visioning future strategic directions.
- Dennis Doran, Vice President for Professional Development of the Construction Management Association of America (CMAA) and the action officer coordinating with CII on the CII/CMAA working agreement.

Seeking knowledge from such experts was a way to challenge the proposed approach as well as to acquire outside the box, “blue-sky” ideas on the future of the PM profession. The research scope of work, the plan for gathering the forecast foundation information, and the research team charter was presented to the thought leaders. At that time, the research team did not have findings or forecasts. The thought leaders provided the following wisdoms to strengthen the forecasting process and further substantiate the proposed research approach:

- researchers should maintain a future focus throughout the process
- perspectives from a large group of practicing project professionals would provide researchers with a broad and diverse view of PM actions, preferences, and inclinations
- researchers should present the results in a clear and concise manner to ensure buy-in and adoption by CII member companies

In addition to the research process reviews, Mr. Voeller (John Voeller, report to RT-281, February 13, 2011) presented research team members with an overview of forecasts for future global trends, along with their potential impact on project risk monitoring. Mr. Doran (Dennis Doran, presentation to RT-281, July 24, 2011) discussed the path forward for professional project management certification. These consultations served as a starting point for further literature review and discussions during the consolidation.

## 4 DATA ANALYSIS, FINDINGS, AND APPLICATIONS

### Defining Future Scenarios

#### *Disruptive Forces and Future PM Challenges*

The future competencies have to put the PM in the position to successfully respond to new and currently not dominating, or even existing, demands and circumstances. Throughout the synthesis process phase, the research team members were concerned with the relationship of the identified future competencies to the specific PM challenges derived from the anticipated shifts. As stated before, many of the forecasted trends are extensions of those already present. The futures forecasting studies concurred that the most significant differences will be the exponential speed at which technology will advance in the next decade, the vast amounts of information generated, and the changes in the workforce. As found in the section on literature review (chapter 3), four primary disruptive forces for PMs were identified that will compel the use of different project management competencies to adequately address project stakeholder needs.

- workforce demographics
- globalization
- technology
- new and changing organizations

The research study labeled these forces as “disruptive” because of their potential impact on the traditional approach to project management. Specific trends and PM challenges, identified in the literature review, for each of the four

disruptive forces are summarized in table 4.1. It is important that PMs be aware of these trends and challenges if they are going to be able to prepare for new, more effective ways to execute projects, to team with others, and to manage the flow of project information.



Table 4.1.  
Disruptive Trends Forecast 2022 and Beyond

Force	Trends Forecast	Challenges for PM
Workforce Demographics	<ul style="list-style-type: none"> <li>• Skilled workforce shortages at all levels</li> <li>• Knowledge and experience gaps</li> <li>• More dispersed workforce</li> <li>• More diverse workforce</li> <li>• Increase in life expectancy</li> </ul>	<ul style="list-style-type: none"> <li>• Workforce diversity, dynamics, and styles</li> <li>• Multi-gender, multi-cultural, multi-generational, multi-lingual project teams</li> <li>• Reliance on nontraditional resources</li> </ul>
Globalization	<ul style="list-style-type: none"> <li>• Global population growth exceeding available resources and straining existing infrastructures</li> <li>• Disappearing commercial barriers among nations</li> <li>• Transfer of wealth between nations</li> <li>• Continued focus on security and global terrorism</li> <li>• Global compliance with increasing and sometimes diverging rules/regulations</li> <li>• Influence of emerging markets</li> <li>• Increased geopolitical risk from less stable but growing developing countries</li> </ul>	<ul style="list-style-type: none"> <li>• Projects in areas with difficult conditions</li> <li>• Safety issues and training beyond traditional areas</li> <li>• Price/schedule/resource pressure means more competitiveness</li> <li>• Global supply chains</li> <li>• Relationship building at multiple locations</li> <li>• Balance of traditional success factors with sustainability objectives and compliance</li> <li>• More oversight and regulation</li> </ul>
Technology	<ul style="list-style-type: none"> <li>• Smart machines/robotics</li> <li>• Radically enhanced communications technology using audio (e.g., voice activation), visual, and social media</li> <li>• Exponential speed of technology innovation</li> <li>• Stakeholders with integrated access to project information</li> <li>• Innovative construction methods and processes</li> </ul>	<ul style="list-style-type: none"> <li>• 24/7/365 access from all directions</li> <li>• Information collected faster than resources can manage and analyze</li> <li>• Information for decision making can change within minutes</li> <li>• Constantly evolving project methods, systems, and software tools</li> <li>• More work will be done offsite in multiple offices and operating centers</li> <li>• Global, virtual teams</li> </ul>
New and Changing Organizations	<ul style="list-style-type: none"> <li>• Global Knowledge Networks replacing subject matter experts</li> <li>• Breakdown of traditional hierarchical organizations</li> <li>• Organization and project structures well beyond traditional organizational boundaries</li> <li>• Knowledge sources inside and outside of the company</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in number of stakeholders with competing agendas</li> <li>• Increase number of non-full-time/contract employees</li> <li>• Shifts in risk sharing models (more joint ventures, etc.)</li> <li>• Low cost centers with more capabilities</li> <li>• Increased probability of unexpected (“black swan”) project risks</li> </ul>

### *PM Skills Trends in Project Research*

As indicated in the literature review, previous research has shown that site managers can impact the overall qualification and cost of a project by as much as 10 percent (Toor and Ofori 2008b). Studies have highlighted successful PMs' common skills and behaviors such as good communications, problem solving, and people skills.

Additionally, the previous research noted that traditionally the construction industry has directed its focus to the management and technical aspects of projects. Today's PMs are typically production oriented with strong technical backgrounds and knowledge of standards and procedures.

The unique and temporary nature of construction projects is widely acknowledged throughout the industry. However, one common feature of all projects is that they involve people. Published research indicates that there will be a shift in how PMs approach projects that will emphasize the need to focus on people or "soft" skills in addition to the technical and management expertise.

### Database Analysis – Emerging Patterns, Trends, and Relationships

Fourteen CII member companies conducted PM seminars, eight owner and six contractor firms, totaling 338 project professionals. The results from the project management training sessions provided 338 lines of data, 233 (69 percent) of which were comprehensive and complete so that a comparative analysis would yield valid conclusions from which to build the competency forecast. This significant amount of information from the front-line view of the current project

management professionals is representative of the entire CII member companies population.

Data mining software was used for initial exploration of the individual participant data, looking for patterns and trends in the results captured from games and exercises. Where possible, statistics such as averages, distributions, and rankings were developed to provide experts with more in-depth views of current project management preferences and activities. The database reviews highlighted profiles of leadership/management styles, stakeholder relationships, and the relevant current and future competencies from a PM's view. The reviews were used as a guide in the development of the future competencies forecast.

Results were grouped into three primary categories:

- expected findings that supported generally held industry views of current project management profiles, activities, and practices
- unexpected findings that did not uphold the research team's previous perceptions of the preferences and activities of current PMs
- additional findings by the PMs via their actions in the PM Game and Capstone Exercise

Refer to Appendix F: Data Mining Trees for the decision trees generated from data mining.

### *Expected Findings*

As expected, the majority of the current practicing project management professionals are male. Of the 233 participants, 82 percent (192) were male and 18 percent (forty-one) were female.

Additional detail analysis of the PM seminar group revealed that 58 percent of the forty-one females had less than ten years' experience; affirming the forecast trends and the research team members' expectation that females will comprise a larger percentage of the total numbers of PMs in the future.

The current PMs are well educated with 62 percent holding at least a Bachelors degree and 31 percent a Masters level degree or higher (*Tree #2 and Tree #4*) reaffirming the expectation that the majority of PMs will hold university degrees in the future.

The majority of current PMs have prior Design/Engineering/Architecture (D/E/A) experience. Additional detail analysis (shown in figure 4.1.) revealed more specifics about a PM's discipline experience.

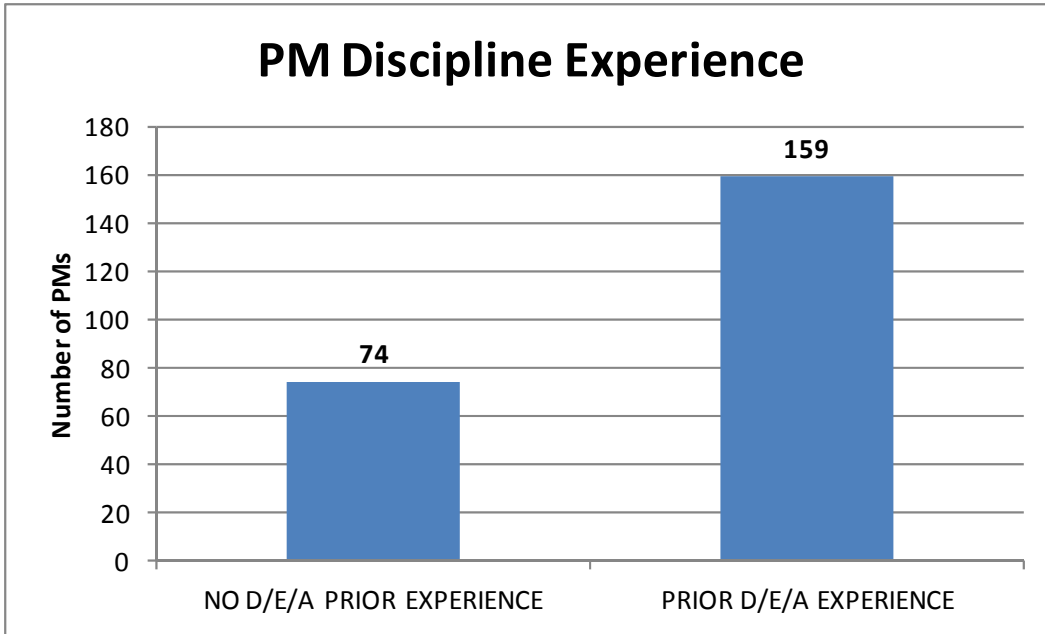


Figure 4.1. Prior Discipline Experience of PMs

The traditional idea that PMs must have an engineering background has become less true today and probably will not be a basic expectation in the future. This information confirmed the expectation that in the next decade, the number of PMs without prior D/E/A experience will likely increase.

Overall, PMs are currently averaging about forty-nine hours per work week (shown in figure 4.2.). In the future, PMs will most likely continue to work at least forty-five hours per week.

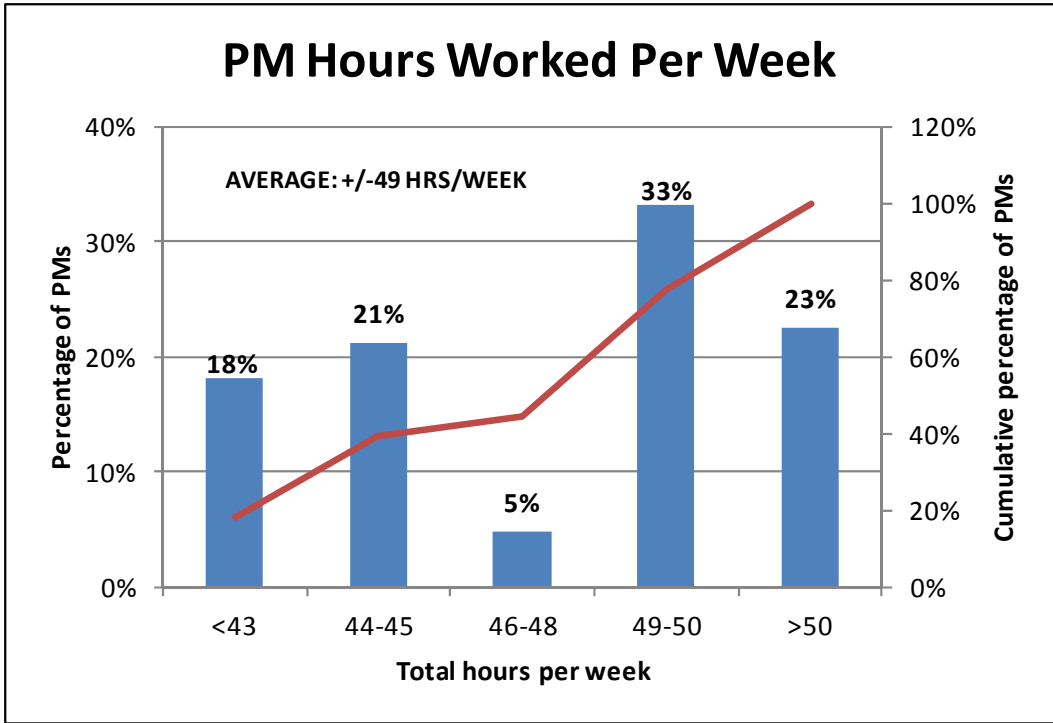


Figure 4.2. PM Hours Worked Per Week

As shown in figure 4.3, a more detailed look at the breakdown of PM activities each week revealed that PMs spend more than 40 percent of their work week hours on the computer, with the male PMs spending fewer hours than female PMs.

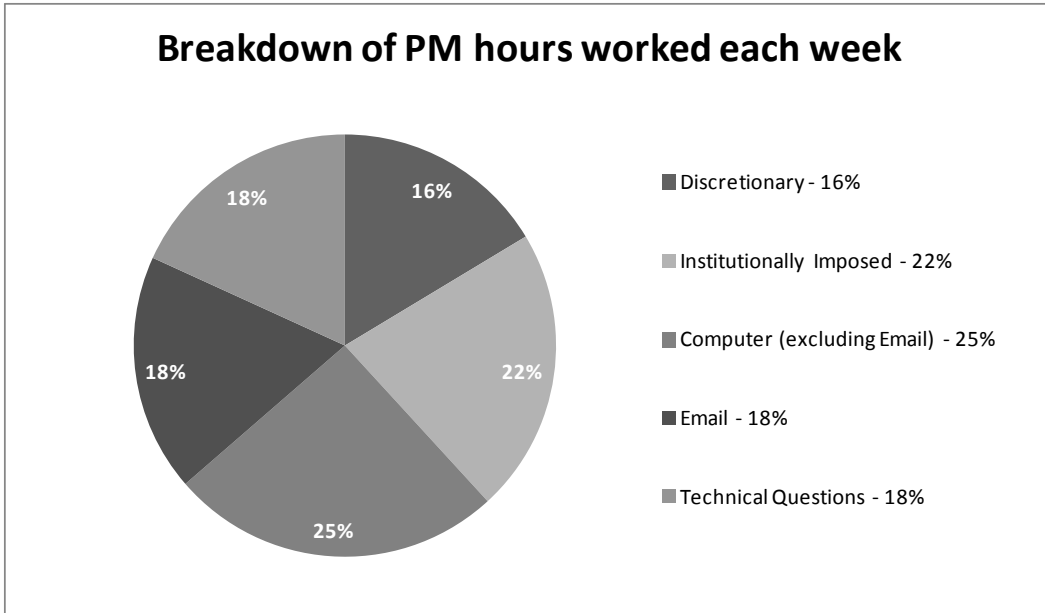


Figure 4.3. Breakdown of PM Hours Worked Per Week

More than half (54 percent) of current PMs have responsibilities in addition to their PM duties. (Refer to Tree #84) In the future, PMs will continue to juggle other corporate/managerial responsibilities in addition to their project leadership duties.

PMs already are facing more complex project scenarios. More than half of the current projects use offsite fabrication, with project scope a factor contributing to the use of offsite fabrication methodologies. (Tree #61, Tree #42) Also, more than half of the current projects include the use of multiple engineering offices. (Tree #129) Based on these trends, it is expected that the PM of the future will most certainly face a complex environment with multiple interfaces, and the competency set needed to successfully manage and lead projects will continue expanding.

These complexity trends significantly increase the number of stakeholders that a PM must interact with each day. From the WOYM Exercise, PMs identified an average of twelve stakeholders on their personal stakeholder molecules and forecasted that number to increase to as many as twenty-eight stakeholders in the future. (Tree #129) Because future PMs are predicted to interact with twice as many stakeholders as current PMs, they will require vastly improved thinking, people, and leadership skills.

The average number of years of EPC (Engineer/Procure/Construct) experience is about nineteen years (see figure 4.4.).

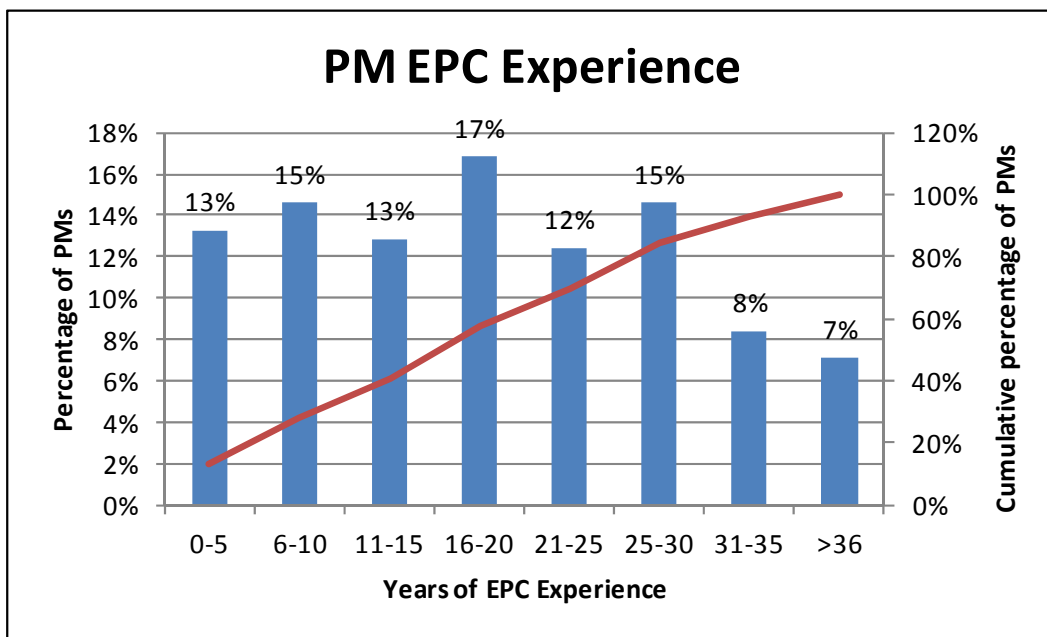


Figure 4.4. Years of EPC Experience

As expected, some hints of variability in a PM's perceptions and activities, depending on his/her years of experience, emerged in the data mining. For example:



- On Tree #1, male PMs with more than 10.5 years of EPC experience perceive that the quality of their relationships with their stakeholders (also known as the  $R_{\text{average}}$  score in the WOYM Exercise) averages greater than 6.75 on a scale of one (least) to 10 (most). Overall, the average relationship quality score was 7.48 for the 233 session participants.
- On Tree #45, PMs with fewer than sixteen years of experience perceive that “effective communication skills, both oral and written,” are an important current competency. As this skill was ranked as the ‘Number One’ competency on both the current and future PM competency lists in the Capstone Exercise, this result is in alignment with the group of PMs as a whole.
- On Tree #107B, PMs with more than eight years until retirement (i.e., zero to thirty-five years of experience) predict “sets clear direction” to be an important future competency, but “front end planning” was not in their selection of Top Ten Future Competencies. It is interesting to note that this finding is in alignment with the entire group as “sets clear direction” was ranked as a Top Ten competency on both the current and future PM competency lists in the Capstone Exercise.

These results did not indicate there are significant differences based on a PM’s years of experience; however, the emphasis on specific competencies is likely to vary depending on a PM’s years of experience.

### *Unexpected Findings*

The research team members anticipated that there would be noticeable differences in the PMs' preferences (e.g., PM Game actions, competency selections, etc.) depending on the organization (e.g., owner versus contractor, public versus private), type of experience (e.g., industry, locations, etc.) or recent project characteristics (project location, scope, etc.) requiring different competencies for different scenarios.

No significant trends or relationships emerged regarding the organization sector---public or private---where PMs work or if their most recent project was for a private or public sector (see Tree #18 and Tree #59).

On Tree #17, the difference between the contractor and owner PMs highlighted the current trend regarding the number of projects managed simultaneously. The contractors' PMs are more likely to be assigned to only one project at a time while the owners' PMs are assigned to manage more than one project simultaneously. However, it was also interesting to note that the PMs from both owner and contractor organizations agree that "provides feedback" is not a current competency. Overall, the skill "provides feedback" ranked number forty out of forty-four competences on the current competencies list in the Capstone Exercise. It is not clear why this competency ranks so low, but it may be a lack of understanding in the industry of the importance of feedback in developing subordinates.

Industry specific experience, e.g., chemical, refining, etc., did not yield any relationships between the PM leadership/management style or competency selections (see Trees #27-37).

The location of the PMs' industry experience did not indicate significant trends or relationships regarding their preferences except for the group with industry experience in the United States (US). Because 215 (92 percent) of the 233 participants had prior industry experience in the US, these results raised flags of interest for the team members.

For more than half (58 percent) of this group, their experience was limited only to working in the US. On Tree #19, the trend emerged that the US experienced PMs were spending more than 2.5 hours per week answering technical questions. Further detailed analysis revealed that the whole group of session participants spends an average of ten hours per week answering technical questions.

For PMs with US experience, eighty-three percent (178 of the 215) had their most recent project located in the US. For the most part, when presented with the Project from Hell scenario in the PM Game (see Tree #26), members of this group did not select the Queen of Hearts leadership action card in their individual entry selections. The Queen of Hearts leadership action card calls for the PM to "Delegate as much of the work as possible to capable people under you." It appears that when faced with a project under stress, this group of PMs does not choose to delegate.

For the most part, the location of a PM's most recent or current project did not yield ties to the Top Ten competencies selection in the Capstone Exercise. However, "sets clear direction and inspires teams/others to peak performance," was ranked in the Capstone Exercise's Top Ten current and future competencies lists. On Tree #107A, 67 of the 233 participants with their most recent project in the US selected this skill as an important current and future competency.

Additionally, the different project characteristics, project scope, project duration, contract type, and project size (i.e., number of employees and Total Installed Cost), yielded little or no linkage with the PMs' management styles or competency selections (see Trees #39-45, 62-67, 46-50, 68-70A, 75, 80).

On projects of all sizes, the PMs indicated that they were not focused on maintaining a balanced lifestyle (Tree #73). They also did not select "manages expectations and control of the group" as an important current competency (Tree#74 and #81). Regardless of project size, when playing the PM Game the PMs did not choose to implement leadership actions such as "realign the project team to match employee skill level to job difficulty and complexity" and "change the work structure to allow higher degrees of freedom to all levels of staff" for the Project from Hell Scenario (Tree #72 and Tree #76).

However, as noted in these results there were no significant relationships or trends uncovered in the data mining exploration and analysis. From this result, research team members concluded that the PM competencies would be transferable across all organizations, industry sectors, and project scopes, as well as applicable to projects of all sizes.

### *Additional Findings*

Detailed analysis of the selections in the PM Game card and the Capstone Exercise revealed more information about current practicing PMs' actions and preferences.

In the PM seminars, the top leadership and management actions selected by PMs, in the individual selections and team play, are grouped into three categories:

- assess and plan
- engage others
- implement with a structure that encourages full participation

The number one action card selected by the 233 seminar participants in all of the individual entry and exit level scenarios is the 'Ten of Spades,' a classical management card with the action "review scope, identify all the work required to complete the project successfully, and implement." The ten of spades was also ranked number one for the individual entry level selections in the Generation Y seminar. Super PMs selected this action card as number one for the New Project scenario, but not for the Project from Hell Scenario.

Through 2012, the skill development of PMs has been focused on establishing and improving their competence, knowledge, and expertise of the technical and management processes and procedures essential for successful project execution. This emphasis on management actions was most evident in a review of the individual PM Card Game individual selections.

For the Entry Level New Project Assignment, the ideal project situation, the PMs' action cards indicated a "don't rock the boat" approach. The ten of spades was the number one action card selected; there were four or more classical management action cards selected out of the total ten actions. The majority did not include the two of spades, "Create a bonus and rewards program with project team for on time completion" in their New Project action plan. They recognized providing good leadership as a motivator and did not see the need for micromanagement. No micromanagement cards were included in the PM seminars' top ten ranked action cards selected for the New Project scenario. For the New Project Assignment, PMs chose, for the most part, to implement a balanced management/leadership approach.

When the project is under stress (known as the "Project from Hell"), current PMs focused their efforts in the Entry Level Individual PFH scenario (shown in figure 4.5) more on management processes and procedures and technical issues rather than on leadership, or people-oriented, actions. Current PMs do not see the value of mentoring their people on the project's success or on their current career status (see Tree #108B). Under this project situation, both PMs with technical backgrounds (previous D/E/A experience) and those without technical backgrounds rely on management actions.

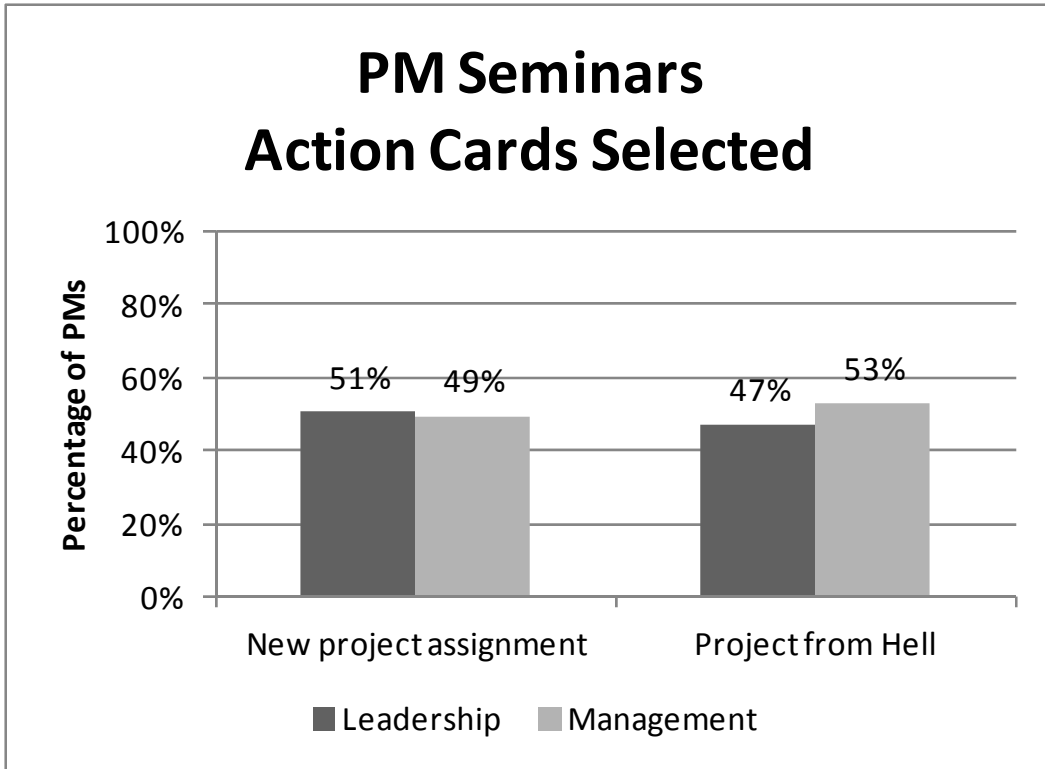


Figure 4.5. PM Seminars: Leadership/Management Balance

For the New Project Assignment (figure 4.6), Generation Y seminar participants also chose to adopt a fairly balanced management/leadership approach while the Super PMs tended to be slightly more leadership oriented.

In the Generation Y seminar, the participants also chose to rely on management actions for the stressed project scenario. The Super PMs tended to adopt a slightly more balanced management/leadership approach for this situation.

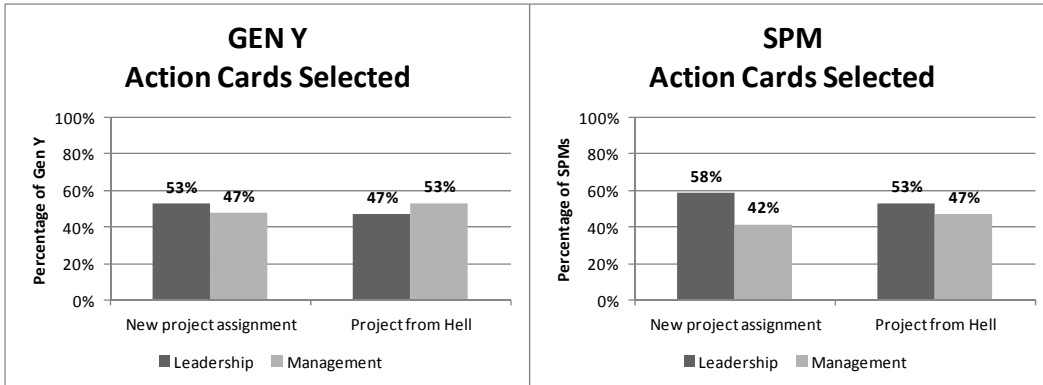


Figure 4.6. Gen Y and SPM Leadership/Management Balance Comparison

For the research study, the key learning from the PM Game was that a PM strives to strike a balance between management and leadership to be successful. This balance will vary depending on the individual leadership/management style and the project circumstances.

From the data mining, initial trends highlighting future attributes for PMs emerged.

- Tree #78 highlighted that 190 of the 233 participants did not see the attribute “self-confidence” as one of the five attributes that will be considered more important for hiring PMs in the future.
- Additionally on Tree #91, another attribute, “sense of humor,” was not selected as an important future attribute by 217 of the 233 participants.
- On Tree #84, the attribute “being humble” was not selected by 223 of the 233 participants.

A popular selection was the attribute “results driven,” which was selected by 41 percent of the PM seminar participants. They believe future PMs will be results-driven individuals; their drive for a successful performance will override



their desire for maintaining a balanced lifestyle, which was selected by only 13 percent of the participants as an important future behavior.

The trend of “people over procedure” emerged from the data mining trees.

- PMs recognize the skill “delegate and empower others” (rather than being “detail-oriented”) as well as the skill “supply chain management.” Additionally, delegation and empowerment will be more important in the future than it is currently. (Tree #105A)
- On Tree #98B, “leads by example” was more popular than “improving their knowledge and skill about business/project laws, regulations, and industry standards.”
- On Tree #99A, the PMs stated preference is “sets clear direction.” This was over the technical skill, “cost, planning and scheduling, and earned value analysis and trending expertise.” An interesting relationship on Tree #107B shows that the majority of PMs who do not agree that “sets clear direction” is an important Top Ten future competency also did not select “front end planning” as a Top Ten future competency.
- Today’s PMs do not consider that expertise in project management systems will be a future, critical competency (Tree #78). It is expected that technology will produce more computer-aided systems, which will be easier to use and understand, and be more intuitive.
- Mentoring is valued for the success of the company and industry in the future; however, to current PMs, mentoring does not have an

immediate impact on project success or on their careers. This mixed signal about mentoring may be a challenge in educating future PMs because mentoring is considered as one of the primary means of educating future leaders (Tree #108B).

## Consolidating the Results

### *Consolidation Review #1 Results*

The research team members began their initial competency consolidation review with a review of the Top Ten Future Competencies from the PM seminar Capstone Exercise (shown in table 4.2). (Refer to Appendix B, figure B.12a-d for the complete list of competencies included in the Capstone Exercise.)

Table 4.2.  
Top-ranked PM Seminar Capstone Exercise Future Competencies

Number of Votes	PM Seminar Capstone Exercise Future Competencies
145	Effective communication skills: oral and written
127	Delegates and empowers others
119	Coordination of multiple activities at multiple locations
118	Sets clear direction and inspires teams/others to peak performance
104	Mentors/grows the next generation
102	Relationship builder: promotes trusted relationships
95	Active listening and observation skills
89	People oriented
79	Actively participates and engages others
72	Leads by example

Additionally, in the initial consolidation review, sixteen research team members reviewed and selected the “Top Ten” competencies on the Post Capstone Competencies List. The short-list, competencies that received six or

more votes, proceeded to the final step in the initial consolidation review (shown in table 4.3).

Table 4.3.  
Top-ranked Post Capstone Competencies

Number of Votes	"Post Capstone" Future Competencies
10	Engagement and motivation
10	Judgment
9	Ethics
9	Virtual collaboration
8	Critical conversations
8	Critical thinking
8	Empowerment
8	Social intelligence
7	Continuous risk monitoring
7	Cross cultural competency
7	Sense making
6	Values appreciation

In the initial consolidation review, sixteen research team members reviewed and selected the “Top Ten” competencies on the list. The short-list, competencies that received four or more votes, proceeded to the final step in the initial consolidation review (shown in table 4.4).

Table 4.4.  
Top-ranked “Write-In” Competencies

Number of Votes	PM Seminar Capstone "Write-in" Competencies
9	Leadership
8	Balance between leadership and management
7	Passion for producing a quality product
6	Ability to deal with complexity
6	Be able to communicate amongst multiple generations
5	Emotional intelligence
5	Servant leadership
4	Good attitude
4	Promotes a winning work/life balance
4	Sees things from others view point

In the final step of this review, the lists were grouped together and like competencies were eliminated. The result was a list of twenty-one future competencies designated for further review and discussion. The industry members then ranked this list of twenty-one competencies as shown in table 4.5.

Table 4.5.  
Top-ranked Consolidated Competencies

Number of Votes	Consolidated Top-Ranked Competencies
16	Effective communication skills: oral and written
14	Sets clear direction and inspires teams/others to peak performance
12	Deals with complexity
12	Relationship builder: promotes trusted relationships
11	Delegates and empowers others
11	Leads by example
11	Participates and engages (Team)
9	Mentors/grows the next generation
9	People oriented
8	Critical thinking
7	Active listening and observation skills
7	Ethics
7	Risk monitoring
7	Sense making
5	Cross cultural competency
4	Balance between leadership and management
4	Judgment
3	Emotional intelligence
3	Maintains work/life balance
0	Engineering, procurement, and construction procedures/processes knowledge*
0	Manages for profitability*

\* These two competencies received zero votes in the ranking step from research team members, and were eliminated from the list for the substantiation reviews.

#### *Identification of Attributes*

In the Capstone Exercise, PM seminar participants were asked to select and mark five attributes from a list of twenty-four that they consider would become more important in hiring PMs in the future. The research team members reviewed the comparison between the future attributes selected as a ‘Top Five’ by more than by forty-eight or greater of the participants in the PM seminars and by more than five or greater of the participants in the Generation Y PM seminar

(shown in table 4.6 and table 4.7). (Refer to Appendix B, figure B.11 a-b for the complete list of attributes included in the Capstone Exercise.)

Table 4.6  
PM Seminar Top-Ranked Future PM Attributes

Number of Votes	PM Seminar Capstone Exercise Future Attributes
100	*Accountable
100	*Honest and trustworthy
95	Results driven
87	*Integrity
82	*Flexibility
77	Innovative
76	Having initiative
72	*Decisiveness
65	*Continually learning
60	Perceptive/intuitive

Table legend:

\*Attribute selections common to table 4.6 and table 4.7

Table 4.7  
Generation Y PM Seminar Top-Ranked Future PM Attributes

Number of Votes	Gen Y PM Seminar Capstone Exercise Future Attributes
11	*Integrity
8	Enthusiastic
7	*Honest & trustworthy
6	*Continually learning
6	*Decisiveness
6	Open mindedness
6	Self-confidence
5	*Accountable
5	*Flexibility
5	Resilience
5	Sense of humor

Table legend:

\*Attribute selections common to table 4.6 and table 4.7

The research team selected the top ten ranked attributes, identified in the PM seminars, as the list of attributes for further review, consolidation, and development. Brief descriptions were developed for each. Integrity, honest and trustworthy were consolidated in the final description reconciliation review.

- integrity: displays truthfulness, has a rigid adherence to a standard of values
- accountable: accepts responsibility for actions, decisions, consequences, and results
- results driven: is compelled to achieve the desired outcomes
- flexibility: adapts to change
- innovative: creative, discovers new ideas
- initiative: follows through energetically
- decisiveness: is firm and resolute
- continually learning: is committed to learning and maturing skills or competencies
- perceptive intuitive: has insight or discernment, knows without the use of rational processes

#### *Substantiation Comparisons*

The industry research team members reviewed the Consolidated Top Ranked Competencies List with the Generation Y and Super PM groups. Each group then selected the “Top Ten” future competencies on the list. The research team members reviewed the comparison between the future competencies

selected as a “Top Ten” by fifty percent (50 percent) or greater in each group (shown in tables 4.8, 4.9, and 4.10).

Table 4.8  
Research Team Consolidated Top-Ranked Competencies

Number of Votes	Research Team Consolidated Top-Ranked Competencies
16	*Effective communication skills: oral and written
14	*Sets clear direction and inspires teams/others to peak performance
12	*Deals with complexity
12	*Relationship builder: promotes trusted relationships
11	*Delegates and empowers others
11	Leads by example
11	Participates and engages (Team)
9	*Mentors/grows the next generation
9	People oriented
8	Critical thinking

Table legend:

\*Competency selections common to Table 4.8, Table 4.9, and Table 4.10

Table 4.9  
Generation Y consolidated top-ranked competencies

Number of Votes	Generation Y Consolidated Top-Ranked Competencies
28	*Effective communication skills: oral and written
24	Ethics
23	*Sets clear direction and inspires teams/others to peak performance
20	Active listening and observation skills
20	Balance between leadership and management
20	*Delegates and empowers others
20	*Mentors/grows the next generation
15	*Deals with complexity
15	*Relationship builder: promotes trusted relationships
15	Risk monitoring

Table legend:

\*Competency selections common to table 4.8, table 4.9, and table 4.10



Table 4.10  
Super PM Consolidated Top-Ranked Competencies

Number of Votes	Super PM Consolidated Top-Ranked Competencies
33	*Delegates and empowers others
31	*Effective communication skills: oral and written
31	*Sets clear direction and inspires teams/others to peak performance
30	Active listening and observation skills
28	Participates and engages (Team)
27	*Relationship builder
26	Ethics
22	Leads by example
21	*Mentors/grows the next generation
19	Balance between leadership and management
19	*Deals with complexity
19	Risk monitoring

Table legend:

\*Competency selections common to table 4.8, table 4.9, and table 4.10

There were six competencies in common on the three lists:

- delegates and empowers others
- effective communication skills
- sets clear direction
- relationship builder
- mentors/grows the next generation
- deals with complexity

The other top ranked competencies included the following:

- leads by example
- participates and engages (team)
- people oriented
- critical thinking

- ethics
- active listening and observation skills
- balance between leadership and management
- risk monitoring

The Generation Y and Super PMs ranked the following competencies more important than the research team members did:

- ethics
- active listening and observation skills
- balance between leadership and management
- risk monitoring.

The research team members and Super PMs agreed that “leads by example” and “participates and engages (team)” were more important than the members of Generation Y did.

#### *Consolidation Review #2 Results*

##### Full team review of data mining results

A key finding from the review of the data mining results concluded that the PM competencies identified by this study would be transferable across all organizations, industry sectors, and project scopes, as well as applicable to projects of all sizes. Different competencies lists for industry sectors, organizations, and project types would not be required.

##### Comparison of current competencies selections

The research team members reviewed the comparison between the current competencies selected as a “Top Ten” by more than by forty-eight or greater of

the participants in the PM seminars and by more than by five or greater participants in the Generation Y PM seminar (shown in table 4.10 and table 4.11).

Table 4.11.  
PM Seminar Capstone Exercise Current Competencies

Number of Votes	PM Seminar Capstone Exercise Current Competencies
173	*Effective communication skills: oral and written
111	*Delegates and empowers others
106	*Active listening and observation skills
101	Sets clear direction and inspires teams/others to peak performance
93	*Leads by example
89	*Cost, planning, scheduling, earned value analysis and trending expertise
88	*Engineering, procurement, and construction procedures/processes knowledge
87	*Relationship builder
84	*Actively participates and engages others
77	*Proactive problem solver/analyzer
72	*Functions well in stressful situations
67	*Manages for profitability
67	*People oriented
61	*Front-end planning knowledge
59	*Coordination across internal and external boundaries
56	Sound decision-making judgment
54	Mentors/grows the next generation
53	*Risk management knowledge
51	*Contract management expertise
49	*Critical thinking

Table legend:

\*Competency selections common to table 4.11 and table 4.12

Table 4.12.  
Gen Y PM Seminar Capstone Exercise Current Competencies

Number of Votes	Generation Y PM Seminar Capstone Exercise Current Competencies
17	*Engineering, procurement, and construction procedures/processes knowledge
12	*Contract management expertise
12	*Manages for profitability
11	*Cost, planning, scheduling, earned value analysis and trending expertise
10	*Effective communication skills: oral and written
9	*Risk management knowledge
8	*Active listening and observation skills
7	*Front-end planning knowledge
7	Possesses business acumen
7	Project systems know-how
6	Develops plans from vision and strategic project objectives
6	Knowledgeable about business/project laws, regulations, and industry standards
6	*Leads by example
6	*People oriented
6	Thinks through situation before acting
5	*Actively participates and engages others
5	*Coordination across internal and external boundaries
5	*Critical thinking
5	*Delegates and empowers others
5	*Functions well in stressful situations
5	Persuasive negotiator with political and diplomatic skills
5	*Proactive problem solver/analyzer
5	*Relationship builder: promotes trusted relationships
5	Safety management knowledge

Table legend:

\*Competency selections common to table 4.11 and table 4.12

There were seventeen competencies in common on the two lists. In general, both groups agreed that technical and procedural (management) knowledge and skills were important. Additionally, both recognized the complexity of the project organization and the importance of critical thinking,

engaging others, and functioning well under the stress of a project. Generally, the leadership competencies were ranked higher in the PM seminars than in the Generation Y seminars. The Generation Y emerging PM group was more focused on their management and technical skills (i.e., contract management expertise and front end planning knowledge) at this juncture of their career.

Four competency areas emerged from the selections:

- technical (e.g., ‘cost, planning, scheduling, earned value analysis’)
- management (e.g., ‘EPC procedures,’ ‘risk management knowledge’)
- leadership (e.g., ‘leads by example,’ ‘delegates and empowers others’)
- cognitive (e.g., ‘critical thinking’)

Comparison of future competencies

The research team members reviewed the comparison between the future competencies selected as a “Top Ten” by more than forty-eight or greater of the participants in the PM seminars and by more than five or greater of the participants in the Generation Y PM seminar (shown in table 4.13 and table 4.14).

Table 4.13.  
PM Seminar Capstone Exercise Future Competencies

Number of Votes	PM Seminar Capstone Exercise Future Competencies
145	*Effective communication skills: oral and written
127	*Delegates and empowers others
119	Coordination of multiple activities at multiple locations
118	*Sets clear direction and inspires teams/others to peak performance
104	*Mentors/grows the next generation
102	*Relationship builder: promotes trusted relationships
95	*Active listening and observation skills
89	*People oriented
79	*Actively participates and engages others
72	*Leads by example
68	Coordination across internal and external boundaries
60	Persuasive negotiator with political and diplomatic skills
58	Champion of change
56	Leverages diversity
56	*Risk management knowledge
55	Proactive problem solver
51	Trained in conflict management
50	Front-end planning knowledge
50	Practices time management techniques
48	Develops plans from vision and strategic project objectives
48	*Functions well in stressful situations

Table legend:

\*Competency selections common to table 4.13 and table 4.14

Table 4.14.  
Gen Y PM Seminar Capstone Exercise Future Competencies

Number of Votes	Generation Y PM Seminar Capstone Exercise Future Competencies
11	*Active listening and observation skills
10	*Leads by example
10	*Mentors/grows the next generation
9	*Effective communication skills: oral and written
8	*Actively participates and engages others
8	*Delegates and empowers others
8	Engineering, procurement, and construction procedures/processes knowledge
8	*People oriented
7	*Risk management knowledge
6	Maintains balanced lifestyle
6	Manages for profitability
6	*Relationship builder: promotes trusted relationships
5	*Functions well in stressful situations
5	*Sets clear direction and inspires teams/others to peak performance

Table legend:

\*Competency selections common to table 4.13 and table 4.14

There were eleven competencies in common on the two lists. In general, both groups were more focused on leadership competencies than technical and procedural (management) knowledge and skills. Both groups still saw the importance of risk management knowledge. Additionally, both recognized the importance of functioning well in stressful situations.

Three of the four competency areas remained important:

- management (e.g., ‘EPC procedures,’ ‘risk management knowledge’)
- leadership (e.g., ‘leads by example,’ ‘delegates and empowers others’)
- cognitive (e.g., ‘coordination of multiple activities at multiple locations,’ and ‘coordination across internal/external boundaries’)

## Comparing current and future

The research team members reviewed the comparison between the current and future competencies selected as a “Top Ten” by more than forty-eight or greater of participants in the PM seminars and by more than five or greater of participants in the Generation Y PM seminars (shown in table 4.15 and table 4.16).

The comparison shows there is a slight shift in future thinking by the current practicing project professionals.

- Effective communication skills were ranked in the ‘Number One’ skill on both the current and future lists, though it received slightly fewer votes in the future (62 percent in the future versus 74 percent on the current list).
- “Delegates and empowers others” remained in the ‘Number Two’ spot on both lists, but this competency gained votes in the future selections (55 percent in the future versus 48 percent on the current list).  
Similarly, “sets clear direction and inspires teams/others to peak performance” remained in the ‘Number Four’ spot on both lists but also gained votes in the future selections (51 percent in the future versus 43 percent on the current list). “Actively participates and engages others (collaborative team player)” remained important to PMs in the ‘Number Nine’ spot, but also declined slightly in the number of votes (34 percent in the future versus 36 percent on the current list).



- Another Top Ten competency, “Relationship builder: promotes trusted relationships (normal and stressed environments),” improved rank from ‘Number Eight’ to ‘Number Six’.
- “Active listening and observation skills” remained important to the PMs but declined in rank from Number Three to Number Seven and number of votes (41 percent in the future versus 45 percent on the current list).
- In the future, the focus on technical and management skills and knowledge fell out of the Top Ten and the PM selections indicate more emphasis on “soft skills” or leadership. Why “cost, planning and scheduling, and earned value analysis and trending expertise” declined in ranking (from #6 (tied) on the current list to #19 on the future list) is not clear because the reasons were not discussed in this exercise, however, one explanation may be due to the advances in technology in these disciplines that allow for these activities to be delegated to others who are expert in these disciplines. The decline in ranking for “Engineering, procurement, and construction procedures/processes knowledge” (from #6 (tied) on the current list to #21 (tied) on the future list) may be due to the fact that knowledge and skills in this area have already been mastered by many of the PMs and they have shifted their focus to areas less familiar to them. It is important to note that the need for these competencies does not completely disappear from the PMs’ view. These two competencies were replaced with people

focused comps – “mentors/grows the next generation” and “people oriented.”

- “Proactive problem solver/analyzer” declined in ranking the future (from #10 on the current list to #15 on the future list), but was replaced with the “coordination of multiple activities at multiple locations,” (from #22 (tied) on the current list to #3 on the future list). This shift is likely due to the recognition of the specific forecast project complexities ahead.

Table 4.15(a).  
Comparison of PM Seminar Capstone Exercise Current and Future Competencies

Number of Votes	PM Seminar Capstone Exercise Current Competencies
173	*Effective communication skills: oral and written
111	*Delegates and empowers others
106	*Active listening and observation skills
101	*Sets clear direction and inspires teams/others to peak performance
93	*Leads by example
89	†Cost, planning, scheduling, earned value analysis and trending expertise
88	†Engineering, procurement, and construction procedures/processes knowledge
87	*Relationship builder: promotes trusted relationships
84	*Actively participates and engages others
77	*Proactive problem solver
72	*Functions well in stressful situations
67	†Manages for profitability
67	*People oriented
61	*Front-end planning knowledge
59	*Coordination across internal and external boundaries
56	†Sound decision-making judgment
54	*Mentors/grows the next generation
53	*Risk management knowledge
51	†Contract management expertise
49	†Critical thinking

Table legend:

\*Competency selections common to table 4.15(a) and table 4.15(b)

†Not a priority for the future

‡New future priority

Table 4.15(b).  
Comparison of PM Seminar Capstone Exercise Current and Future Competencies

Number of Votes	PM Seminar Capstone Exercise Future Competencies
145	*Effective communication skills: oral and written
127	*Delegates and empowers others
119	‡Coordination of multiple activities at multiple locations
118	*Sets clear direction and inspires teams/others to peak performance
104	*Mentors/grows the next generation
102	*Relationship builder: promotes trusted relationships
95	*Active listening and observation skills
89	*People oriented
79	*Actively participates and engages others
72	*Leads by example
68	*Coordination across internal and external boundaries
60	‡Persuasive negotiator
58	‡Champion of change
56	‡Leverages diversity
56	*Risk management knowledge
55	*Proactive problem solver
51	‡Trained in conflict management
50	*Front-end planning knowledge
50	‡Practices time management techniques
48	‡Develops plans from vision and strategic project objectives
48	*Functions well in stressful situations

Table legend:

\*Competency selections common to table 4.15(a) and table 4.15(b)

†Not a priority for the future

‡New future priority

There are fourteen competencies in common on the two lists. In general, there was more focus on leadership competencies than technical and procedural (management) knowledge and skills. The PMs were anticipating more complexity. Three of the four competency areas remained important:

- Management (e.g., ‘risk management knowledge’)

- Leadership (e.g., ‘leads by example,’ ‘delegates and empowers others,’ etc.)
- Cognitive (e.g., ‘coordination of multiple activities at multiple locations,’ and ‘coordination across internal/external boundaries’)

Table 4.16(a).  
Comparison of Generation Y PM Seminar Capstone Exercise Current and Future Competencies

Number of Votes	Generation Y PM Seminar Capstone Exercise Current Competencies
17	*Engineering, procurement, and construction procedures/processes knowledge
12	†Contract management expertise
12	*Manages for profitability
11	†Cost, planning, scheduling, earned value analysis and trending expertise
10	*Effective communication skills: oral and written
9	*Risk management knowledge
8	*Active listening and observation skills
7	†Front-end planning knowledge
7	†Possesses business acumen
7	†Project systems know-how
6	†Develops plans from vision and strategic project objectives
6	†Knowledgeable about business/project laws, regulations, and industry standards
6	*Leads by example
6	*People oriented
6	†Thinks through situation before acting
5	*Actively participates and engages others
5	†Coordination across internal and external boundaries
5	†Critical thinking
5	*Delegates and empowers others
5	*Functions well in stressful situations
5	†Persuasive negotiator with political and diplomatic skills
5	†Proactive problem solver/analyzer
5	*Relationship builder: promotes trusted relationships
5	†Safety management knowledge

Table legend:

\*Competency selections common to table 4.16(a) and table 4.16(b)

†Not a priority for the future

‡New future priority

Table 4.16(b).

Comparison of Generation Y PM Seminar Capstone Exercise Current and Future Competencies

Number of Votes	Generation Y PM Seminar Capstone Exercise Future Competencies
11	*Active listening and observation skills
10	*Leads by example
10	‡Mentors/grows the next generation
9	*Effective communication skills: oral and written
8	*Actively participates and engages others
8	*Delegates and empowers others
8	*Engineering, procurement, and construction procedures/processes knowledge
8	*People oriented
7	*Risk management knowledge
6	‡Maintains balanced lifestyle
6	*Manages for profitability
6	*Relationship builder: promotes trusted relationships
5	*Functions well in stressful situations
5	‡Sets clear direction and inspires teams/others to peak performance

Table legend:

\*Competency selections common to table 4.16(a) and table 4.16(b)

†Not a priority for the future

‡New future priority

There were eleven competencies in common on the two lists. In general, there was more focus on leadership competencies than technical and procedural (management) knowledge and skills. The Generation Y PMs were not concerned with anticipating more complexity. Two of the four competency areas remained important:

- management (e.g., ‘risk management knowledge’)

- leadership (e.g., ‘leads by example,’ ‘delegates and empowers others,’ etc.)

Merging the results

The research team members reviewed and merged the current and future competencies selected as a “Top Ten” by more than forty-eight or greater of participants in the PM seminars with the Top Ranked Future Competencies from Consolidation Review #1.

Table 4.17(a)  
Comparison of PM Seminar Capstone Exercise Competencies and Consolidated Competencies

Number of Votes	PM Seminar Capstone Exercise Current Competencies
173	*Effective communication skills: oral and written
111	*Delegates and empowers others
106	*Active listening and observation skills
101	*Sets clear direction and inspires teams/others to peak performance
93	*Leads by example
89	Cost, planning, scheduling, earned value analysis and trending expertise
88	EPC procedures
87	*Relationship builder: promotes trusted relationships
84	*Actively participates and engages others
77	Proactive problem solver
72	Functions well in stressful situations
67	Manages for profitability
67	*People oriented
61	Front-end planning knowledge
59	Coordination across internal and external boundaries
56	Sound decision-making
54	*Mentors/grows the next generation
53	*Risk management knowledge
51	Contract management expertise
49	Critical thinking

Table legend:

\*Competency selections common to table 4.17(a), table 4.17(b), table 4.17(c)

Table 4.17(b). Comparison of PM Seminar Capstone Exercise Competencies and Consolidated Competencies

Number of Votes	PM Seminar Capstone Exercise Future Competencies
145	*Effective communication skills: oral and written
127	*Delegates and empowers others
119	Coordination of multiple activities at multiple locations
118	*Sets clear direction and inspires teams/others to peak performance
104	*Mentors/grows the next generation
102	*Relationship builder: promotes trusted relationships
95	*Active listening and observation skills
89	*People oriented
79	*Actively participates and engages others
72	*Leads by example
68	Coordination across internal and external boundaries
60	Persuasive negotiator with political and diplomatic skills
58	Champion of change
56	Leverages diversity
56	*Risk management knowledge
55	Proactive problem solver
51	Trained in conflict management
50	Front-end planning knowledge
50	Practices time management techniques
48	Develops plans from vision and strategic project objectives
48	Functions well in stressful situations

Table legend:

\*Competency selections common to table 4.17(a), table 4.17(b), table 4.17(c)



Table 4.17(c).  
Comparison of PM Seminar Capstone Exercise Future Competencies and Consolidated Competencies

Number of Votes	Consolidated Top-Ranked Competencies
16	*Effective communication skills: oral and written
14	*Sets clear direction and inspires teams/others to peak performance
12	Deals with complexity
12	*Relationship builder: promotes trusted relationships
11	*Delegates and empowers others
11	*Leads by example
11	*Participates & engages (Team)
9	*Mentors/grows the next generation
9	*People oriented
8	Critical thinking
7	*Active listening and observation skills
7	Ethics
7	*Risk monitoring
7	Sense making
5	Cross cultural competency
4	Balance between leadership and management
4	Judgment
3	Emotional intelligence
3	Maintains work/life balance
0	Engineering, procurement, and construction procedures/processes knowledge
0	Manages for profitability

Table legend:

\*Competency selections common to table 4.17(a), table 4.17(b), table 4.17(c)

There are ten competencies common to all three lists:

- effective communication skills
- sets clear direction
- relationship builder
- delegates and empowers others
- leads by example

- participates and engages others
- mentors/grows the next generation
- people oriented
- active listening and observation skills
- risk monitoring

Several of the competencies have similar meanings and/or are related

resulting in the following groupings:

- sound decision-making, critical thinking, sense making, and judgment (also known as cognitive intelligence)
- coordination of multiple activities at multiple locations, coordination across internal/external boundaries, and deals with complexity
- leverages diversity and cross-cultural competency

Four competency areas re-emerge on the three lists:

- technical (e.g., ‘cost, planning, scheduling, earned value analysis’)
- management (e.g., ‘EPC procedures,’ ‘risk management knowledge’)
- leadership (e.g., ‘leads by example,’ ‘delegates and empowers others’)
- cognitive (e.g., ‘critical thinking’)

A competency list emerged for further review, consolidation, and development:

- effective communication skills
- active listening and observation skills
- sets clear direction

- relationship builder
- delegates and empowers others
- leads by example
- participates and engages others
- mentors/grows the next generation
- people oriented
- risk monitoring
- sound decision-making, critical thinking, sense making, and judgment  
(also known as cognitive intelligence)
- coordination of multiple activities at multiple locations, coordination  
across internal/external boundaries, and deals with complexity
- leverages diversity and cross-cultural competency
- emotional intelligence
- cost, planning, scheduling, earned value analysis
- balance between leadership and management
  - manages for profitability
  - EPC procedures
  - contract management expertise
  - front-end planning
  - trained in conflict management
  - practices time management
  - develops plans from vision and strategic project objective
  - persuasive negotiator

- champion of change
- proactive problem solver
- functions well in stressful situations
- maintains work/life balance

### *Consolidation Review #3 Results*

#### Review of the results

Four competency areas re-emerged from the review of the previous consolidation review:

- technical (e.g., ‘cost, planning, scheduling, earned value analysis’)
- management (e.g., ‘EPC procedures,’ ‘risk management knowledge’)
- leadership (e.g., ‘leads by example,’ ‘delegates and empowers others’)
- cognitive (e.g., ‘critical thinking’)

Several of the competencies have similar meanings and/or are related (overlap) resulting in the following groupings:

- effective communication skills and active listening and observation skills
- sound decision-making, critical thinking, sense making, and judgment (also known as cognitive intelligence)
- coordination of multiple activities at multiple locations, coordination across internal/external boundaries, and deals with complexity
- leverages diversity and cross-cultural competency

- participates and engages others, delegates and empowers others, and sets clear direction
- EPC procedures and contract management
- emotional intelligence and people oriented

A competency list emerged for further review, consolidation, and development.\*

- \*effective communication skills
- \*active listening and observation skills
- \*sets clear direction
- \*relationship builder
- \*delegates and empowers others
- \*leads by example
- \*participates and engages others
- \*mentors/grows the next generation
- \*people oriented
- \*risk monitoring
- sound decision-making, \*critical thinking, sense making, and judgment (i.e., cognitive intelligence)
- coordination of multiple activities at multiple locations, coordination across internal/external boundaries, and \*deals with complexity
- leverages diversity and cross-cultural competency
- emotional intelligence

- cost, planning, scheduling, earned value analysis (i.e., technical skills and knowledge)
- \*balance between leadership and management
  - manages for profitability
  - EPC procedures
  - contract management expertise
  - front-end planning
  - trained in conflict management
  - practices time management
  - develops plans from vision and strategic project objective
  - persuasive negotiator
  - champion of change
  - proactive problem solver
  - functions well in stressful situations
  - maintains work/life balance

\* The competencies on this list indicated with an asterisk (\*) indicate common top ranked competencies from the Generation Y and Super PM reviews.

## Consolidating more like items

Several of the competencies have similar meanings and/or are related (overlap) resulting in the following groupings. A second grouping review resulted in the following competency groups.

- manages for profitability, EPC procedures, contract management expertise, front-end planning, trained in conflict management (i.e., policies, processes, and procedures)
- leads by example, practices time management, persuasive negotiator, champion of change, proactive problem solver, functions well in stressful situations, work/life balance (i.e., leadership techniques and traits)

## Finding and closing the gaps

The list was reviewed against the list of disruptive forces and trends looking for possible gaps. As a result of this review, the following gaps were noted on the list above:

- knowledge and use of electronic tools and emerging technologies (video, blogging, social media, robotics, innovative construction methods, etc.)
- finding/working with knowledgeable resources outside of the traditional organization structure
- business knowledge

The resulting short-list of competencies emerged:

- effective communication skills
- active listening and observation skills
- sets clear direction
- relationship building
- delegates and empowers others
- participates and engages others
- mentors/grows the next generation
- people oriented
- risk monitoring
- cognitive intelligence
- deals with complexity
- leverages diversity
- emotional intelligence
- technical knowledge and skills
- policies, processes, and procedures
- technology knowledge and skills
- knowledge resourcing
- business knowledge
- leadership traits and techniques



## Defining the competency areas

Before grouping the competencies, definitions were developed and agreed upon by research team members for each of the four competency areas identified as essential to address the disruptive forces ahead.

- The competency area, “technical/virtual,” includes the knowledge and skills related to the involvement or use of technology. Two future project management competencies were identified in this competency area.
- The competency area, “management,” is a set of activities, procedures, boundaries, and structures that allow an organization to achieve its goals in a disciplined way. Four future project management competencies were identified in this competency area.
- The competency area, “cognitive,” includes those intellectual processes that enable the project manager to learn from, make sense of, and disseminate information effectively. Three future project management competencies were identified in this competency area.
- The competency area, “leadership,” includes those traits designed to align, motivate, and inspire a team to act and achieve project objectives. Five future project management competencies were identified in this competency area.

## Grouping the Competencies

The short-list of competencies was grouped into each of the following four competency areas:

- Technical/virtual:
  - technical knowledge and skills
  - technology knowledge and skills
- Management:
  - policies, processes, and procedures
  - business knowledge
  - risk monitoring
  - knowledge sourcing
- Cognitive:
  - effective communication skills
  - active listening and observation skills
  - cognitive intelligence
  - deals with complexity
  - emotional intelligence
- Leadership:
  - sets clear direction
  - relationship building
  - delegates and empowers others
  - participates and engages others
  - mentors/grows the next generation
  - leverages diversity
  - leadership traits and techniques

## Definitions and Final Consolidation

The final list was refined and reviewed with guidance from the research team industry members. Noted in the summary below are the rationalizations, comments, and findings supporting the inclusion of each competency in the forecast. Like competencies were merged and adjustments were made to strengthen their future orientation and relevance. Expanded descriptions for each competency were refined into a more focused wording and are discussed in the section consolidating the results of this chapter. The final revised list of fourteen project management competencies with description is as follows.

- Technical/virtual:
  - a) Technical knowledge and skills = “Is technically multi-disciplined.”

Advances in the development of integrated project systems will permit the PM of the future to delegate more of the project technical requirements to others. The addition of even more discipline areas, where functional literacy is needed in a global backdrop, will lead to the requirement that future PMs will need to be knowledgeable across multiple technical, project management, and construction disciplines.

The traditional idea that PMs must have an engineering background has become less true today and probably will no longer be a basic expectation in the future. This information

confirmed the expectation that in the next decade, the number of PMs without prior D/E/A experience will likely increase.

- b) Technology knowledge and skills = “Demonstrates practical understanding of technology.”

The future PM must be technologically aware and use electronic tools to acquire, process, and manage information. She/he will encourage others to use emerging technologies (video, blogging, social media, robotics, innovative construction methods, etc.) to get work done and to develop and practice new competencies. Advances in construction methods, robotics, and management process technologies will add to the escalation of this competency.

- Management:

- a) Policies, processes, and procedures = “Understands project management.”

The disruptive forces will place emphasis on a PM’s organizational capacity to bring order and discipline to get work done. The PM will need to rely on the competence of team members to utilize these prescribed protocols effectively and efficiently while retaining the capacity to be adaptive to changing conditions. The fundamentals of project management will remain as a foundational necessity for the future PM.

The number one action card selected by the 233 seminar participants in all of the individual entry and exit level scenarios is the “Ten of Spades,” a classical management card with the action “review scope, identify all the work required to complete the project successfully, and implement.” The Ten of Spades was also ranked number one for the individual entry level selections in the Generation Y seminar. The Super PMs selected this action card as number one for the New Project scenario, but not for the Project from Hell Scenario.

Through 2012, the skill development of PMs has been focused on establishing and improving their competence, knowledge, and expertise of the technical and management processes as well as procedures essential for successful project execution. This emphasis on management actions was most evident in a review of the individual selections in the individual PM Card Game.

b) Business knowledge = “Possesses keen business insight.”

The increased geopolitical risk from projects in less stable countries, the emergence of added project success factors (e.g., sustainability and compliance), the global ripple effects of unexpected “black swan” events and price/schedule/resource pressures are realities that will impact most projects in the future. The PM must be able to understand the business implications such disruptive trends have on successful project completion.

“Possesses keen business insight” was identified as a stand-alone competency in recognition of the ripple effects of major disruptive trends that will impact most major EPC projects (e.g., supply chain disruption, etc.). Future PMs will have to consider more than the profit and loss implications of just their project on the larger competitiveness of their organization.

c) Risk monitoring = “Monitors risk continually.”

The extent of globalization disruption forecast for 2022 and beyond demands continuous risk monitoring and a robust response capability. The future PM will need to be aware of political disturbances and financial developments that could interfere with material and equipment deliveries, or the availability of skilled resources. Global “black swan” events will have ripple effects that impact many if not most major projects. She/he will be required to more closely and persistently monitor all elements of project risk including the strength of contractors and subcontractors, the certainty of suppliers and vendors, and the health of their material resources, finance, transportation, human resource and corporate functions to ensure that current contract demands are not disrupted. The PM will need the ability to identify and acquire specialty personnel, equipment, and services throughout the world.

This competency was highlighted for the researchers via the blue-sky thinking session with E&C Industry Thought Leader,

John Voeller (John Voeller, report to RT-281, February 13, 2011). Additionally, 24 percent of the 233 participants in the PM seminars Capstone Future Exercise recognized ‘risk management knowledge’ as a Top Ten future competency. ‘Risk monitoring’ was ranked as a Top Ten future competency by about 50 percent of the Generation Y and Super PMs respectively.

d) Knowledge sourcing = “Builds knowledge networks.”

Having all the right resources directly embedded on a project team will be rare in the future. In their network of experts, PMs will need the ability to select, maintain, and utilize high-caliber people from many resources and many different countries. New organizational structures may have less formal team members and an expanded informal global support network. “Builds knowledge networks” was identified as a stand-alone competency in recognition that the formal project team will need considerably more outside expertise.

The forecasted complexity trends significantly increase the number of stakeholders that the PM must interact with each day. From the WOYM Exercise, the PMs identified an average of twelve stakeholders on their personal stakeholder molecules and forecasted that number to increase to as many as 28 stakeholders in the future (Tree #129). Because PMs of the future are predicted to interact with twice as many stakeholders than current PMs, they

will require vastly improved thinking, people, and leadership skills.

- Cognitive:
  - a) Effective communication skills + Active listening and observation skills = “Communicates effectively.”

In recognition of the strong relationship between the two competencies, they were consolidated into ‘communicates effectively’ and the term “virtual” was added to the description to address the advances in communications technologies.

Technology will increase the amount of information available and the speed with which it is shared. The PM will be dealing with significant increases in the volume of information available from multiple resources. In the future, s/he will need to choose their method of communication in a timely manner and help others separate important information from unimportant. The PM will also need the ability to assess messages coming globally from new media forms such as video blogging and other on-line collaboration technologies and to respond appropriately often in near-real time.

On Tree #45, PMs with fewer than sixteen years of experience, perceive that “effective communication skills, both oral and written” is an important current competency. This result is in alignment with the group of PMs as a whole as this skill was



ranked as the 'Number One' competency on both the Current and Future PM Competency lists in the Capstone Exercise.

- b) Cognitive intelligence and deals with complexity = "Makes complex decisions."

The researchers consolidated 'coordination of multiple activities at multiple locations' and 'coordination across internal/external boundaries' into a single competency 'deals with complexity' in earlier consolidation steps. Both 'deals with complexity' and 'critical thinking' were considered as top future competencies in recognition of the forecasted increased complexity due to the impacts of globalization and the speed of technological changes on PM decision-making in the future and research highlighting the importance of cognitive intelligence (analytical thinking) in dealing with complex situations. Recognizing the strong relationship between the two competencies they were consolidated into 'makes complex decisions' for the future competencies forecast.

Much like the experience of current PMs, the PM of the next decade will contend with strong global forces that require quick responses to unplanned events and an accelerated rate of change while dealing with complicated company and project organizations across multiple locations. There will be an increased emphasis on capital projects to be "efficient, reliable, cost effective, and

sustainable” and the PM will have to balance the objective to reduce energy usage and CO<sub>2</sub> emissions with traditional cost and schedule targets. And the future PMs will be required to manage this complexity in different settings, both face-to-face (in person) and virtually in “real time” as vast amounts of data from numerous and varied sources come in to them. The anticipated high rate of change, unprecedented increase in the amount of available information, technological innovation, exploding global communications, and exponential increase in culturally diverse relationships will place the PM of the future in increasingly more complex work environments. This complexity demands skill and practice in analytical, conceptual and adaptive thinking to make sound and reasonable decisions and develop solutions in often ambiguous and high stress situations.

PMs are already facing more complex project scenarios. More than half of the current projects use offsite fabrication with project scope a factor contributing to the use of offsite fabrication methodologies (Tree #61, Tree #42). Also, more than half of the current projects include the use of multiple engineering offices (Tree #129). Based on these trends, it is expected that the PM of the future will most certainly face a complex environment with multiple interfaces and the competency set needed to successfully manage and lead projects will continue expanding.

- c) Emotional intelligence and people oriented = “Displays emotional maturity.”

Increased project complexity, dispersed work teams, multiple work locations and changing organizational structures require the future PM to not just connect with, but also understand and relate to, team members. The PM of the future needs to gain his/her power by earning the admiration and respect of their team.

‘People oriented’ was ranked as a Top Ten future PM competency in the PM Seminar Capstone Exercises. After the PM seminars, the researchers added ‘emotional intelligence’ to the list of competencies in recognition of competency research highlighting its importance.

- Leadership:

- a) Sets clear direction and participates and engages others and delegates and empowers others = “Engages others.”

‘Actively participates and engages others,’ ‘sets clear direction,’ and ‘delegates and empowers others’ were all ranked in the Top Ten of the PM seminar capstone future competencies exercise. The leadership competencies tend to overlap but the researchers determined it essential to emphasize specific leadership competencies. Recognizing the strong relationship between the three competencies, ‘actively participates and engages others, sets

clear direction, and delegates to others were consolidated into engages others.’

Because project work of the future may be more broadly dispersed and accomplished by project teams that operate in both real and virtual settings—with key stakeholders from different cultures and different generations—clear and frequent engagement is a necessity. The PM will need to use multiple sophisticated technologies to his/her advantage. Recognizing the need to identify individual team talents in addition to their functional skills will leverage team productivity and commitment to meet the project objectives.

b) Relationship building = “Builds relationships.”

The number of significant stakeholder relationships will continue to increase; the data indicating an increase by at least double. As these stakeholder numbers increase, the PMs will have increased time demands to build and maintain quality relationships necessitating the need to mentor their team and ensure that they are prepared to be empowered for other essential tasks. For the up-and-coming PMs, developing a reputation for treating others fairly, making sound decisions and getting results will have long term career impact — especially with people s/he may never engage face-to-face.

- c) Mentors/grows the next generation = “Mentors people.”

The PM has a crucial role in retaining personnel as well as developing future personnel. Competence in this skill is critical to deal with forecasts of workforce shortages and to replace the loss of experienced PMs who are retiring from the industry. Many of the PM competencies are synergistic and overlap with one another. Specifically, in this case, mentoring helps to build trust, communicate effectively, leverage diverse thinking and engage others.

- d) Leverages diversity = “Leverages diverse thinking.”

Longer life spans will mean more generations in the workforce and more experience diversity. Cultural blending of global network non-traditional team members will force PMs to think and operate with a more sophisticated diversity competence. The emerging workforce—with its growing number of women, minorities and generations—requires PMs to apply adaptive thinking to deal with a complex array of opinions, values and cultures. ‘Leverages diverse thinking’ was identified as a stand-alone competency in recognition of these dynamic changes in the workforce.

- e) Leadership traits and techniques = “Builds trust.”

The development of this competency began with “lead by example” as a Top Ten future competency in the PM seminar capstone exercise. “Lead by example” is one of many leadership

descriptors also known as leadership truisms. Given the hundreds of such truisms, the idea that each PM would select the ones they most embraced took root. Situational, servant, transformational, resilient and other leadership approaches led to the notion that collectively they ‘build trust.’

The PM of the future will play a significant role in the retention of personnel. She/he will be one of the single, biggest factors in helping team members be engaged contributors to the company, and to develop themselves as leaders. The ability of PMs to remain resilient while continuously demonstrating their character and competence to meet project challenges will define their capacity to motivate the team to achieve success.

#### Confirming the Future Relevance of the Competencies

The future competencies have to put the PM in the position to successfully respond to new and currently not dominating or even existing demands and circumstances. Throughout the consolidation and review sessions the researchers were concerned with the relationship of the identified future competencies to the specific PM challenges derived from the anticipated shifts.

The future PM challenges provided a reference point to test every identified competency for its relevance in addressing and responding to one or more of them. The matrix was developed by reviewing each competency definition and then identifying the specific PM challenges (as identified from the literature review) each competency addresses. The matrix was then reviewed by

the research team industry members. A repeated testing of this correspondence also helped in the description and condensation into the recommended competencies. The future PM challenges provided a reference point to test every identified competency for its relevance in addressing and responding to one or more of them. This matrix is shown in figure 4.7.

Every identified future competency addresses one or more of the specific PM challenges identified in figure 4.7.

		FUTURE PM COMPETENCIES												
		TECH			MANAGEMENT			COGNITIVE			LEADERSHIP			
		Technically multi-disciplined	Demonstrates practical understanding of technology	Possesses keen business insight	Understands project management	Builds knowledge networks	Monitors risk continually	Makes complex decisions	Displays emotional maturity	Communicates effectively	Leverages diverse thinking	Builds relationships	Engages others	Mentors people
PM CHALLENGES	<b>WORKFORCE DEMOGRAPHICS</b>													
	Workforce diversity, dynamics, and styles					●			●	●	●	●	●	●
	Multi-gender, multi-cultural, multi-generational, multi-lingual project teams					●			●	●	●	●	●	●
	Reliance on nontraditional resources					●			●		●	●	●	●
	<b>GLOBALIZATION</b>													
	Projects in areas with difficult conditions	●	●	●	●		●	●						●
	Safety issues & training beyond traditional areas				●		●	●		●	●		●	
	Price/schedule/resource pressure means more competitiveness	●		●	●		●	●		●	●		●	
	Global supply chains	●	●	●	●	●	●	●	●	●	●	●	●	●
	Relationship building at multiple locations				●			●	●	●	●	●	●	
	Balance traditional success factors w/ sustainability objectives & compliance			●	●			●	●	●	●	●	●	
	More oversight and regulation			●				●	●	●	●	●	●	
	<b>TECHNOLOGY</b>													
	24/7/365 access from all directions		●					●		●			●	
	Information collected faster than resources can manage and analyze		●			●		●		●				
	Information for decision-making will change in minutes		●			●		●		●				
	Constantly evolving project methods, systems, and software tools	●	●		●			●		●				
	More work done off-site	●	●	●	●	●	●	●	●	●	●	●	●	●
	Global, virtual teams		●					●	●	●	●	●	●	●
	<b>NEW AND CHANGING ORGANIZATIONS</b>													
	Increase in number of stakeholders with competing agendas							●	●			●		●
	Increase in number of non-fulltime/contract employees				●	●	●	●	●		●	●	●	
	Shifts in risk sharing models (more JVs, etc.)	●		●	●		●	●	●	●	●	●	●	
Low cost execution centers with more capabilities	●		●	●		●	●	●	●	●	●	●		
Increased probability of unexpected ("black swan") project risks	●	●	●	●	●	●	●	●	●	●	●	●	●	

Figure 4.7. Future Competencies Linkage-Challenges Matrix

## Forecast

### *Future PM Competencies*

As mentioned above, many of the future trends that PMs will face are extensions of those already present in today's environment. And the competencies that will be needed will not be entirely new to PMs. This forecast builds on previous research and combines it with the insight of current industry professionals.

The list of competencies was reviewed against the list of disruptive forces and trends looking for gaps and cross-referenced to ensure that the PM will be prepared to address these future challenges. Each competency was confirmed once more with the knowledge gained from the PM seminars and literature review. Descriptions for each competency were refined into a more focused wording and expanded definitions and adjustments were made to strengthen their future orientation and relevance. Ultimately fourteen competencies in four competency areas were identified - summarized in figure 4.8. The expanded descriptions for each of the fourteen competencies follow figure 4.8.



COMPETENCY AREAS	FUTURE PM COMPETENCIES
<p><b>Technical / Virtual:</b> The knowledge and skills relating to the involvement or use of technology</p>	<p><b>Is technically multi-disciplined.</b> Demonstrates knowledge across multiple technical, project management, and construction disciplines with deep expertise in at least one.</p> <p><b>Demonstrates practical understanding of technology.</b> Is up to date on project-related technology and uses it effectively to lead and enable team members to work efficiently.</p>
<p><b>Management:</b> A set of activities, procedures, boundaries, and structures that allow an organization to achieve its goals in a disciplined way</p>	<p><b>Possesses keen business insight.</b> Embraces the parent organization's strategic purpose/goals and translates these into practical concepts relevant to the project.</p> <p><b>Understands project management.</b> Knows and executes the policies, processes, procedures, and best practices that lead to successful project execution.</p> <p><b>Builds knowledge networks.</b> Creates and maintains a global knowledge network inside and outside of the team and organization.</p> <p><b>Monitors risk continually.</b> Persistently monitors known and unforeseen strategic and operational risks to maintain a robust response capability.</p>
<p><b>Cognitive:</b> The intellectual processes that enable one to learn from, make sense of, and disseminate information</p>	<p><b>Makes complex decisions.</b> Thinks analytically, conceptually, and adaptively and makes sense of new information across multiple levels of detail.</p> <p><b>Displays emotional maturity.</b> Understands and controls emotions while showing empathy for others and using these skills to lead others.</p> <p><b>Communicates effectively.</b> Listens to understand and is able to articulate ideas and complex concepts clearly and convincingly to a wide range of audiences.</p>
<p><b>Leadership:</b> Traits designed to align, motivate, and inspire a team to act and achieve project objectives</p>	<p><b>Leverages diverse thinking.</b> Uses the power of diversity to benefit from cultural, gender, experience, and generational differences.</p> <p><b>Builds relationships.</b> Builds collaborative relationships with clients, peers, global knowledge networks, subordinates, and superiors to achieve business objectives.</p> <p><b>Engages others.</b> Demonstrates active involvement, fosters teamwork, aligns differences, and leverages individuals' talents to achieve objectives.</p> <p><b>Mentors people.</b> Consistently teaches, coaches, and mentors to help ensure individual and team success, as well as develop the next generation.</p> <p><b>Builds trust.</b> Practices his or her leadership truisms chosen to enable others to have a firm reliance on their character and competence under stress.</p>

Figure 4.8. Future PM Competencies

Technical/virtual:

*Is technically multi-disciplined*

- The PM is technically multi-disciplined---knowledgeable across multiple technical, project management, and construction disciplines

with deep expertise in at least one area. PMs will develop deep mastery in at least one technical or project management discipline and expand their capacity to converse in the language of a broader range of disciplines. Literacy in safety management, project controls, scheduling, procurement, quality control, legal compliance, sustainability, dealing with the media, security, terrorism threats, unexpected “black swan” risk response, environmental stewardship, local cultural and political considerations, etc.

*Demonstrates practical understanding of technology*

- The PM demonstrates practical understanding of technology—is up-to-date on project related technology and uses it to enable team members to work efficiently. The PM:
  - is technologically aware and stays current with emerging trends
  - is comfortable using electronic media and tools to acquire, track, interpret, integrate and disseminate project relevant data and information
  - encourages others to develop dexterity in the use of information, communication, and process improvement and construction innovations tools to breach geographical and cultural barrier
  - shows intellectual curiosity and is a champion for technological change.

Management:

*Possesses keen business insight*

- The PM possesses keen business insight---embraces the parent organization's strategic purpose and goals, and translates these into practical concepts relevant to the execution of the project.
- Conversant and aware of his/her own organization as well as customer's business needs and objectives; the PM must build a foundation of business acumen that enables complex decisions based on sound business principles, customer consultation and an appreciation of unintended consequences resulting from decisions made.

*Understands project management*

- The PM understands project management---knows and executes the policies, processes, procedures and practices that lead to successful project execution.
- Every PM will need functional knowledge of basic construction industry processes, execution policies and best practices specific to the corporation h/she belongs to and to the customer's organization.

*Builds knowledge networks*

- The PM builds knowledge networks---creates and maintains a global knowledge network inside and outside of the team and organization.
- The PM is familiar with, and has access to, a wide array of specialized, global knowledge experts in academia, government agencies, professional associations, media, and independent consulting organizations—many of whom are not in their formal project team structure—to build a robust capacity to make sound complex decisions and help assure project success.

*Monitors risk continually*

- The PM monitors risk continually---persistently monitors known and unforeseen strategic and operational risks to maintain a robust response capability.
- The PM is always mentally alert to recognize unexpected changes, developments and emerging trends that have the potential of adversely or favorably affecting a project's progress.
- She/he uses formal risk management processes to identify, assess and prioritize all known risks, and build a robust capability to respond to unknown or “black swan” risks. She/he takes action to minimize the chance any identified detrimental events will occur and plans ahead to quickly respond when known or unforeseen risk events do occur.

Cognitive:

*Makes complex decisions*

- The PM makes complex decisions---the ability to think analytically, conceptually and adaptively, to make sense of new information across multiple levels of detail.
- PMs must generate new solutions and arrive at decisions by asking appropriate questions, applying past knowledge to novel situations and approaching problems from multiple angles.

The PM must:

- have the ability to determine the significance of ongoing actions and to correctly use data from multiple sources
- think broadly, conceptually and in the abstract, examining carefully and thoroughly multiple levels of detail, to make sense of new, inconsistent, incomplete and sometimes even erroneous information
- integrate, organize and simplify complex ideas and facts and take action even in the face of conflicting objectives and priorities
- develop workable solutions using “dominant information” (the minimum essential information needed to anticipate the outcome of a given event)
- be alert and adaptive to situations when diversity, interdependence, and ambiguity threaten to undermine a project’s objectives

*Displays emotional maturity*

- The PM displays emotional maturity---understands and controls his/her emotions with empathy for others and uses these skills to lead others.
- Increased project complexity, dispersed work teams and multiple work locations demand that the future PM has the an ability to not just connect with, but also understand and relate to, team members from a genuine, authentic and self-aware standpoint.
- PMs who have mastered the first two skills---understanding and controlling their emotions and having empathy for others---are usually effective when managing relationships because they are “tuned-in” to others. They typically approach people from a standpoint that is genuine, authentic and self-aware.

*Communicates effectively*

- The PM communicates effectively---listens actively and is able to articulate ideas and complex concepts clearly to a wide range of audiences.
- The skilled PM chooses the proper media (verbal, written, virtual) to share his or her message in one-on-one and group settings. S/he chooses words, images, and behaviors that are consistently convey meaning---checking to ensure that the message is understood by the audience.

- The PM has acquired the ability and systems to filter, distill and condense an increasing amount of available information into the elements relevant to the project. She/he helps others separate important information from the unimportant, recognizing the large volume of different sources and the speed with which both useful and misleading information can be disseminated.

She/he listens actively giving full attention to the speaker and responding in a way that invites dialogue and the sharing of ideas. This demands a quick and accurate assessment of the concerns, interests and feelings of others to correctly interpret their words, tone and gestures. Uses dialogue effectively to ascertain and confirm the needs and intent of the speaker.

Leadership:

*Leverages Diverse Thinking*

- The PM leverages diverse thinking---uses the power of diversity to benefit from cultural, gender, and generational differences.
- The PM values, appreciates, and respects others and is receptive to a wide range of opinions and approaches to project work. She/he understands global issues and can leverage the diversity of others' knowledge, experiences and perspectives to increase innovation and productivity.
- The PM encourages the sharing of different opinions and perspectives while leading a workforce that will increasingly include women and

minorities, as well as people from different cultures, generations, and experiences to develop joint and integrated positions and decisions.

#### *Builds Relationships*

- The PM builds relationships: methodically builds collaborative relationships with customers, peers, global knowledge networks, subordinates and superiors to achieve business objectives.
- She/he sets the example for relationship-building and demonstrates the role a PM plays in developing strong relationships based on trust and respect. The PM has the reputation for treating others fairly, making sound decisions---often under stress---and getting results. She/he understands the value, and the huge dividends, this aspect generates in being able to empower others and execute a successful project.
- She/he establishes solid relationships with government agencies, local authorities, and community organization responding to their concerns and recognizing their responsibilities.

#### *Engages Others*

- The PM engages others---fosters teamwork, aligns differences, and leverages individuals' talents to achieve objectives.
- The PM gains support for project goals and objectives through active participation and involving others. She/he fosters teamwork by finding common ground, leveraging the strengths of others, and keeping the team focused on achieving results. She/he recognizes and aligns “agenda” differences.



- The PM sets clear, unambiguous goals, delegates, and empowers others to take action and assume ownership and accountability for achieving results. She/he sorts, prioritizes, decides and communicates objectives clearly and concisely and ensures that others understand and are clear about their responsibilities.
- The PM helps and guides others to accept increasingly greater responsibilities by generating and demonstrating trust in others.
- The PM uses technology that enables others to act in virtual environments. This allows key stakeholders from different cultures, different generations, and residing in multiple locations to act in concert toward the common project goal.

#### *Mentors People*

- The PM mentors people---consistently teaches and mentors to help assure individual and team success as well as to develop the next generation.
- Consistently teaches, coaches and mentors others to guide their individual success and ensure the success of the entire project team. This competency, often perceived as having little immediate impact on a project, is fundamental to improving overall performance, meeting customer expectations, delivering sustained results and demonstrating an authentic caring for each individual's development. All team members share this role, regardless of position or job responsibility. PMs must recognize that mentoring is a two-way scenario. The

protégée has a great deal to offer in helping the more experienced mentor stay abreast of technology and contend with generational and cultural differences.

### *Builds Trust*

- The PM builds trust---practices chosen leadership truisms that enable others to have a firm reliance on the PM's character and competence under stress.
- Trust is the one thing that changes everything. It is the foundation that enables a PM to be respected as a leader and thus exert the influence on others based on his/her character and competence more than positional authority.
- Trust creates an environment where people are viewed as the organization's key asset and, as such, are developed and coached to achieve high customer satisfaction and bottom line results while developing themselves to be a more valued employee. Many descriptors of good leadership truisms have evolved over the centuries and, when applied by leaders, have proven time and again to be genuine developers of trust. For example "lead by example," where the PM creates a model of behavior and actions for team members each day on the project. Others include "be accessible, even tempered, enthusiastic, admit when wrong, practice life-long learning, have a positive attitude, be decisive, and know your people." Each leader will choose to emphasize certain behaviors and actions consistent with

her/his talents and style all with the aim of demonstrating that his/her character and competence can be trusted especially under prolonged stressful conditions.

*Key Attributes for the Future PM*

The fourteen competencies recommended and described herein consider the PM as a complete individual, and consist not only of a set of desirable competencies and skills that can be learned and applied when required by a specific project, but also presuppose the existence of personal attributes essential for long-term success.

The future may demand new skills and behaviors, but it will not change the fundamental attributes associated with PMs today. For the purpose of this research, character-related components (values and attributes) were considered constant. The ongoing attributes are shown in figure 4.9.

ATTRIBUTE	CHARACTERISTICS
Integrity	Displays truthfulness, has a rigid adherence to a standard of values
Accountable	Accepts responsibility for actions, decisions, consequences, and results
Results Driven	Is compelled to achieve the desired outcomes
Flexibility	Adapts to change
Innovative	Creative, discovers new ideas
Initiative	Follows through energetically
Decisiveness	Is firm and resolute
Continually Learning	Is committed to learning and maturing skills or competencies
Perceptive / Intuitive	Has insight or discernment, knows without the use of rational processes

Figure 4.9. Ongoing PM Attributes

#### Applications

This competency forecast will be used as a basis to create training tools that CII member companies can use for recruiting and professional development programs as well as PM education at the university level. The fourteen recommended competencies can be learned—and continuous learning will span a PM’s career. This especially applies to a PM who moves from one project to another and who frequently heads more than one project simultaneously. The speed of a PM’s development progression is dependent on her/his access to education and training, as well as available opportunities to gain project experience.

In the next decade, universities will continue to focus on management and technical competencies, and will seek to develop critical thinking. Additionally, leadership (people skills) will be added to the project management curricula.

Corporate learning and development programs, typically required for company specific processes and procedures training, will also be expanded to include leadership development, mentoring, peer interaction, and learning for PMs. Project management certification programs, led by industry professional organizations, will continue to be important to ensure standardization of management and technical skills across all sectors. However, the addition of leadership (people skills) to the certification competency hierarchy is not expected to be included in the certification requirements during the next ten years (Dennis Doran, presentation to RT-281, July 24, 2011).

In addition to developing the competencies needed, the research team industry members also identified tools, games, and exercises that will support the development and growth of future PMs.

The Meta Tool: PM Competency Development Tool Selection Guide (PM Meta Tool) was developed by the research team through a series of reviews in which industry team members scored the effectiveness (on a scale of zero to four) of each game and exercise to strengthening attributes and competencies, identified by the full RT-281 team, that are critical to the success of future PMs. The PM Meta Tool (shown in Appendix G) provides curricula for seminars covering a PM's specific competencies. The curricula should be created in response to general challenges that an organization foresees. Each curriculum lists a number of specific individual or team (class) activities and their duration. The material needed for each of the activities is, by itself, an implementation tool, hence the name of meta-tool (a tool about tools). The interaction with the PM Meta Tool

starts by selecting a number of challenges that will conceivably be faced by the company. Those challenges are linked to a matrix of competencies needed by PMs to overcome the challenges. The competencies are further linked to a separate matrix of exercises that improve the specific competencies. Some of the exercises are for individuals and some are for teams (class). The user can add tools to the PM Meta Tool that are not a part of the PM seminars, but were experienced or used by several members of the team (e.g., CII Executive Leadership Program).

The PM Future Dictionary is a team ‘read, discuss, and learn’ improvement tool, which incorporates the dictionary of future project management terms, developed for this research, into individual and team activity.

The research team also recommended three of the games and exercises used in the PM seminar, which offer the kind of engaged learning experiences that go beyond the simple teaching. The PM Game, Who’s on Your Molecule, and the Hassles in Construction exercise have been tested in professional environments, and incorporate knowledge derived from extensive academic research. The transfer of this knowledge to the participants occurs during their intense intellectual involvement. The engagement in these activities demands continuous reflection, introspection, and decision making to address project related problems. Additional learning takes place during the frequent discussion periods among small peer groups. These discussions foster the exchange of personal experience and knowledge; they help participants arrive at collective decisions during the subsequent analysis of the success or failure of the joint decisions. The PM Magic

Deck of Action Cards is particularly effective at establishing an interactive, collaborative learning environment, one in which PMs are presented with hypothetical project scenarios for which they choose cards representing various project management actions and approaches.

## 5 CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

The primary goal of the research was to identify and define specific attributes and competencies required for PMs to successfully respond to the many changes already being experienced within the industry, as well as any future challenges. Additionally, the research set out to identify methods to transfer these project management skills both to individuals in the field of project management and to students in university construction management and engineering programs. RT-281 set out to answer this question: “What skill set will be required for the PM of the future?” From a scientific point of view, the research question was translated into the following hypothesis:

- By the year 2022, a PM’s competencies will expand from the current primary focus on technical and management proficiency to include an emphasis on leadership (i.e., “soft skills”).

This research study used an innovative approach to identify future PM competencies and available tools for PM skills, and to improve those that PMs already possess. Consolidating the project management training results, provided for this study by CII companies with an extensive review of published industry forecasts, presented a vast amount of information from which to identify and predict the competencies needed to master future projects and generate greater industry confidence in the results. The development of PMs to acquire the competencies described herein will not only underpin the future success of a



project but also support the growth of the construction industry in an exceedingly competitive environment.

The research study describes the competencies needed to master project management in 2022 and beyond. The role of the individual leading and overseeing the capital facilities efforts already has changed over the past decade. Driven by new circumstances, demands and tools, this role will continue to evolve and transform itself. Disruptive shifts can be discerned on the horizon that will bring about substantial challenges for PMs during the next decade. Different workforce demographics, globalization, rapidly evolving technology (particularly in the areas of information and data management), and unprecedented organizational structures will demand new and expanded project management skills.

Many of the changes predicted for the construction industry in the next decade are more evolutionary than revolutionary. New technical, management, cognitive, and leadership competencies will be required, mostly in combination. In addition to the traditional technical and management skills, the role of the future PM will require greater competence in communications, relationship building, complex decision making, business insight, risk management, and diverse thinking while engaging others. Future PMs also will require competencies in coaching and mentoring.

Many of the recommended competencies are familiar to current PMs. Nevertheless, each competency was chosen to place emphasis and focus in a

specific area that the research determined as essential to confront the disruptive forces that lie ahead.

- Technical and management activities that dominated a PM's actions in the past and often still do today, will increasingly be taken over by electronic tools and become less dominant, although still important, even while their complexity increases.
- The future PM will be dealing with much more complexity in an unprecedented environment. Cognitive skills, closely related to leadership, will be recognized as an important aspect demanding special attention by future PMs. They are the intellectual processes that enable individuals to learn from, make sense of, and disseminate information effectively.
- The future PM will interface with twice the number of stakeholders than do current PMs. She/he will require vastly improved leadership, people, and thinking skills to those needed in the past or even today

There is considerable synergy and some overlap among the competencies identified in this study. Nevertheless, each competency was chosen to emphasize a specific area that the research determined was essential to confronting the disruptive trends that lie ahead. One set of competencies from among the four areas—cognitive, technical, management, and leadership— does not replace the others, but each one is additive, and the successful PM will need the entire competency tool kit. The emphasis on certain competencies is expected to vary due to individual leadership styles and/or project circumstances. In addition

competencies should be recognized in educational and on-the-job training programs.

There will always be a wide range of competencies about which a PM needs to have a working literacy. This requires PMs to perform in a manner proficient enough to accomplish the purpose, not strive for perfection as a standard in everything.

The fourteen recommended competencies can be learned---and continuous learning will span a PM's career. This especially applies to a PM who moves from one project to another or simultaneously heads more than one project. Developing competency (proficiency) in future competencies is the variable component of a PM's professional continuing education. Competencies develop as a PM's career progresses. The speed of progression is dependent on the individual PM, his/her access to education and training, and available opportunities to gain project experience.

In the next decade, university curricula, corporate learning and development programs, and professional organization development programs will be expanded to include leadership development, mentoring, and peer interaction and learning for PMs. However, the addition of leadership (people skills) to the certification competency hierarchy is not expected to be included in the certification requirements in the next ten years.

This competency forecast will be used as a basis to create training tools that CII member companies can use for recruiting and professional development programs as well as PM education at the university level. For this study, in

addition to the competency forecast, the research team industry members identified simulation games, exercises, and tools as components of a project management development program in a classroom setting. These tools, incorporate knowledge derived from extensive academic research and have been used in professional environments. The participants are engaged in activities that demand continuous reflection, introspection, and decision making to address project related problems. Additional learning takes place during the frequent discussion periods among small peer groups.

The development of PMs to acquire the competencies described herein will not only underpin the future success of a project but also support the growth of the construction industry, as well as the client's business, in an exceedingly competitive environment. A versatile PM with the competencies to successfully deal with a diverse and changing set of challenges will be a valuable asset to the industry. He/she will add a value that exceeds what other competitors would offer and will be one of the ways a company can stay ahead of the competition and become the project management team of choice.

#### Recommendations for Future Research

This research has identified those essential project management competencies needed for 2022 and beyond. The next research step is to measure the effectiveness of these competencies. Future research is recommended to study the correlation between the competencies and the following success indicators:

- project success

- company success
- retention of key personnel
- employee turnover
- repeat customer business
- win/loss ratios
- health and safety indicators
- employee morale
- PM role (i.e., magnitude of responsibility)—the level of competencies and the PM's role

Studies of the effectiveness of competency development tools are needed.

Additionally as highlighted in this report, project management training and development offers multiple benefits for the individual to learn and improve, and for a company to learn from the participants how to improve its performance. More research into the use of simulation games and exercises as an alternative methodology for collecting data for project management research as well as company feedback is needed. Specifically, the Hassles in Construction Exercise provided this research team's member companies with more information about the daily project hassles and barriers from the front-line view of their current PMs. Additional research efforts to develop a feedback reporting tool from the Hassles in Construction Exercise are warranted. The benefit of this research effort would provide member companies with feedback on where to specifically focus efforts to improve project productivity.

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APPENDIX A:  
PM DICTIONARY

## Terms, Acronyms, and Phrases for PMs of the Future

### 1. *Acronyms Common to the Industry*

- E&C is the acronym for “Engineering and Construction.”
- EPC is the acronym for “Engineering, Procurement, and Construction.”
- EPCM is the acronym for “Engineering, Procurement, Construction, and Maintenance.”
- PM is the acronym for “Project Manager.”

### 2. *Active Listening and Observation*

*Active listening* is a “structured way of listening and responding to others.”

Giving his or her full attention to the speakers, the PM will need the ability to quickly and accurately assess the concerns, interests, and feelings of others and adapt his or her words, tone, and gestures accordingly. In addition to focusing on the people (key project stakeholders), PMs of the future will also need the ability to assess the messages coming to them from new media forms, e.g., video blogging and other collaborative online collaboration technologies (e.g., social media).

### 3. *Attribute*

An *attribute* is a fundamental quality or characteristic of a person. The PM Skills of the Future research study found that, while the future may demand new skills, it will not change the fundamental attributes associated with PMs today. Integrity, accountability, initiative, decisiveness, among other traits, will remain

vital to the character of E&C industry PMs. The research study addressed the attributes that need special emphasis in the next decade. Although the attributes stay the same, the expectation is that the PM will understand and embrace the attributes' importance early in his or her career, strengthen them in mid-career, and serve as an exemplar of them in his or her advanced career. These ongoing attributes are shown in the figure below.

ATTRIBUTE	CHARACTERISTICS
Integrity	Displays truthfulness, has a rigid adherence to a standard of values
Accountable	Accepts responsibility for actions, decisions, consequences, and results
Results Driven	Is compelled to achieve the desired outcomes
Flexibility	Adapts to change
Innovative	Creative, discovers new ideas
Initiative	Follows through energetically
Decisiveness	Is firm and resolute
Continually Learning	Is committed to learning and maturing skills or competencies
Perceptive / Intuitive	Has insight or discernment, knows without the use of rational processes

Figure A.1. Future PM Attributes

#### 4. *Black Swan Events*

*Black Swan* describes unthinkably rare, immensely important, events that are as unpredictable in advance as they are inevitable in hindsight.

5. *Business Acumen*

For the PM of the future, *business acumen* is the keenness, quickness, fluency, and accountability in understanding and dealing with the language of business, finance, and markets associated with the project.

6. *Career Milestone*

Today, *career milestones* are usually linked to the structure of a company and, by extension, to one's career. A career milestone represents a new position, assignment, or accomplishment that validates progression in one's vocation. Examples of career milestones include a first job, a promotion to site engineer or to senior project engineer, a first job with budgetary responsibilities, or a promotion to PM, project director, or senior executive. The younger generations are already taking a less-linear view of career progression, so their milestones are likely to differ from the traditional ones. For simplification, the study divided career progression into early, middle, and advanced.

7. *Certification*

*Certification* is the assessment by an independent, accredited third-party of peers possessing the currently necessary level of knowledge and experience in a specific field. Examples of certifications are those offered by the Project Management Institute (PMI) and the Construction Management Association of America (CMAA) in conjunction with the Construction Management Certification Institute (CMCI).

## 8. *Competency*

*Competency* is the broad term that encompasses behaviors, knowledge, and a combination of skills that make the PM qualified to bring about the successful realization of project goals. Competencies are developed and honed over an extended period of time, usually months to years. The PM Skills of the Future study identified four categories of competences for PMs.

- *Technical/Virtual Competencies*: knowledge and skills relating to a particular subject and involving or using computer technology.
- *Management Competencies*: a set of activities, procedures, boundaries, and structures that allow an organization to achieve its goals in a disciplined way (e.g., planning, organizing, hiring, rewarding, policy making, allocating resources, and documenting).
- *Cognitive Competencies*: intellectual processes that enable one to learn from, make sense of, and disseminate information. Cognitive skills, or “the capabilities needed to learn and make sense from new information,” will be essential for the PM to be able to navigate the complexities and rapid changes ahead. The PM will need to be able to ask questions, apply past knowledge to new situations, think about problems from different angles, and then generate new and unique solutions.
- *Leadership Competencies*: reflect traits designed to align, motivate, and inspire a team so that team members want to act and achieve project objectives.

9. *Competent*

*Competent* is a subjective term for judging a level of knowledge of concepts and skills needed to perform specific actions, and apply techniques in a manner adequate to the purpose. The complex nature of engineering and construction industry projects incorporates a multitude of rapidly evolving elements. Thus, competence can be fleeting.

10. *Cross-Culturally and Generationally Adept*

The PM must work well with male and female team members from different cultures and generations. Values appreciation, mutual respect, and receptiveness of others' opinions, values judgments and ethical standards, and has an understanding of global issues are needed to successfully leverage the diversity of the PM's knowledge, experiences, and perspectives to increase innovation and productivity on the project.

11. *Deals with Complexity*

*Deals with complexity* is the decision-making ability to evaluate the significance of what is happening and effectively use the correct data from multiple sources to make sound and reasonable decisions, then develop solutions when faced with increasingly complex situations. This complexity will require that the PM has the ability to discern the minimum essential information (i.e., the minimum of information necessary to anticipate a given event) to be able to anticipate the outcome of a given event.



12. *Delegates and Empowers*

Delegates and empowers others is the process of distributing authority from the PM to other individuals who have exhibited the competence to execute the assigned tasks or responsibilities in real and virtual settings, and in a multicultural project environment.

13. *Disruptive Forces*

The *disruptive forces* are the drivers that will dramatically change the way the E&C industry approaches projects, forms project teams, and manages the flow of project information—in effect, breaking up the old ways of getting work done. The PM Skills of the Future study identified four primary drivers or disruptive forces: workforce demographics, globalization, technology, and new and changing organizations.

Many of the forecasted trends are simply extensions of those already present in today's environment. The different forecasting studies indicate that the most significant differences between current and future trends will be the exponential speed at which technology will advance in the next decade, the vast amounts of information generated, and the type of changes that will take place in the workforce. The direct PM challenges resulting from these disruptive forces further supported the competencies that must be acquired or given a greater emphasis to prepare for the future.

14. *E-quaintance*

An *e-quaintance* is an internet acquaintance (e.g., an internet friend or colleague.) *E-quaintance* is an example of the new language emerging from social media usage and global business dealings.

15. *Eco-efficient*

An eco-efficient solution represents the best solution from an environmental and ecological perspective.

16. *Emotional Intelligence*

*Emotional intelligence (EI)* is about how people manage themselves and their relationships. EI has two skill components. Self-management is the awareness of one's strengths and weaknesses, openness to feedback, and sensitivity to how he or she learns from an experience. Relationship management, critical to the PM for working with people, is having the social intelligence to read nonverbal cues from others and hearing what a person from a different social environment or foreign culture is really saying or meaning.

17. *Generation Y*

*Generation Y*, also known as Millennials, is the generation that is approximately 20 to 30 years of age in 2012. Generation Y will constitute the major generational group of PMs in 2022. Members of this generation are technologically proficient, professionally mobile, well-travelled, and open to change.

18. *Going to Abilene*

*Going to Abilene* refers to the “Abilene Paradox” which involves a common breakdown of group communication in which each member mistakenly believes that their own preferences are counter to that of the group and, therefore, does not raise objections. A common phrase relating to the Abilene paradox is a desire to not “rock the boat.”

19. *Hassles and Problems*

*Hassles* are chronic troubles, nuisances, or unwanted annoyances not normally worth the difficulty they generate. A *problem* is a difficult situation or condition that demands a solution or action.

20. *Key Project Drivers*

*Key project drivers* are the fundamental customer expectations that underlie a capital investment. They should be clarified and agreed upon during the project negotiation period.

21. *Knowledge*

Knowledge is specific information and understanding about something acquired through experience, education, or discovery.

22. *Leadership Truisms*

A truism is defined as a “self-evident or obvious truth.” Many descriptors of good leadership truisms have evolved over the centuries and been proven time and again to be true when applied by leaders. For example, “lead by example,” whereby the PM creates a model of behavior and actions for his or her team members each day on the project. Other truisms are “create an environment of

trust,” “have a positive attitude,” “be decisive,” and “know your people.” Each leader will choose to emphasize certain truisms consistent with his or her talents and style, but the basic truisms deserve remembering, since they have proven their value.

23. *Mentoring*

The term *mentoring* comes from Greek mythology. Mentor was the trusted counselor of Telemachus when his father, Odysseus, went to fight in the Trojan wars. *Mentoring* is the activity of counseling or teaching by a trusted individual interested in developing others by sharing his/her wisdom and experience.

24. *Motivation*

*Motivation* includes the numerous ways to get people to embrace project goals and make them their own.

25. *Multidisciplined*

A *multi-disciplined* person has established a concentrated technical expertise in at least one technical/project discipline and has expanded that to a broader range of knowledge in multiple technical/project disciplines, e.g., safety management, project controls, scheduling, procurement, and quality control.

26. *Multi-faceted Communication*

*Multi-faceted communication* includes those oral, written, and virtual communications skills to effectively articulate information and convey direction through a common understanding of the meaning of words, system of symbols, signs, and behaviors. Effective communication comprises the communicator, the

message itself, the medium of the message, and the receiver(s). This competency now includes media in different settings, both real (face-to-face) and virtually.

27. *Profession*

A *profession* is commonly understood as a body of qualified people of character in a specific field (in this case the E&C industry) for greater social good. A profession requires lifelong learning, expert knowledge, and competence applied with discretion. It assumes a self-policing ethical culture and altruistic view of service.

28. *Professional*

A *professional* is one who has the character, competence and judgment to “do the right thing” well (i.e., correctly apply specific knowledge) even under stress.

29. *Project Coordinator*

A project coordinator is an individual who reports to a higher-level PM who has the responsibility for keeping a project running smoothly by coordinating activities, resources, equipment, and information.

30. *Project Management*

*Project management* is the discipline of planning, organizing, and allocating resources to bring about successful completion of project goals and objectives while honoring project constraints.

31. *Project Manager (PM)*

A *PM* is one who is trained in and practices the principles of project management. The *PM* is the individual responsible for leading and allocating

resources to bring about the successful realization of project goals while honoring project constraints.

32. *Project Leader/Manager (PLM)*

A *PLM* blends the art of leadership and the discipline of management to bring about successful completion of project goals and objectives in an optimal way.

33. *Project Success*

*Project success* is the satisfaction of stakeholder needs and it is measured by the success criteria identified and agreed upon at the start of the project. Stakeholders will have differing viewpoints for project success, which must be taken into account. However, success criteria generally include project completion according to the following parameters:

- within a specified time frame
- within budget
- at specified performance levels
- at specified quality levels under safe conditions

A *successful PM* leads successful projects in a way that fully engages the spirit and energy of the project team and the stakeholders, plus creates the desire for all involved to work together on future challenges.

34. *Satisfice*

*Satisfice* describes performing task(s) proficiently enough to accomplish them in a manner adequate to the purpose; not striving for mastery as a standard in everything.

35. *Setting Clear Direction*

*Setting clear direction* is the ability to synthesize multiple perspectives, issues, and insights into a set of clear, prioritized directions, and communicate them to the project team in real and virtual settings as well as in a multicultural project environment.

36. *Skill*

*Skill* is the term used to describe someone's capacity to perform a specific action or task. Skills are learned more quickly than competencies, generally over days to months.

37. *Social Media*

*Social media* are the web-based and mobile technologies used to turn communication into interactive dialogue.

38. *Strategic Imperatives*

Strategic imperatives are the fundamental concepts and behaviors that drive all actions and decisions. In the past, the three strategic imperatives for construction were "on budget," "on time," and "on performance." Future additional imperatives may be "safe," "ecologically efficient," and "sustainable." The relative priority of strategic imperatives may shift, but they are not negotiable.

39. *Stakeholder*

A *corporate stakeholder* is a party that can affect or be affected by the actions of the business as a whole. *Project stakeholders* are individuals and

organizations that are actively involved in the project, or whose interests may be affected as a result of project execution or project completion. They also may exert influence over the project's objectives and outcomes. The project management/leadership team must identify the stakeholders, determine their requirements and expectations, and, to the extent possible, manage their influence in relation to the requirements to ensure a successful project.

40. *Style*

*Style* is a customary way of doing something.

41. *Substantiation*

*Substantiation* is third-party testing of research insights and conclusions that shows the results are worthy of confidence.

42. *Sustainability*

*Sustainability* is the consciousness of and compatibility with prevailing environmental, ecological, economic, financial, social, cultural, political, and regulatory systems. *Sustainability* is often equated only to environmental aspects, but true sustainability has many more dimensions.

43. *Talent*

*Talent* is a natural or endowed ability.

44. *Team Building and Teamwork*

*Team building* is the planned and deliberate process of encouraging effective working relationships. Positive communication, leadership skills, and the ability to work closely together as a team to solve problems are necessary to



bring out the best in a team and ensure self-development. *Teamwork* is the cooperative effort to work together toward a common goal.

45. *Tech Savvy*

Being tech savvy involves the use of computers and other electronic tools to accomplish the following goals:

- acquire, process, and manage information
- access new media forms (e.g., video blogging and voice activated interfaces) and critically assess the contents
- learn and practice skills
- use the Internet to explore topics, gather information, and communicate

46. *Telematics*

*Telematics* is the integration of interactive, voice-activated calling functions, personalized Internet radio access, and display functions into equipment units.

47. *Trend Drivers*

*Trend drivers* are the underlying conditions or events that determine the direction in which the future is moving.

48. *Trust*

*Trust* is the firm reliance on the integrity, ability, or character of a person or thing. It is the requirement for pinning one's hopes on another as someone honorable, dependable, and ethical. A trustworthy person is one who is warranting trust.

49. *Values*

*Values* are the culture-specific principles, standards, and beliefs that drive behavioral choices.

50. *Virtual*

The PM of the future will be communicating and collaborating with key project stakeholders by means of various digital media such as video conferencing, video blogging, and other collaborative online technologies. The future PM also will require knowledge of, familiarity with, an environment that is simulated on a computer or computer network, as well as other tech devices (e.g., iPhone, iPad, and iPod), making other than face-to-face interaction possible.

51. *Virtual Presence*

*Virtual presence* is the active participation in a meeting, event, or visual inspection without being physically present.

52. *Vision*

*Vision* is the ability to perceive, through mental acuteness or keen foresight, a condition or environment not actually visible.

APPENDIX B:

PROJECT MANAGEMENT SEMINAR TRAINING EXERCISE FORMS

Your alias: \_\_\_\_\_

### SECTION 1: BACKGROUND & EXPERIENCE

1. What is your gender?     Male     Female
  
  2. How would you define the culture in which you were raised?  
 North American             African             Asian             Western European  
 Eastern European             Hispanic             Mediterranean  
 Other, please specify \_\_\_\_\_
  
  3. What is the highest degree or level of school you have completed?  
 High school graduate/GED             Associate degree             Bachelor's degree  
 Master's degree             Professional degree (ex: MD, JD)  
 Doctorate degree (ex: PhD, EdD)
  
  4. What is your experience prior to becoming a PM (mark all that apply)?  
 Designer/Engineer/Architect     Accounting/Finance     Project Controls     Procurement  
 Construction Management     Contracts/Legal     QA/QC     Safety  
 Other, please specify \_\_\_\_\_
  
  5. How many total years of EPC Industry experience do you have?  
 0 – 5 years     6 – 10 years     11 – 15 years     16 – 20 years  
 21 – 25 years     25 – 30 years     31 – 35 years     36 years or more, please specify \_\_\_\_\_
  
  6. How many years have you worked as a Project Manager?  
 0 – 5 years     6 – 10 years     11 – 15 years     16 – 20 years  
 21 – 25 years     26 years or more, please specify \_\_\_\_\_
  
  7. How many projects have you led as Project Manager during your career?  
 0 – 5     6 – 10     11 – 15     16 – 20     21 – 25  
 26 or more, please specify \_\_\_\_\_
  
  8. The role of the organization you work for is:     Owner     Contractor     Both
  
  9. The organization you currently work for is in which of the following:  
 Public sector (federal, state, or local/municipal government)  
 Private (for profit) sector
  
  10. As a Project Manager, where are the projects you have worked located? (mark all that apply)  
 Domestic United States     Canada     Latin America/South America  
 Caribbean Islands     Africa     Europe  
 Middle East     Asia/Australia     Arctic/Antarctic
  
  11. As a Project Manager, what industries have your projects represented? (mark all that apply)  
 Building     Energy     Refining     Chemicals & Pharmaceuticals  
 Manufacturing     Water & Sewer     Transportation     Hazardous Waste  
 Power     Telecommunications     Other, please specify \_\_\_\_\_
- How many more years do you plan to work before retiring? \_\_\_\_\_ years

Figure B.1(a). PM Experience Form (Page 1 of 2)

Your alias: \_\_\_\_\_

**SECTION 2: CURRENT/MOST RECENT PROJECT EXPERIENCE**

1. How many projects do you currently manage simultaneously?  
 1       more than 1, please specify \_\_\_\_\_
  
2. What is the scope of your most recent project or current project(s)?  
 Engineering only                       Engineering and Procurement                       EPC  
 EPC, Commissioning, & Start-up       Maintenance only                       O&M  
 Other, please specify \_\_\_\_\_
  
3. What is the type of contract on your most recent or current project(s)?  
 Cost reimbursable                       Lump sum                       Guaranteed maximum  
 Cost plus fixed fee                       Other, please specify \_\_\_\_\_
  
4. Where is your most recent or current project(s) located?  
 Domestic United States                       Canada                       Latin America/South America  
 Caribbean Islands                       Africa                       Europe  
 Middle East                       Asia/Australia                       Arctic/Antarctic
  
5. Your most recent or current project is for the benefit of the:  
 Public sector (federal, state, or local/municipal government)  
 Private (for profit) sector
  
6. Does your most recent or current project involve multiple engineering office locations?  
 No                       Yes, please specify the number of offices \_\_\_\_\_
  
7. Does your most recent or current project(s) involve offsite prefabrication?       Yes       No
  
8. What is the planned duration of your most recent project or current project? (If you manage multiple projects, what is the average/typical duration of a project?)  
 0 – 6 months                       7 – 12 months                       1 year                       2 years                       3 years  
 more than 3 years, please specify \_\_\_\_\_
  
9. How many employees does your organization have on your most recent or current project? (If you manage multiple projects, what is the sum total of persons employed on all?)  
 0 – 10                       10 – 20                       20 – 50                       50 – 100  
 100 – 500, please specify \_\_\_\_\_                       500 or more, please specify \_\_\_\_\_
  
10. What is the size (Total Installed Cost-US\$) of your contract scope for your most recent project or current project? (If you manage multiple projects, what is the sum total of all of your projects?)  
 \$0 - \$50,000                       \$50,000 - \$100,000                       \$100,000 - \$500,000  
 \$500,000 - \$1M                       \$1M - \$5M                       \$5M - \$10M                       \$10M - \$50M  
 \$50M - \$100M                       \$100M - \$500M                       \$500M - \$1Billion                       more than \$1Billion
  
11. Do you have other responsibilities concurrent to your PM role?  
 No                       Yes, please specify your additional responsibilities \_\_\_\_\_
  
12. How many (average) hours do you work per week? \_\_\_\_\_ hours

Figure B.1(b). PM Experience Form (Page 2 of 2)

4♣	Reward the individual putting in the most hours in order to inspire others.
3♦	Perform an analysis of individual employees' strengths and weaknesses and realign jobs within teams to match employee skill levels and job difficulty.
4♦	Give complete reasoning for all directions.
10♠	Review scope, identify all the work required to complete the project successfully, and implement.
3♥	Identify and meet with all internal and external stakeholders, evaluate the status of the relationships, and analyze the relationships to see how you can change your behavior.
K♣	Focus on the details and personally help with administrative duties to catch up.
9♠	Identify and define the problem; combine, unify and coordinate the various processes and project activities necessary to solve it.
J♣	Hire extra office support staff to deal and help sort through all the documentation, keep records.
8♥	Don't kill the messenger; ask for honest and frequent feedback.
2♥	Focus efforts on a few "trusted relationships" to mend the relationship problems occurring.
5♦	Insure that the demands for information are passed in simple and non-technical terms.
6♠	Identify problems; set clear and achievable objectives.
5♥	Listen to the stakeholders and acknowledge their problems even if they are not yours.
2♦	Look for controls, rules, and procedures to abolish.
A♣	Bring on board a third party "specialty company" for inspection service to control quality issues.
4♥	Get out on the project, tell them they are doing a good job, and pat them on the back.
9♥	Use participative decision-making processes and share the decision making with subordinates.

Figure B.2(a). PM Deck of Magic Action Cards (page 1 of 3)

9♣	Seek to become an expert of the technical aspects of the project.
3♣	Fire the worst performing staff person and replace with a fresh and energetic employee.
A♥	Immediately schedule meetings with all employees to determine their views and their recommendations of the inherent problems.
K♦	Identify staff talent and reassign them to positions where they can turn the project around.
K♥	Promote ethical relations and openness.
Q♣	Increase the information flow to allow better centralization of decision making.
Q♥	Delegate as much of the work as possible to capable people under you.
K♠	Identify conflicts and conduct conflict resolution sessions knowing the PM is responsible to resolve all disputes.
9♦	Start weekly face-to-face communication with the client.
7♠	Identify the risk on the project and develop a plan to mitigate those risks.
J♥	Realign the project team to match employee skill level to job difficulty and complexity.
2♣	Review and revise the project policies and procedures, clearly stating your management objectives.
7♣	Post action items status to reveal to the team who needs help with their work.
10♥	Hire a 3rd party expert to identify the problems and to provide recommended solutions.
8♣	Suspend all vacations and place everyone on mandatory overtime (10 hours a day) until the project is back on schedule.
3♠	Use a wild card to promote someone on the project, the PM's choice.
7♥	Live by the new Golden Rule, treat people how they want to be treated.

Figure B.2(b). PM Deck of Magic Action Cards (page 2 of 3)

<b>Q♦</b>	<b>Prioritize your activities by being selective with whom you spend time.</b>
<b>8♠</b>	<b>Organize a cyclical process of Plan, Do, Check, Act, and Implement, into the project team.</b>
<b>A♠</b>	<b>Re-plan the entire project and create a new schedule.</b>
<b>4♠</b>	<b>Institute one-on-one meetings with all your subordinates.</b>
<b>A♦</b>	<b>Redefine the job positions and responsibilities.</b>
<b>6♣</b>	<b>Call a meeting to clearly lay down project objectives and let the employees know what will happen if they let you down.</b>
<b>7♦</b>	<b>Increase the rewards of the higher performers.</b>
<b>Q♠</b>	<b>Conduct an alignment meeting with all stakeholders.</b>
<b>J♠</b>	<b>Create, install, and use a performance review system.</b>
<b>6♥</b>	<b>Create a communication plan to improve the communications with all stakeholders and conduct classes in the use of cross communication awareness.</b>
<b>10♦</b>	<b>Practice complete openness by meeting with the owners' representatives and explain problem, constraints, and what to expect.</b>
<b>2♠</b>	<b>Create a bonus and rewards program with project team for on time completion.</b>
<b>J♦</b>	<b>Change the work structure to allow higher degrees of freedom to all levels of staff.</b>
<b>5♠</b>	<b>Make policies explicit, transparent, and apply them fairly across all employees.</b>
<b>10♣</b>	<b>Provide additional rules that help your staff make better decisions.</b>
<b>8♦</b>	<b>Create weekly report documentation of risks that you do not control, who caused it, and impact relating to the cost and time of project.</b>
<b>5♣</b>	<b>Set up mandatory reporting daily so the PM will have all information to discuss the specifics of the situation and be able to control upcoming events.</b>
<b>6♦</b>	<b>Create a performance measurement system with simple measurements that are directly connected to goals of the organization, hold employees accountable, and provide immediate feedback.</b>

Figure B.2(c). PM Deck of Magic Action Cards (page 3 of 3)



**Entry Level Assessment (your “new project assignment”)**

*The PM has won the lottery and resigned. You are next in the queue to take over a high-profile project. The existing team members seem to be knowledgeable about their function. This project is a great career opportunity for you.*

Mark the top 10 action cards that you will keep you successful as the Project Manager for this project on the table below. Keep this page for your records. Copy the marks you made on the table onto page 2. **Write your alias on both pages. Hand page 2 in to the Facilitator.**

Your alias Keep this page for your records

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

Figure B.3(a). PM Game Entry Level “New Project” (page 1 of 2)

**Entry Level Assessment (your “new project assignment”)**

Your alias \_\_\_\_\_

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

**Hand this page in to the Facilitator.**

Figure B.3(b). PM Game Entry Level “New Project” (page 2 of 2)

**Entry Level Assessment (the “Project from Hell”)**

*Just before the coveted project assignment is to begin, the PM of another project has had a heart attack and will not be able to return to work.*

*Your assignment has changed and you will take over the “Project from Hell” (PFH). The project is plagued with all kind of problems: morale, safety, unhappy owner, inexperienced subcontractors, government audits, scope changes, and weather.*

Read all the action cards again and mark the 10 actions that you now personally think have the potential of turning the PFH around on the table below. Keep this page for your records. Copy the marks you made on the table onto page 2. Write your alias on both pages. **Hand page 2 in to the Facilitator.**

Your alias Keep this page for your records

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

Figure B.4(a). PM Game Entry Level “Project From Hell” (page 1 of 2)

**Entry Level Assessment (the “Project from Hell”)**

Your alias \_\_\_\_\_

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

**Hand this page in to the Facilitator.**

Figure B.4(b). PM Game Entry Level “Project From Hell” (page 2 of 2)

## Hassles Exercise Team Worksheet

Team name \_\_\_\_\_

Team Members (assigned alias) Names:

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

The Team will follow this 7-Step Improvement Model and each of the PM Team Members will apply their facilitating and problem solving skills.

### 7-STEP IMPROVEMENT MODEL

Step 1 – Identify hassles and prioritize

Step 2 – “Root Cause Analysis”

Step 3 – Information needed to manage the hassle

Step 4 – Barriers preventing the problem from being solved

Step 5 – Goals for the problem solving

Step 6 – Action plan

Step 7 – Delegate implementation

Figure B.5(a). Hassles in Construction Exercise Form (page 1 of 5)

**Step 1 – Identify hassles and prioritize**

After team discussion, the Recorder will list and prioritize four (4) hassles the team members have encountered as PMs. **Team:** please share these hassles with the entire class.

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

**Step 2 – “Root Cause Analysis”**

Focusing on your assigned hassle, do a root cause analysis, and identify the real problem behind that hassle.

**Problem** \_\_\_\_\_

***5 ‘whys’ and how do you measure that?***

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Step 3 – Information needed to manage the problem**

Select the type of information needed to solve the problem.

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_

Figure B.5(b). Hassles in Construction Exercise Form (page 2 of 5)

**Step 4 – Barriers preventing the problem from being solved**

Discuss and select three (3) barriers which your team feels that will hamper solving the problem.

Barrier # \_\_\_\_\_,  
\_\_\_\_\_

Barrier # \_\_\_\_\_,  
\_\_\_\_\_

Barrier # \_\_\_\_\_,  
\_\_\_\_\_

**List of barriers:**

- |   |   |
|---|---|
| 1. Lack of available client funding                                   | 23. Not my problem  |
| 2. Problem/s has not been identified or accepted by management yet    | 24. Cross culture communication problems                                |
| 3. Lack of understanding of the need for a solution                   | 25. Not invented here syndrome  |
| 4. We have always done it this way, why change                        | 26. Lack of political capital (I already asked too many times)          |
| 5. Lack of workforce training   | 27. The problem is too difficult, so do nothing                         |
| 6. Inadequate planning  | 28. I am just sick of the hassle  |
| 7. Dictatorial management style                                       | 29. Too much happening at home (cannot concentrate)                     |
| 8. Poor time management skills, too busy                              | 30. Unmotivated partners  |
| 9. Too busy reacting to be able to plan                               | 31. I do not like you, I will not help you                              |
| 10. Little knowledge about the stakeholders that influence the system | 32. I am working by the book and lack flexibility                       |
| 11. Poor Stakeholder's relations                                      | 33. That is not ethical, I will not get involved                        |
| 12. Not understanding the return on investment                        | 34. That is not moral, I will not do it                                 |
| 13. Perceived lack of empowerment                                     | 35. The client has inexperienced staff                                  |
| 14. Lack of empowerment (forbidden to do it)                          | 36. Have never seen it before   |
| 15. Inadequate staffing   | 37. Cannot see a solution equitable to all                              |
| 16. Over staffing, wrong mix of talent                                | 38. Whatever we do – it will be detrimental to our profit and interests |
| 17. In-house knowledge gaps   | 39. "They" will shoot the messenger                                     |
| 18. Too many layers of management                                     | 40. It will make huge waves   |
| 19. Too many players to properly coordinate                           | 41. Let someone else shoulder the blame                                 |
| 20. Poor internal relationships                                       | 42. I cannot reach out to get help                                      |
| 21. Not organized effectively   | 43. Don't know who would be able to help                                |
| 22. Too many personal agendas   |   |

Figure B.5(c). Hassles in Construction Exercise Form (page 3 of 5)

**Step 5 - Goal Setting**

Create goals for data collecting and problem solving. By setting and accomplishing manageable goals, we stay motivated, engaged, and are propelled by a growing sense of confidence.

- S** Specific
- (M)** Measurable
- A** Attainable
- R** Relevant
- (T)** Time Bound

Please create one to three 'MT' goals needed to overcome the problem. The **Team** will share these goals with the entire class.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Step 6 – Prepare the planning document**

**The Planning Team’s Responsibilities are:**

- Identify the hassles
- Define the problem/s
- Describe the information to be collected
- State the desired goal/s
- Offer the solution/s
- Provide the handoff/s to the implementing action team.

**Identify and find appropriate knowledge providers to help with the problem.**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Figure B.5(d). Hassles in Construction Exercise Form (page 4 of 5)

**Step 7 – Action Plan**

**Implementation action plan and solving the problem**

The following five-step plan has been shown to work.

- 1. **Task** – Clearly define the problem in writing before charging off to look for solutions.
- 2. **Responsible Person** – Each problem needs a champion, a person in charge who is tasked to complete the AIP plan.
- 3. **Date/Deadline** – Actions seem to run on without a dead line or finish date.
- 4. **Resources** – When assigning responsibilities to people, we need to support them with funds and personnel.
- 5. **Progress Check** – Schedule periodical progress checks to ensure the action team is on schedule and has not detoured into a dead end.

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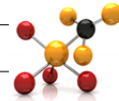
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***All done! Please make sure your aliases are on Page 1 and hand your completed Hassle Team Worksheet (one per team) in to the Facilitator.***

Figure B.5(e). Hassles in Construction Exercise Form (page 5 of 5)

Your alias:

You keep this form



## WHO'S ON YOUR MOLECULE?

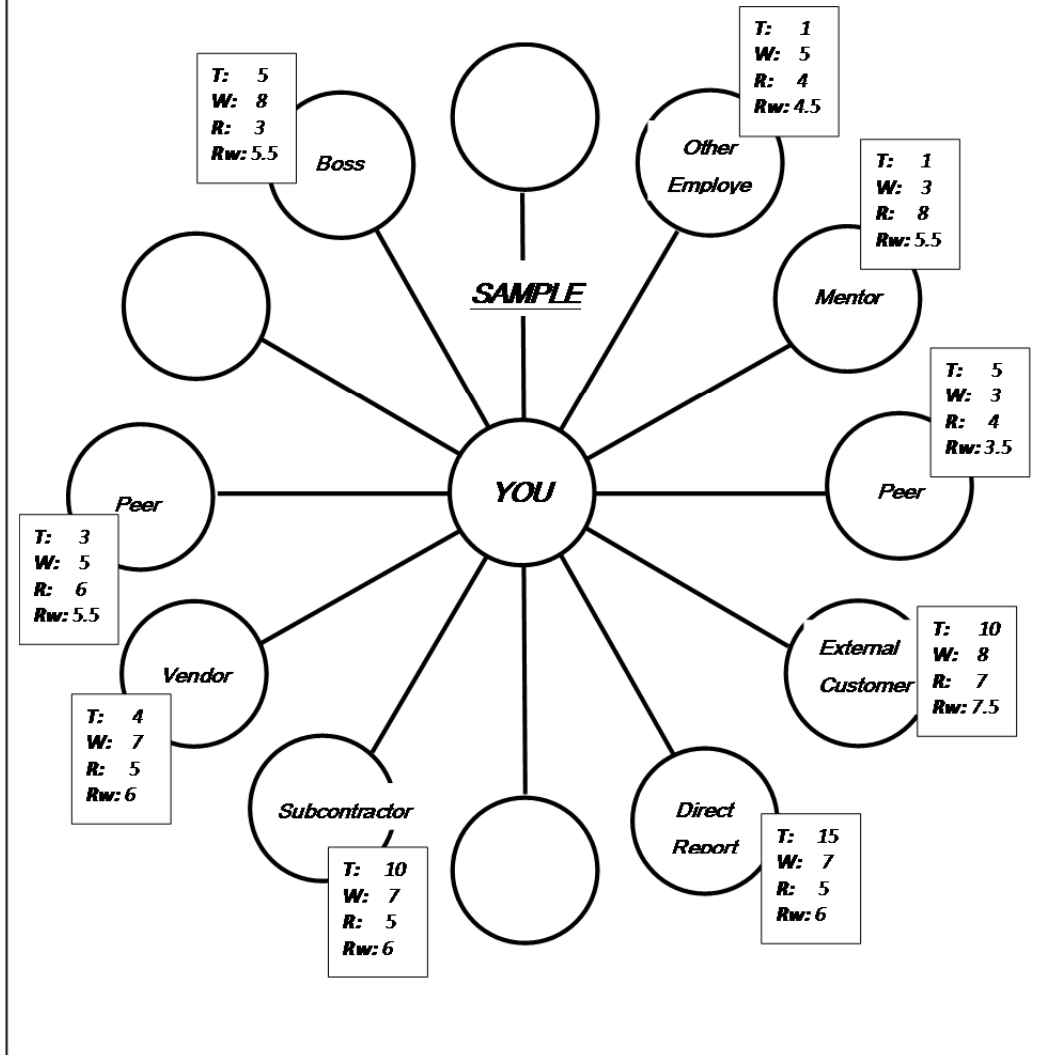
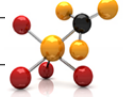


Figure B.6(a). Who's on Your Molecule? Exercise Form (page 1 of 7)



**Your alias:** You keep this form 

**SAMPLE  
WHO'S ON YOUR MOLECULE?  
DATA SHEET**

DETACH HERE ←→ DETACH HERE

<i>For your records</i>		<i>Hand in to the Trainer</i>						
	NAME	A CATEGORY	INTERNAL	EXTERNAL	B TIME	C WEIGHT	D R-SCORE	F R <sub>w</sub>
1	Bill	Boss	✓		5	8	3	5.5
2	Fred	Mentor	✓		1	3	8	5.5
3	Sue	Peer	✓		5	3	4	3.5
4	Megan	Ext. customer		✓	10	8	7	7.5
5	John	Direct report	✓		15	7	5	6
6	George	Vendor		✓	4	7	5	6
7	Mark	Subcontractor		✓	10	7	5	6
8	Stan	Peer	✓		3	5	6	5.5
9	Charlie	Other employee	✓		1	5	4	4.5
10								
<b>SUM:</b>						47		$R_w = (C+D)/2$

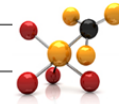
**Calculate  $R_{avg} = 5.2$**   
*R<sub>avg</sub> = Sum of R-Scores / Total number of Stakeholders = 47 / 9 = 5.2*

You keep this side of the page ←→ Detach and hand this page in to the Trainer.

Figure B.6(b). Who's on Your Molecule? Exercise Form (page 2 of 7)

Your alias:

You keep this form



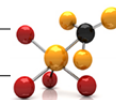
## WHO'S ON YOUR MOLECULE? DATA SHEET INSTRUCTIONS

<b>Step</b>		<b>Action</b>
<b>1</b>	<b>WHO</b> Column A	<b>Identify your stakeholders by name (first names only are fine), and category.</b> <b>CATEGORIES:</b> Boss Internal Customer Mentor External Customer Peer Vendor Direct report Thought Provider Other employee Others (please be specific)
<b>2</b>	<b>TIME</b> Column B	<b>Estimate the time you spend (in hours) with each stakeholder.</b>
<b>3</b>	<b>WEIGHT</b> Column C	<b>Determine the WEIGHT (importance of the relationship) with each stakeholder.</b> Using a 1 to 10 scale, determine how important each stakeholder is with 10 equaling a very important stakeholder and 1 for a less important stakeholder.
<b>4</b>	<b>R SCORE</b> Column D	<b>Evaluate the quality of the relationship.</b> Using a 1 to 10 scale, determine how good or bad the relationship is with each stakeholder, with 10 equaling a very good relationship and 1 for a very bad relationship.
<b>5</b>	<b>SUMs</b>	<b>Total all the R scores and count the total number of stakeholders.</b>
	<b>R<sub>avg</sub></b> Column E	<b>Calculate the R average score.</b> Divide the Total R-score by the number of stakeholders.
	<b>R<sub>w</sub></b> Column F	<b>Calculate the R weighted score.</b> $R_w = \text{individual R-score plus W (weight) divided by 2 for each stakeholder. Do not average all of your } R_w \text{ scores.}$
<b>6</b>	<b>Evaluation</b>	<b>Complete the Evaluation Form.</b>

Figure B.6(c). Who's on Your Molecule? Exercise Form (page 3 of 7)

Your alias:

*You keep this form*



## ***WHO'S ON YOUR MOLECULE?***

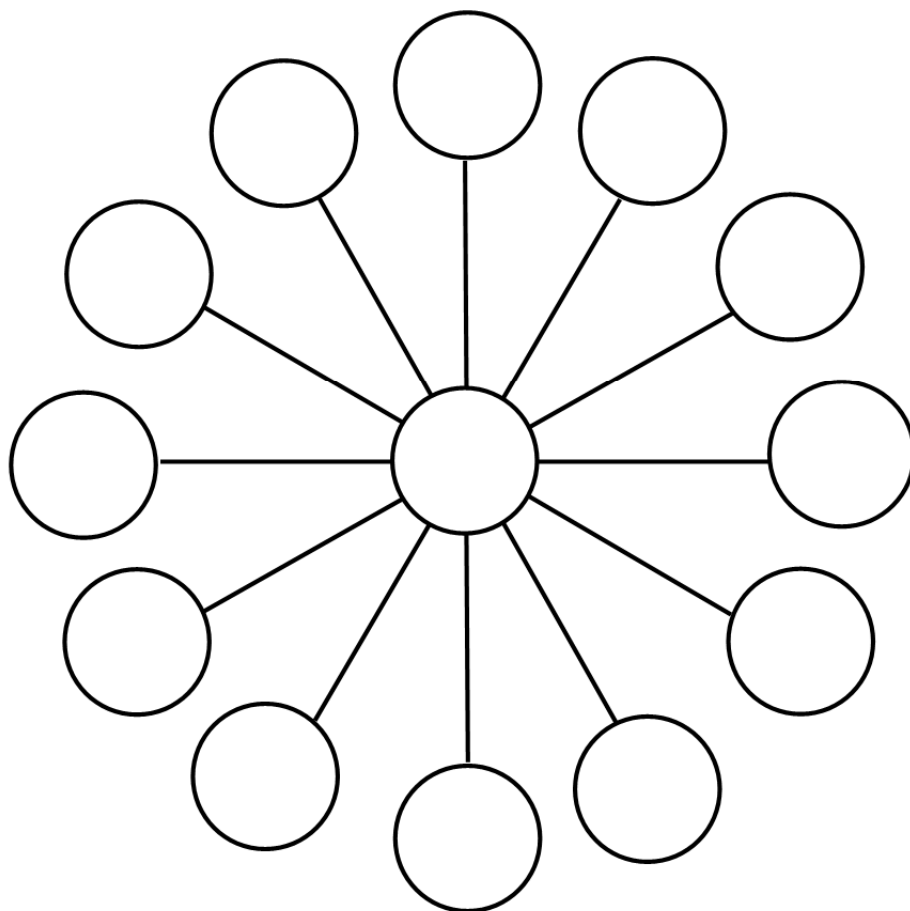
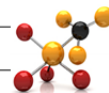


Figure B.6(d). Who's on Your Molecule? Exercise Form (page 4 of 7)

Your alias:

Hand this form in to the Trainer.



### WHO'S ON YOUR MOLECULE? DATA SHEET

DETACH HERE		DETACH HERE						
For your records		Hand in to the Trainer						
	NAME	A CATEGORY	INTERNAL	EXTERNAL	B	C	D	F
					TIME	WEIGHT	R-SCORE	R <sub>w</sub>
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
<b>SUM:</b>							$R_w = (C+D)/2$	

Calculate  $R_{avg} =$  \_\_\_\_\_


$R_{avg} = \text{Sum of R-Scores} / \text{Total number of Stakeholders} = 47/9 = 5.2$

You keep this side.

Detach and hand this page in to the Trainer.

Figure B.6(e). Who's on Your Molecule? Exercise Form (page 5 of 7)

**Your alias:** You keep this form



**WHO'S ON YOUR MOLECULE?**  
Evaluation Form

\_\_\_\_\_ **Overall  $R_{avg}$  score?**  
 \_\_\_\_\_ **How many stakeholders did you have?**

**What is your highest R-score & stakeholder? Why is it the highest?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is your highest  $R_w$  score & stakeholder? Why is it the highest?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is your highest Weight & stakeholder? Why is it the highest?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is your highest Time Stakeholder? Why is it the highest?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is your lowest R-scores & Stakeholder? Why is it the lowest?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is your lowest  $R_w$  score & stakeholder? Why is it the lowest?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is your lowest Weight scores & stakeholder? Why is it the lowest?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is your lowest Times & Stakeholder? Why is it the lowest?**

\_\_\_\_\_

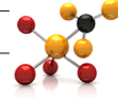
\_\_\_\_\_

\_\_\_\_\_

Figure B.6(f). Who's on Your Molecule? Exercise Form (page 6 of 7)

Your alias: \_\_\_\_\_

*Hand this form in to the Trainer.*



**WHO'S ON YOUR MOLECULE?**  
Reflections Form

1. How much discretionary time do you have?  
\_\_\_\_\_ hours per week
2. How much institutionally imposed time must you deal with each week?  
\_\_\_\_\_ hours per week
3. How much time do spend each week working on the computer (excluding emails)?  
\_\_\_\_\_ hours per week
4. How much time do you spend each week answering emails?  
\_\_\_\_\_ hours per week
5. How much time do you spend each week dealing with technical questions on your project?  
\_\_\_\_\_ hours per week

***Looking ahead 10 years:***

6. How many stakeholders do you think that the person in your [PM] position will have?  
\_\_\_\_\_ stakeholders

7. What skills will be needed to build positive relationships?

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Figure B.6(g). Who's on Your Molecule? Exercise Form (page 7 of 7)

**Your Team is the new PM on the "Project from Hell."**

*Turn this page in*

Your Team Name \_\_\_\_\_

- Team members' aliases:
- 1) \_\_\_\_\_
  - 2) \_\_\_\_\_
  - 3) \_\_\_\_\_
  - 4) \_\_\_\_\_
  - 5) \_\_\_\_\_

**Team Instructions and Scorecard**

*This document will be turned in to the Facilitator at the end of the game. Please keep your separate notes.*

**Start the Game**

1. Use **one** deck of "52 PM Magic Action Cards" without the Jokers.
2. Distribute all the Magic Action Cards among the Players.  
(13 action cards per player for team of 4)
3. Each player reads and becomes familiar with his / her hand of 13 Action Cards.

**Round One**

4. Each Player takes turns in proposing and advocating an action card.
5. The teams will discuss each proposed action card, **agree on the top 10**, and mark them on the table below.

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

6. These ten cards become the team's hand.

Figure B.7(a). PM Game Team Play Form (page 1 of 5)

### Round Two

The team will now rank the top 10 cards in order of their effectiveness using the Table below. (1 through 10 with #1 being the most effective).

*Turn this page in*

	SUIT				How it improves the project
	♣	♦	♥	♠	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11	Wild Card (Joker 😊)				

Figure B.7(b). PM Game Team Play Form (page 2 of 5)



**Round Three**

Predict how each card will improve the PFH.

*Turn this page in*

**Round Four**

Your team will draft (write) a new Wild Card (Joker) that team members will prepare based on their own professional experience.

**Round Five**

Please profile the team’s hand and describe your team’s leadership management style in a three or four word statement. This is your team’s motto.

**Example: Identify – Plan - Implement & Measure. (IPIM)**

**Your Team Motto is** \_\_\_\_\_

**Round Six**

Each team will select two wisdoms (lessons learned) from playing the PFH Magic Action Card Game.

1. \_\_\_\_\_

2. \_\_\_\_\_

**Round Seven**

Each team will share the following with the group:

- 1. What is your top card and how will it improve the project?
- 2. What is your wild card?
- 3. What is your Team Motto?
- 4. What are the 2 lessons learned from playing the PFH Game?

Figure B.7(c). PM Game Team Play Form (page 3 of 5)

## Round Eight

*Turn this page in*

Please discuss within your team and take notes:

1. What is the most significant change you have experienced in your PM activities over the past 10 years?

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2. What do you anticipate will be the most significant change in your PM activities 10 years from now?

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3. In the opinion of your team, what are the top 10 actions one needs to take to become more competitive as a PM in the future? (You may select from the list below or add additional actions)

1. Use Humor
2. Respect all people
3. Set realistic goals
4. Have fun
5. Be the Captain of your own ship
6. Delegate
7. Always have a plan B
8. Start Assignments early
9. Always arrive early (Lombardi Time)
10. Stay physically fit
11. Prior preparation is the key to success
12. Be humble
13. Plan your day
14. Control your ego
15. Defeat procrastination
16. Appreciate the fact that there are no short-cuts to success
17. Become a subject matter expert
18. Do an outstanding job plus one more thing
19. Dress for the job you want...not the job you have

Figure B.7(d). PM Game Team Play Form (page 4 of 5)

20. Be an inspiration to others
21. Understand we live and work in a fishbowl
22. Embrace moderation in all things
23. Know who's on your molecule (your relationships)
24. Always have someone in charge
25. Read quality books
26. Do it right the 1st time
27. Early to bed, early to rise
28. Know your audience
29. Never let the fear of failure stop you
30. Be accountable for your own action/inaction
31. Always raise the bar for yourself
32. Surround yourself with talented people
33. Prioritize
34. Seek opportunities to grow
35. Make tasks seem effortless
36. Learn to separate your business life from your personal life
37. Stay true to yourself
38. When speaking to others, give your full attention
39. Be efficient at work
40. Make your conversations interesting to others
41. Don't overreact
42. Give 100% effort in everything you do
43. Always ask questions when you don't know the answer
44. Be patient with your co-workers
45. Actively listen to the opinion of others
46. Work on your public communication daily
47. Be friendly to all those around
48. Embrace your support group
49. Continuing education
50. Know your boss
51. Fight Complacency

*Turn this page in*

Please add your own favorite if not on this list

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***All done!***

***Please make sure your aliases are on Page 1 and hand your completed PFH Team Scorecard (one per team) in to the Facilitator.***

Figure B.7(e). PM Game Team Play Form (page 5 of 5)

**Exit Level Assessment (the “Project from Hell”)**

*Your efforts have had a positive effect and the project has taken a turn for the better.*

Individually go through the entire deck once more and with your newly acquired insight and wisdom select 10 cards that you now believe would have been most appropriate the straighten out the project. Mark the 10 cards you selected on the table below. Keep this page for your records. **Copy the marks you made on the table onto page 2.** **Write your alias on both pages. Turn page 2 in to the Facilitator.**

Assigned alias Keep this page for your records

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

Figure B.8(a). PM Game Exit Level Selection (page 1 of 2)

**Exit Level Assessment (the “Project from Hell”)**

Assigned alias \_\_\_\_\_

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

**Hand this page in to the Facilitator.**

Figure B.8(b). PM Game Exit Level Selection (page 2 of 2)

Exit Level Assessment (“Cards we cannot use”)

Read all the action cards again and mark the actions that you now personally feel cannot be used in your company. Keep this page for your records. Copy the marks you made on the table onto page 2. **Write your alias on both pages. Hand page 2 in to the Facilitator.**

Your alias Keep this page for your records

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

Figure B.9(a). PM Game Exit Level “Cards We Cannot Use” (page 1 of 2)

Exit Level Assessment (“Cards we cannot use”)

Your alias \_\_\_\_\_

2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣	A♣
2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦	A♦
2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥	A♥
2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠	A♠

Hand this page in to the Facilitator.

Figure B.9(b). PM Game Exit Level “Cards We Cannot Use” (page 2 of 2)

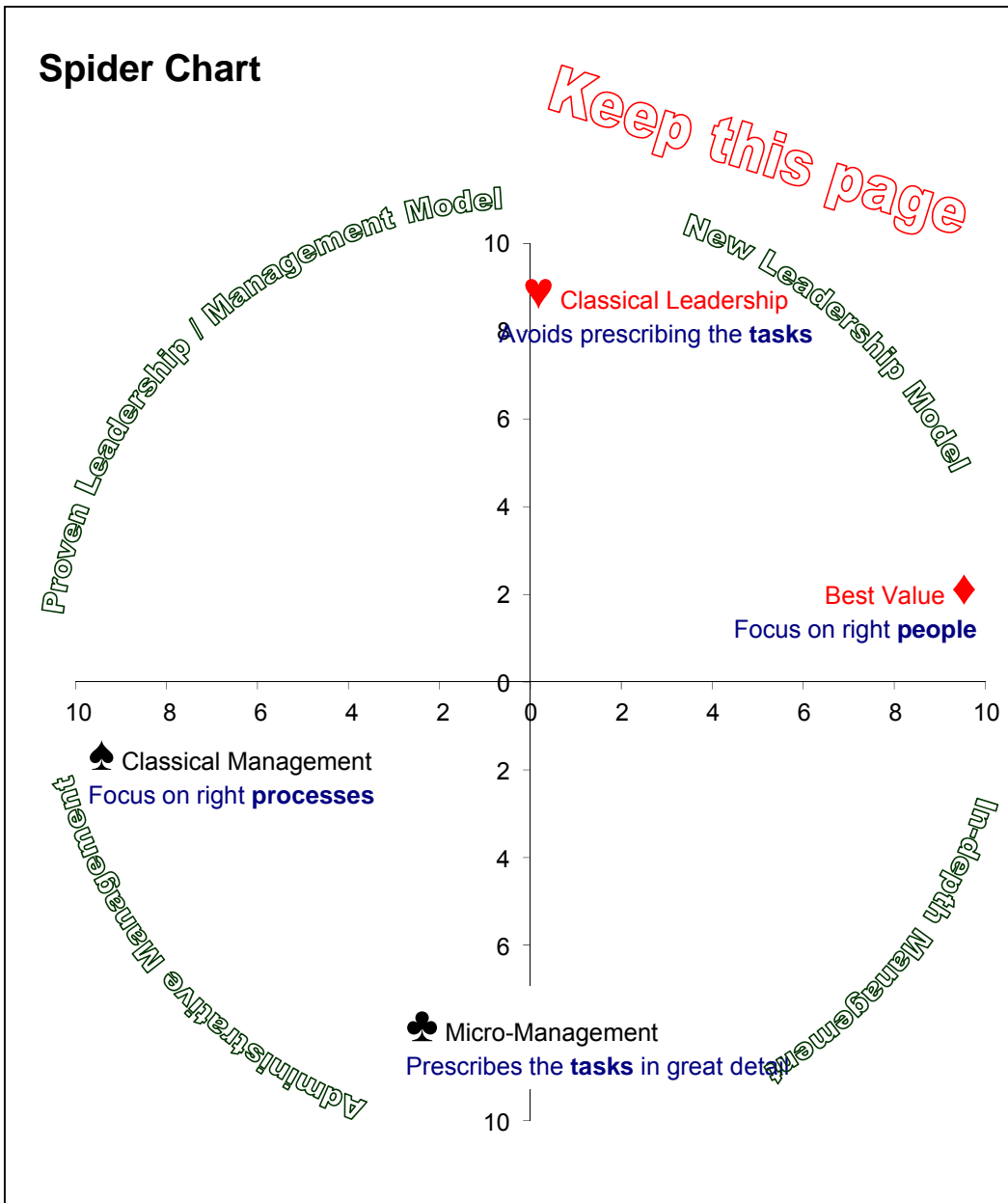


Figure B.10. PM Game Spider Chart

Your alias \_\_\_\_\_ *Keep this page for your records*

**PM Character (Attributes/Values)**

**INSTRUCTIONS:**

Select and mark with an 'X' the 5 attributes you think will become more important in hiring PMs in the future. Add attributes as needed.

Character (Attributes/Values)*	
	Accountable
	Authentic caring
	Continually learning
	Courageous
	Decisiveness
	Dedication
	Emotionally balanced
	Enthusiastic
	Fairness
	Flexibility
	Honest & trustworthy
	Humbleness
	Having initiative
	Innovative
	Integrity
	Open mindedness
	Optimism
	Perceptive/Intuitive
	Persistence
	Reflective thinking
	Resilience
	Results driven
	Self-confidence
	Sense of humor
	<i>(Add Attribute/Value)</i>
	<i>(Add Attribute/Value)</i>
	<i>(Add Attribute/Value)</i>

\* **Attributes** (fundamental qualities and characteristics) and **Values** (foundational principles and beliefs).

**What is the most important additional skill you would like to have to be competitive in the future?**

\_\_\_\_\_

Figure B.11(a). Capstone Exercise-PM Character Form (page 1 of 2)

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Your alias \_\_\_\_\_

**PM Character (Attributes/Values)**

Character (Attributes/Values)*	
	Accountable
	Authentic caring
	Continually learning
	Courageous
	Decisiveness
	Dedication
	Emotionally balanced
	Enthusiastic
	Fairness
	Flexibility
	Honest & trustworthy
	Humbleness
	Having initiative
	Innovative
	Integrity
	Open mindedness
	Optimism
	Perceptive/Intuitive
	Persistence
	Reflective thinking
	Resilience
	Results driven
	Self-confidence
	Sense of humor
	(Add Attribute/Value)
	(Add Attribute/Value)
	(Add Attribute/Value)

\* **Attributes** (fundamental qualities and characteristics) and **Values** (foundational principles and beliefs).

**What is the most important additional skill you would like to have to be competitive in the future?**

\_\_\_\_\_

Figure B.11(b). Capstone Exercise-PM Character Form (page 2 of 2)



**Your alias** Keep this page for your records

**PM Competencies, Knowledge, Skills**

1. Think of the PM competencies 10 years ago and today:
  - a. Add at least one competency that is not identified on the list below.
  - b. Select and mark with an 'X' the Top 10 Current PM Competencies.
2. Think of the PM competencies 10 years from now:
  - a. Add at least one more competency that is not identified on the list below.
  - b. Select and mark with an 'X' the Top 10 Future PM Competencies.
  - c. Circle the 'X' to indicate which of the future competencies you will start working on in the next year.

Top 10 Current	Competencies, Knowledge, Skills	Top 10 Future
	Able/willing to speak the truth to power	
	Active listening and observation skills	
	Actively participates and engages others (collaborative team player)	
	Adept at talent management	
	Champion of change	
	Contract management expertise	
	Coordination across internal and external boundaries	
	Coordination of multiple activities at multiple locations	
	Cost, planning & scheduling, and earned value analysis and trending expertise	
	Critical thinking (applies logic and other intellectual criteria like depth...)	
	Delegates and empowers others	
	Detail oriented and thorough	
	Develops plans from vision and strategic project objectives	
	Drives information integration into projects	
	Effective communication skills: oral, & written	
	Effective facilitator with story-telling ability	
	Engineering, procurement, and construction procedures/processes knowledge	
	Functions well in stressful situations	
	Knowledgeable about business/project laws, regulations, and industry standards	
	Leads by example	
	Leverages diversity (fosters inclusive workplace)	
	Maintains balanced lifestyle	
	Manages expectations and control of the group	
	Manages for profitability	
	Mentors/grows the next generation	
<i>Table continues on the next page</i>		

Figure B.12(a). Capstone Exercise-PM Competencies Form (page 1 of 4)

**Your alias** Keep this page for your records

<b>Top 10 Current</b>	<b>Competencies, Knowledge, Skills</b>	<b>Top 10 Future</b>
	Front-End Planning knowledge	
	People oriented	
	Persuasive negotiator with political and diplomatic skills	
	Possesses business acumen	
	Practices time management techniques	
	Proactive problem solver/analyzer	
	Proficiency reading/interpreting plans and specifications	
	Project systems know-how	
	Provides feedback	
	Relationship builder: promotes trusted relationships (normal and stressed environments)	
	Risk management knowledge	
	Root cause analysis know-how	
	Rules compliance	
	Safety management knowledge	
	Sets clear direction and inspires teams/others to peak performance	
	Sound decision-making judgment ("least-worst" option)	
	Supply chain management know-how	
	Thinks through situation before acting	
	Trained in conflict management/resolution skills	
	<i>(Add Skill)</i>	
	<i>(Add Skill)</i>	
	<i>(Add Skill)</i>	

Figure B.12(b). Capstone Exercise-PM Competencies Form (page 2 of 4)

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**Your alias \_\_\_\_\_**

<b>Top 10 Current</b>	<b>Competencies, Knowledge, Skills</b>	<b>Top 10 Future</b>
	Able/willing to speak the truth to power	
	Active listening and observation skills	
	Actively participates and engages others (collaborative team player)	
	Adept at talent management	
	Champion of change	
	Contract management expertise	
	Coordination across internal and external boundaries	
	Coordination of multiple activities at multiple locations	
	Cost, planning & scheduling, and earned value analysis and trending expertise	
	Critical thinking (applies logic and other intellectual criteria like depth...)	
	Delegates and empowers others	
	Detail oriented and thorough	
	Develops plans from vision and strategic project objectives	
	Drives information integration into projects	
	Effective communication skills: oral, & written	
	Effective facilitator with story-telling ability	
	Engineering, procurement, and construction procedures/processes knowledge	
	Functions well in stressful situations	
	Knowledgeable about business/project laws, regulations, and industry standards	
	Leads by example	
	Leverages diversity (fosters inclusive workplace)	
	Maintains balanced lifestyle	
	Manages expectations and control of the group	
	Manages for profitability	
	Mentors/grows the next generation	
<i>Table continues on the next page</i>		

Figure B.12(c). Capstone Exercise-PM Competencies Form (page 3 of 4)

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Your alias \_\_\_\_\_

Top 10 Current	Competencies, Knowledge, Skills	Top 10 Future
	Front-End Planning knowledge	
	People oriented	
	Persuasive negotiator with political and diplomatic skills	
	Possesses business acumen	
	Practices time management techniques	
	Proactive problem solver/analyzer	
	Proficiency reading/interpreting plans and specifications	
	Project systems know-how	
	Provides feedback	
	Relationship builder: promotes trusted relationships (normal and stressed environments)	
	Risk management knowledge	
	Root cause analysis know-how	
	Rules compliance	
	Safety management knowledge	
	Sets clear direction and inspires teams/others to peak performance	
	Sound decision-making judgment ("least-worst" option)	
	Supply chain management know-how	
	Thinks through situation before acting	
	Trained in conflict management/resolution skills	
	<i>(Add Skill)</i>	
	<i>(Add Skill)</i>	
	<i>(Add Skill)</i>	

Figure B.12(d). Capstone Exercise-PM Competencies Form (page 4 of 4)

APPENDIX C:  
OUTPUT FROM PM SEMINAR GAMES AND EXERCISES

The output from the PM seminar was captured on the exercise forms built into the games and exercises. The information collected included: professional background and recent project experience for each participant; each action card selected; the number of stakeholders; and how the PMs spend their time in a week. The variables captured for each participant are shown in figure C.1.

Game/Exercise		Variable
Experience Review	Background & Experience	Gender
		Culture where PM was raised
		Highest degree or level of school
		Discipline experience prior to becoming a PM (e.g., Design, Project Controls, etc.)
		Years of EPC Industry experience
		Years worked as a PM
		Number of projects led as a PM
		Role of current organization (e.g., owner, contractor)
		Sector of current organization (e.g., public, private)
		Location of projects led as a PM
		Industries of projects led as a PM
		Years to retirement
		Current / most recent Project Experience
	Most recent project: project scope (e.g., Engineering only, EPC, etc.)	
	Most recent project: type of contract (e.g., cost reimbursable, lump sum, etc.)	
	Most recent project: geographical region	
	Most recent project: sector (e.g., public or private)	
	Most recent project: multiple engineering office locations	
	Most recent project: offsite fabrication	
	Most recent project: duration	
	Most recent project: number of project employees	
	Most recent project: Total Installed Cost of contract scope	
	Additional responsibilities concurrent to PM role	
Average hours worked per week		
WOYM	Stakeholders	Total number of stakeholders

Game/Exercise		Variable
Exercise		Number of external stakeholders
		Number of internal stakeholders
		R <sub>average</sub> score
	PM Reflections	Hours/week of discretionary time
		Hours/week of institutionally imposed time
		Hours/week working on the computer (excluding emails)
		Hours/week answering e-mails
		Hours/week dealing with technical questions on the project
	Number of stakeholders PMs will have in 10 years	
PM Game	Entry Level Selection	Top 10 action cards to ensure success for the "new project assignment"
		Top 10 action cards to ensure success for the "Project from Hell"
	Team Play	Top 10 action cards to ensure success for the "Project from Hell"
		Most effective 'Number one' ranked card
	Exit Level Selection	Top 10 action cards to ensure success for the "Project from Hell"
Capstone Exercise	PM Character (attributes/values)	Five attributes that will become more important in hiring PMs in the future
	PM Competencies, Knowledge, Skills	Top 10 Current PM Competencies (10 years ago and today)
		Top 10 Future PM Competencies (10 years from now)

Figure C.1. Output from PM Seminar Games and Exercises

APPENDIX D:

LIST OF POST CAPSTONE COMPETENCIES



As the research process unfolded, new competencies with a future focus were identified. This listing of “post capstone” competencies was developed by C.H. Dunn, retired industry consultant for CII RT-281. The list identifies 34 future oriented skills, knowledge, and behaviors not included in the Capstone Exercise list of PM skills, knowledge, and behaviors that was used in the PM seminars. Some of these competencies are pure in their source, and the reference has been indicated with the competency. Others are blends from varied sources (e.g., dictionaries, literature search references, thought leaders, individual team members, consultants, academics, and Generation Y members). These proposed competencies are listed in alphabetical order and no effort was made to cluster them into like groupings (e.g. leadership vs. management vs. technical or thinking competencies, information overload management competencies, or communication competencies).

- Acumen

Keeness and quickness in understanding and dealing with a situation. See *Learning Agility*, *Critical Thinking*, and *Train Instincts* for complimentary terms. A 2010 FMI PM survey concluded that acumen and fluency in business and finance would be especially important.

- Adaptive Thinking

Proficiency at coming up with solutions beyond that which is rule-based. The key disruptive forces, identified by the Institute for the Future (IFTF) for the University of Phoenix Research Institute,

“Future Work Skills 2020” report, argues that future high-skill jobs will involve abstract tasks requiring an enhanced degree of situational adaptability. (Davies et al. 2011)

- Attitude

The manner of acting, feeling, or thinking that shows one’s beliefs, values or disposition; state of mind. They are judgments; generally positive or negative views of a person, or event. For a PM, who has to balance the demands of many stakeholders, attitude is the visible manner in which he or she chooses to interpret circumstances.

- Black Swan Robustness

The competency of building a robust capability for mitigating negative, or exploiting positive, BIG surprises that have major impact.

- Competent Data Interpreters

Individuals skilled in finding multiple and related data sources, and capable of deriving from them the information and knowledge necessary to their specific undertaking.

- Computational Thinking

Ability to translate vast amounts of data into abstract concepts and understand cross-data reasoning, or able to act in the absence of data and not be paralyzed when lacking an algorithm for every system.

(Davies et al. 2011)

- **Continuous Risk Monitoring**  
Ability to monitor and analyze the overall risk from a combination of PM organization knowledge plus knowledge of project awareness and supply surety. This enhances situational awareness and makes decision making faster and, where possible, more predictive/proactive. (John Voeller, report to RT-281, February 13, 2011)
- **Cognitive Surplus/Cognitive Overload**  
Excess of information that impairs the process of knowing in the broadest sense. It includes perception, memory, and judgment. It is the result of the dissemination and accessibility of large amounts of often superfluous and unreliable information through the internet. It directly relates to the need to limit data to “dominant information.” This competence is the skill to proficiently contend with this condition. The IFTF report called this Cognitive Load Management and defined it as “social filtering to discern relevant dominant information that rises above the noise.” (Davies et al. 2011)
- **Creativity**  
Describes the ability to think and act in original and imaginative ways in order to achieve project success. (Trivellas and Drimoussis 2010)
- **Critical Conversations**  
Discussions between persons when a broad number of agenda positions and interdependencies are involved, and opinions vary, and

emotion runs strong. This competence is the skill to proficiently contend with this condition.

- **Critical Thinking**  
Awareness and ability to apply logic and other intellectual criteria such as clarity, breadth, depth, accuracy, context, relevance, reflection, and significance. This requires having the correct and necessary dominant information.
- **Cross-cultural Competency**  
Ability to sense and respond to new cultural settings and seek the benefits of the diversity they offer. (Davies et al. 2011)
- **Crowdsourcing**  
Obtaining feedback from large groups through open communication.
- **Design Mindset**  
Ability to develop work processes by recognizing the kind of thinking different tasks require. (Davies et al. 2011)
- **Digital Decision-making**  
Ability to exercise judgment to effectively make “Yes/No” type decisions with the assistance of the computer.
- **Empowerment**  
Having the ability to delegate to another (or others) the responsibility for taking action and making decisions within a defined scope or area of responsibility. The implication is that the one delegated to has

earned the trust of the delegator in his or her competence and character to carry out the assigned responsibly.

- Engagement and Motivation

Project Team members reflect the personal buy-in from all individuals associated with the project. (Trivellas and Drimoussis 2010)

- Ethics

Embraces the morally accepted conduct or behavior representing personal and professional freedoms as well as boundaries. (Trivellas and Drimoussis 2010)

- Global Knowledge Networking

Ability to select, maintain, and use a high-quality personal network of knowledge providers.

- Information Literacy

The ability to find, evaluate, and use data and information effectively to make decisions and solve problems. Rather than drown in an abundance of information, it is the competency to differentiate dominant information.

- Judgment

The capacity to make sound and reasonable decisions based on one's *Character* and *Competence* when faced with multi-dimensional, complex scenarios. The “soundness” of judgment is based on a moment in time and the information available at that moment. It is

rarely flawless as later events and circumstances reveal new information and conditions change.

- Learning Agility

The ability to learn from experience, and subsequently apply that learning to perform successfully under new or first time conditions.

Highly learning agile individuals learn the right lessons from experience and apply that learning to new situations. It is an important element of potential. Research indicates that those individuals with greater learning agility are significantly more successful after they are promoted than others are. Acumen and trained instincts are complimentary competencies.

- New Media Literacy

Ability to critically assess content that uses new media forms, which visually stimulate and persuade and leverage the content in persuasive communication. These are tools that break away from the static slide approach of programs such as *Power Point*. In short, the ability to “Read” non-verbal cues from enhanced visual capabilities where depth of field and other features provide almost a sense of face-to-face interaction. An example of this capability is the VLOG (Video blogging, a form of Web television), on-line “collaboratory” of mind-expanding technology in Howard Rheingold’s Social Media Classroom. (Davies et al. 2011)

- **Openness**

Refers to the cultivation of an open climate among individual so as to benefit from their input, suggestions, worries and concerns, avoiding discrimination on the grounds of age, gender, sexual orientation, religion, cultural differences or disability. (Trivellas and Drimoussis 2010)
- **Project Awareness**

Ability to acquire and analyze summary knowledge from all contractors and sub-contractors, using automated neutral information passage from their individual systems in native form, without any conditioning. (John Voeller, report to RT-281, February 13, 2011)
- **Reliability**

Reflects the ability to meet time and quality projects' specifications. (Trivellas and Drimoussis 2010)
- **Resource Finder**

Ability to find and acquire specialty personnel, equipment, and services anywhere in the world, and anticipate their need before these resources become an issue. (John Voeller, report to RT-281, February 13, 2011)
- **Sense-Making**

Ability to determine the deeper meaning or significance of what is being experienced; unique insights critical to good decision-making. (Davies et al. 2011)

- Social Intelligence

Ability to connect to others in a deep and direct way to sense and stimulate reactions and desired interactions. Feeling is just as complicated as sense-making. The emotional and social robots we are creating are not feeling machines. Socially intelligent leaders are able to quickly assess the emotions of those around them and adapt their words, tone, and gestures, accordingly, in order to build relationships of trust with larger groups of people, of varied cultures and generations, in diverse settings. (Davies et al. 2011)

- Supply Surety

Ability to monitor suppliers and vendors, not in terms of project buys but rather in terms of material resource, financial, transportation, human resource, and corporate condition disruptions in the supplier/vendor organizations and their competitors, which could prevent meeting contractual demands. (John Voeller, report to RT-281, February 13, 2011)

- “T-Shaped” Transdisciplinarity

Literacy in, and ability to understand, concepts across multiple disciplines. The “T-shape” represents a deep expertise in at least one-field with a capacity to converse in the language of a broader range of disciplines over multiple careers - enabled by longer lifespans. (Davies et al. 2011)



- Train “Instincts”

While the common definition of instinct is an unlearned impulsive behavior, the capacity to respond spontaneously and appropriately under extreme duress can be learned. How a PM (or leader) learns to respond in “moments of truth” reveals true values, character, and competence. Instinctual behavioral shortcuts that produce an appropriate response with minimal conscious thought is a skill that can be learned. Acumen and Learned Agility are complementary competencies.

- Values Appreciation

Is based on mutual respect and on the receptiveness of others’ opinions, value judgments and ethical standards. (Trivellas and Drimoussis 2010)

- Virtual Collaboration

Ability to drive engagement and lead as a member of a virtual team. (Davies et al. 2011)

APPENDIX E:

LIST OF "WRITE-IN" FUTURE COMPETENCIES

In the Capstone Exercise, PM seminar participants could also write-in their own suggestions to be included on the lists. The write-in competencies were summarized, combining the duplicate entries (e.g. multi-lingual, speaks more than one language, etc.) and eliminating the duplicates that are included on the exercise's list of forty-four competencies---resulting in fifty-seven additional competencies for consideration by research team members.

1. Ability to adapt to customer's needs.
2. Ability to analyze people.
3. Ability to compensate for lack of expertise of others.
4. Ability to deal with complexity.
5. Ability to work with subcontract/contractors.
6. Able to assess facilities and forecast capital needs.
7. Able to train others.
8. Acknowledges and celebrates success.
9. Admits when wrong.
10. Applies technical knowledge to project management.
11. Approachable character.
12. Awareness/understanding of lean manufacturing and six sigma tools.
13. Balance between leadership and management.
14. Balance between patience and action.
15. Be able to communicate among multiple generations.
16. Be true to yourself.
17. Become PMP certified.

18. Cast vision.
19. Clearly understands objectives from client perspective, and communicates those to the project team.
20. Disciplined agility.
21. Emotional intelligence.
22. Emotionally intelligent.
23. Even tempered-not emotional/moody.
24. Experience.
25. Expertise @ time management.
26. Formal project management education.
27. Global execution expertise.
28. Good attitude.
29. Integration of lessons learned to PMO.
30. International business.
31. IP Protection knowledge.
32. Knowledge of clients' business practices.
33. Knowledge of latest information technology and how to use it in project process.
34. Knowledge of ROI/cashflow.
35. Knows management tools available.
36. Knows their limits.
37. Leadership.
38. Manage and lead multiple personalities.

39. Manage client expectations.
40. Manage perceptions.
41. Mental, physical, emotional fitness.
42. Organizational skills throughout the project.
43. Passion for producing a quality product.
44. Patience.
45. Prevent problems before they occur.
46. Proficiency in flexible design.
47. Project financial acumen.
48. Promote a winning work/life balance.
49. Recognition of success/willingness to celebrate success milestones.
50. Seeks to create an environment with no personnel turnover.
51. Sees things from others' view point.
52. Servant leadership.
53. Set key performance indicators for project.
54. Understanding organizational dynamics.
55. Understands "agile" professional management.
56. Visionary - able to see future trends.
57. Willingness to travel.

APPENDIX F:

DATA MINING TREES

# Tree 1: Gender

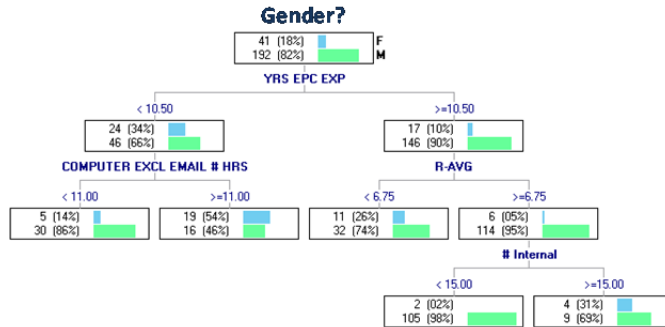


Figure F.1. Data Mining Tree #1

# Tree 1A: Computer hours excluding email

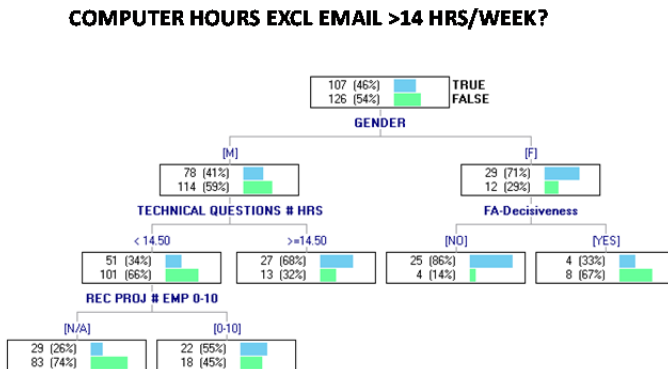


Figure F.2. Data Mining Tree #1A

## Tree 2: Bachelor Degree

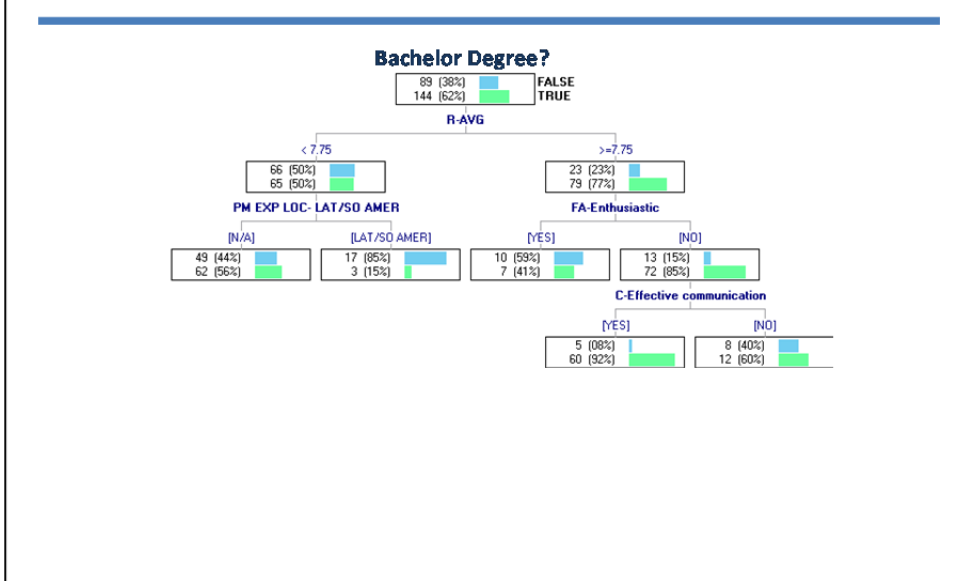


Figure F.3. Data Mining Tree #2

## Tree 3: Background-North American

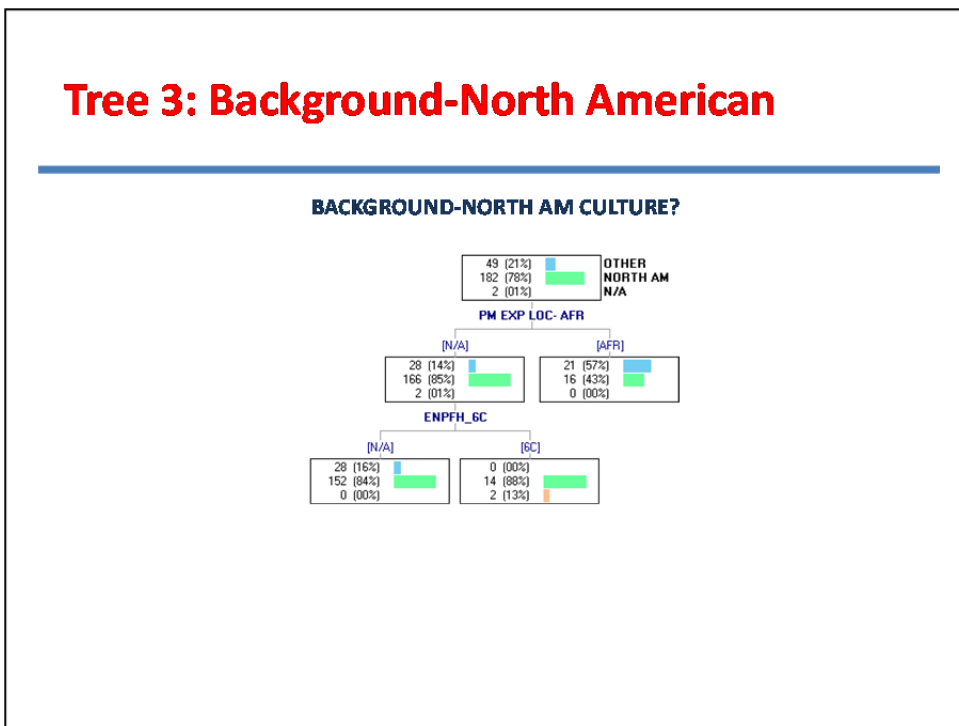


Figure F.4. Data Mining Tree #3



# Tree 4: Masters Degree

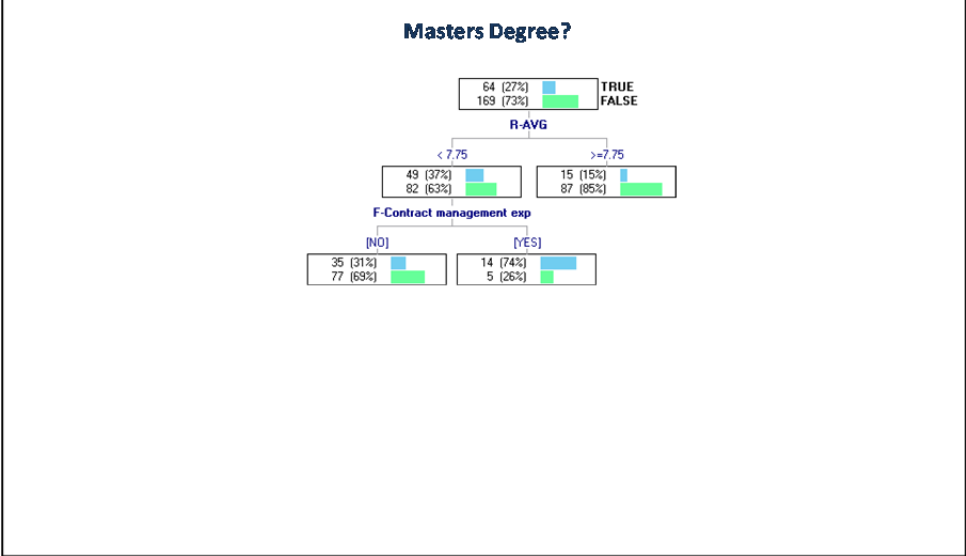


Figure F.5. Data Mining Tree #4

# Tree 5: Prior D/E/A Experience

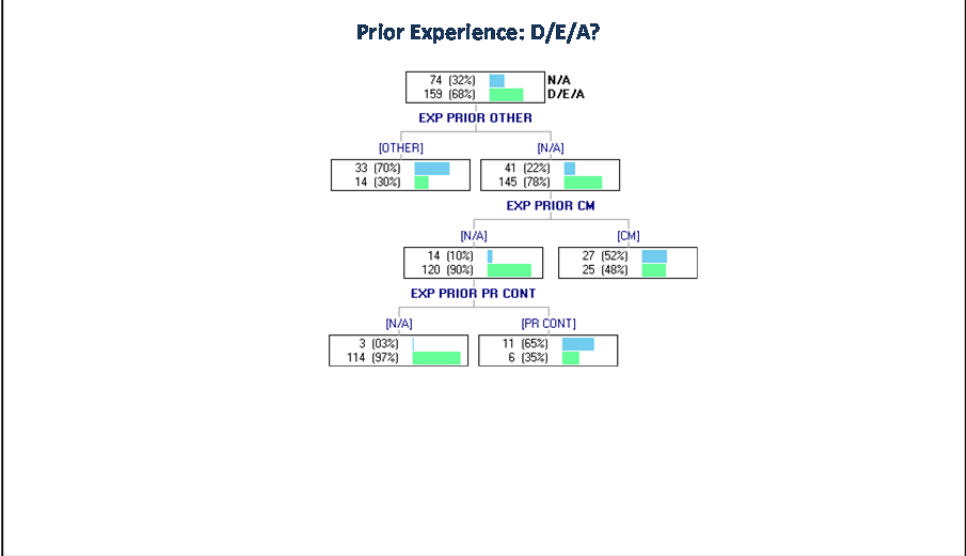


Figure F.6. Data Mining Tree #5

# Tree 6: Prior Const Mgmt Experience

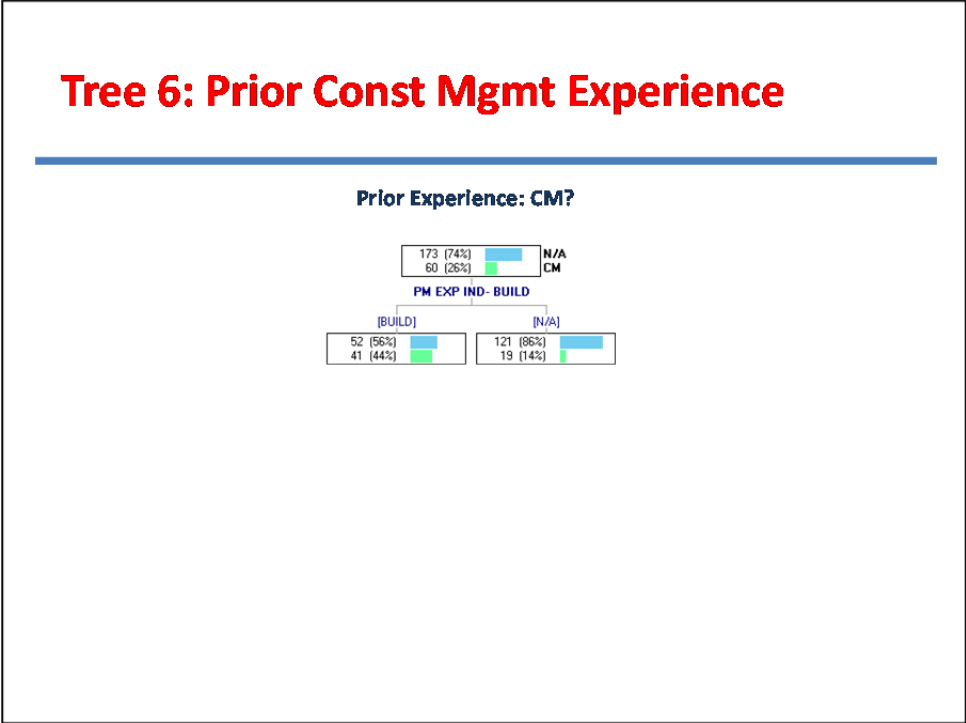


Figure F.7. Data Mining Tree #6

# Tree 7: Prior Project Controls Experience

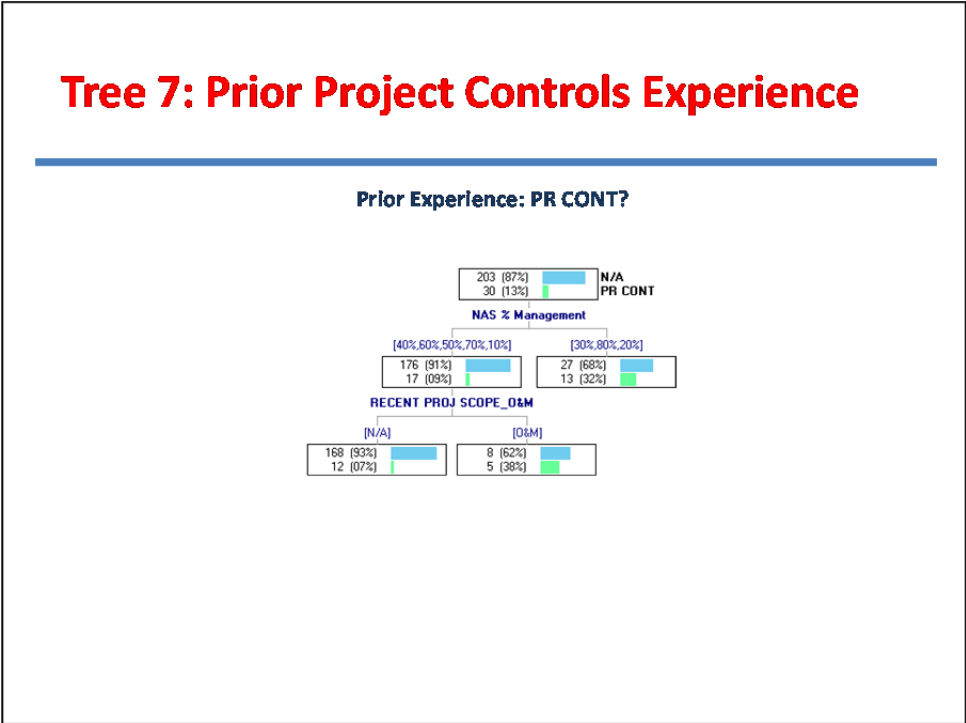


Figure F.8. Data Mining Tree #7

## Tree 8: Prior Safety Experience

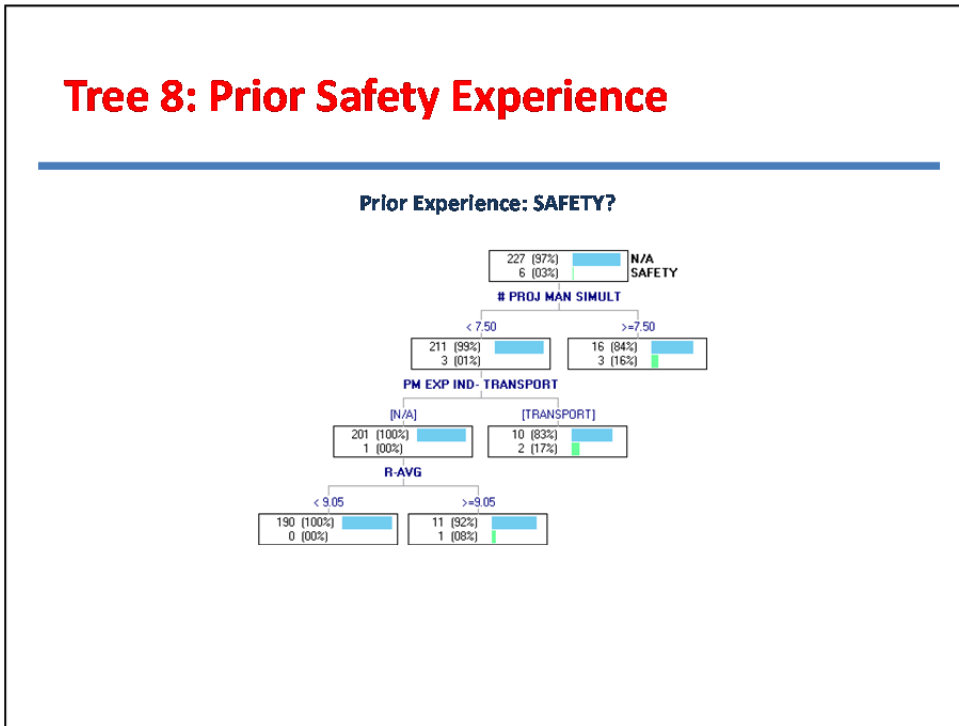


Figure F.9. Data Mining Tree #8

## Tree 9: Prior Other Experience

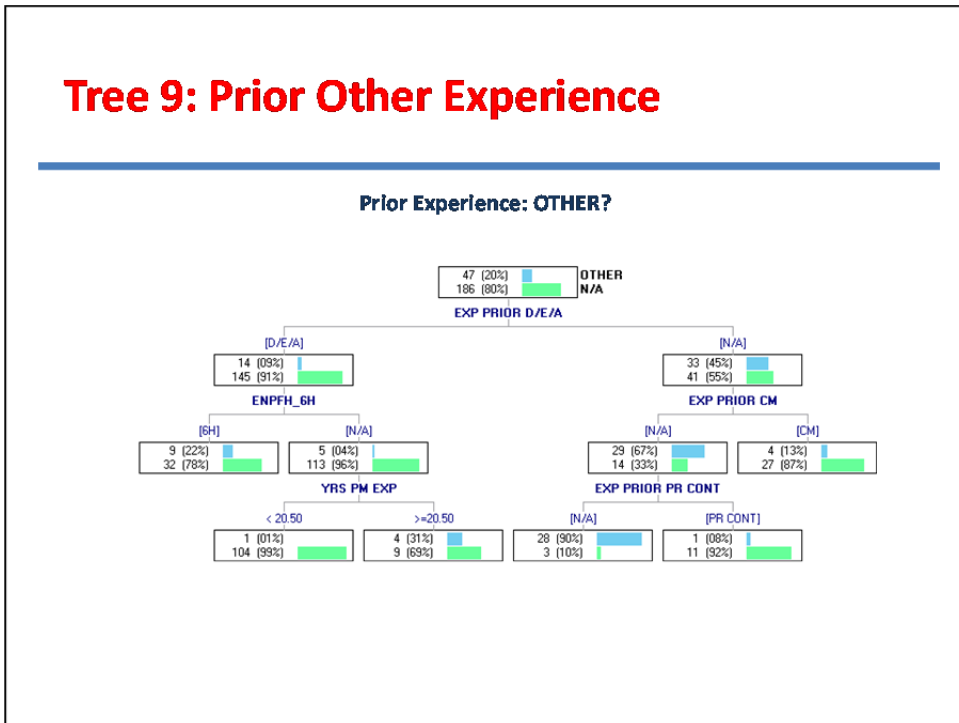


Figure F.10. Data Mining Tree #9

## Tree 10: Prior Acct/Finance Experience

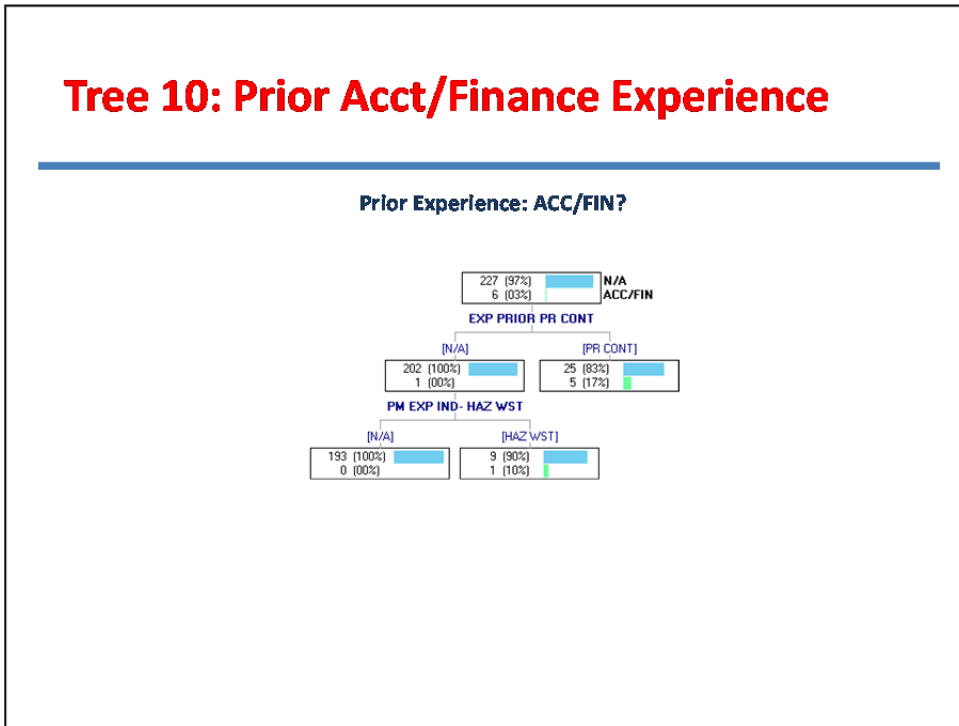


Figure F.11. Data Mining Tree #10

## Tree 11: Prior QA/QC Experience

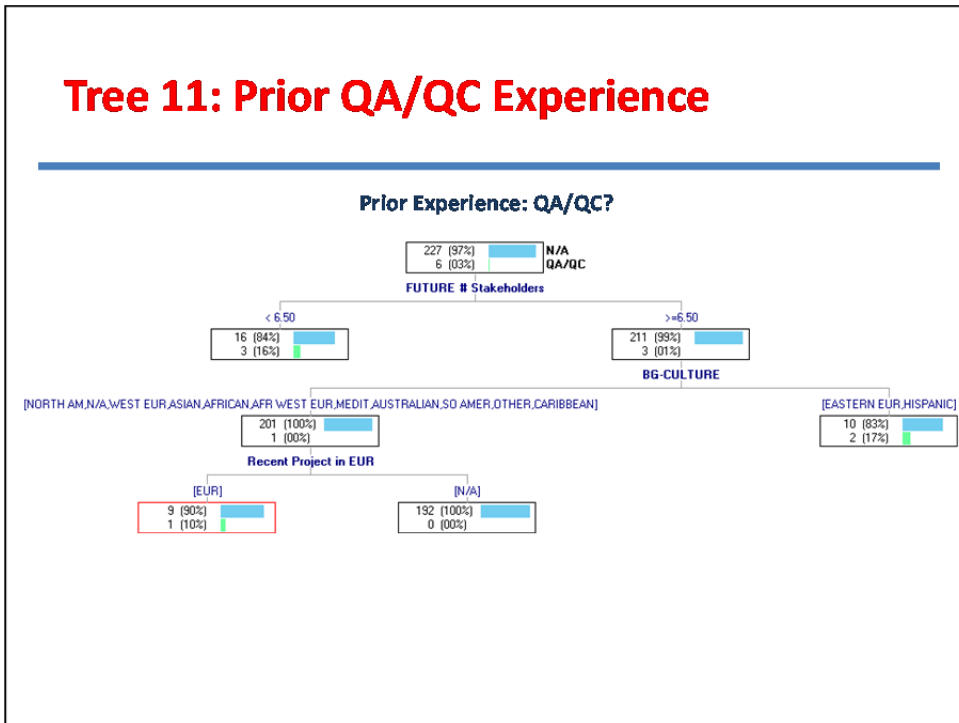


Figure F.12. Data Mining Tree #11

## Tree 12: Prior Procurement Experience

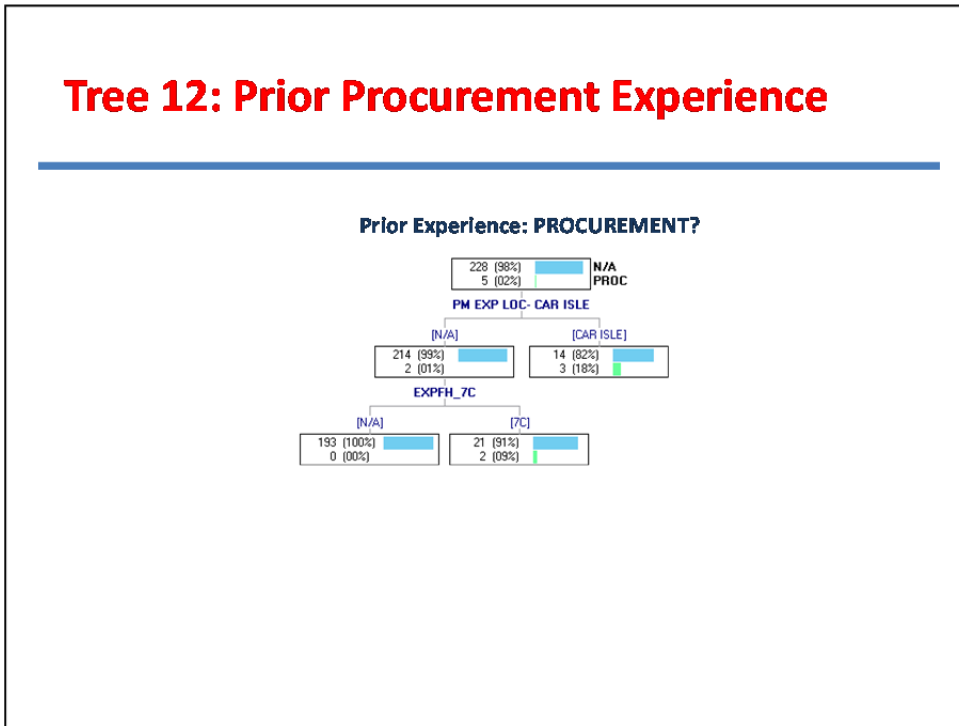


Figure F.13. Data Mining Tree #12

## Tree 13: Prior Contract/Legal Experience

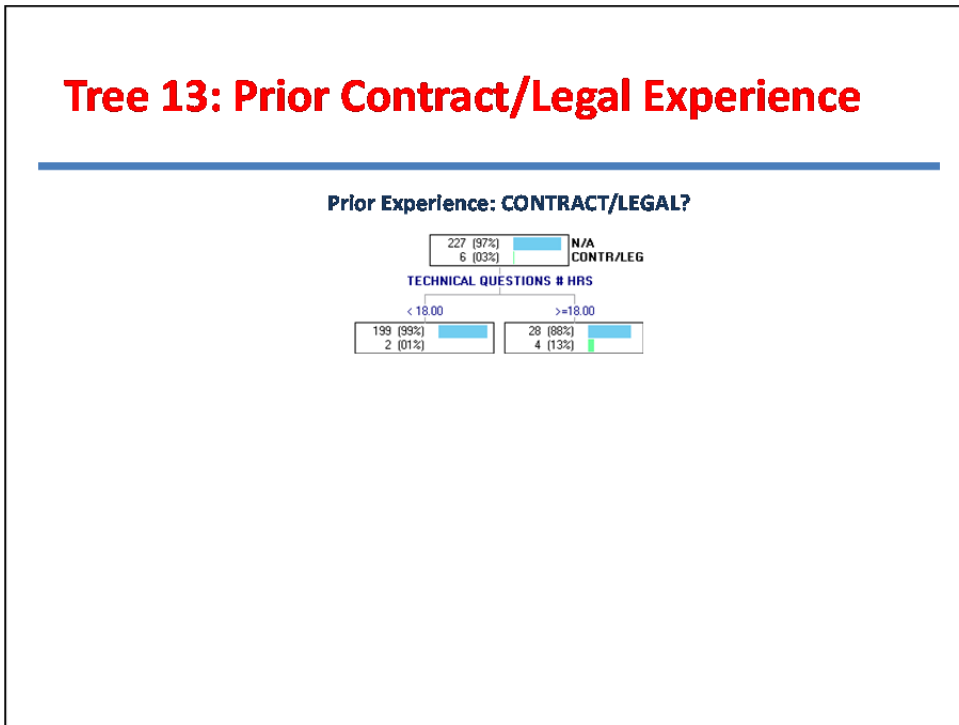


Figure F.14. Data Mining Tree #13

## Tree 14: EPC Experience >10 Years

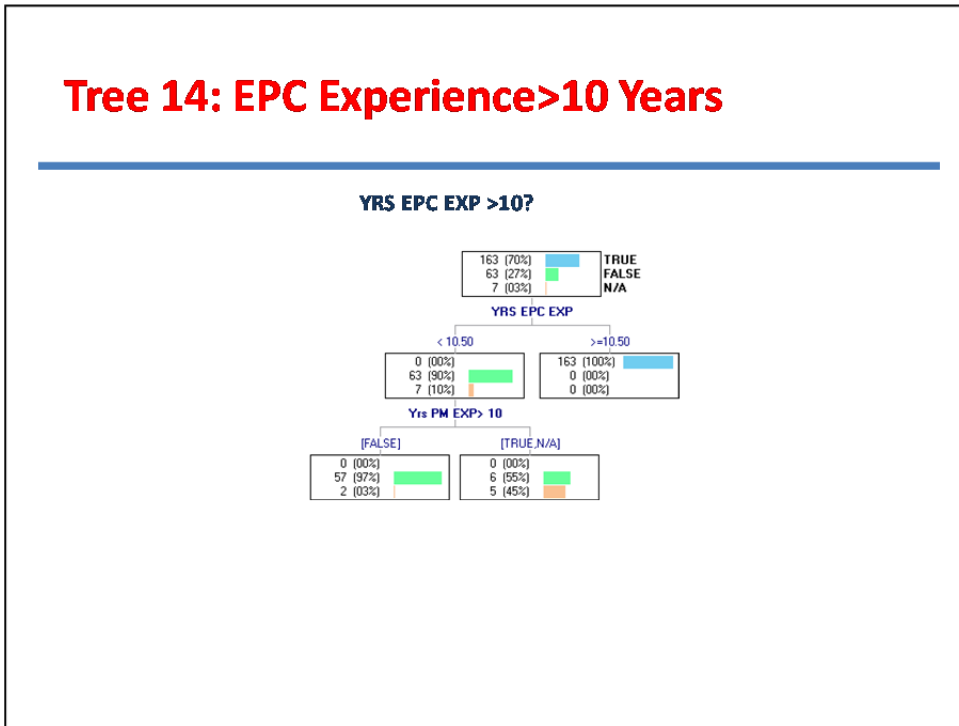


Figure F.15. Data Mining Tree #14

## Tree 15: Project Mgmt Experience >10 Years

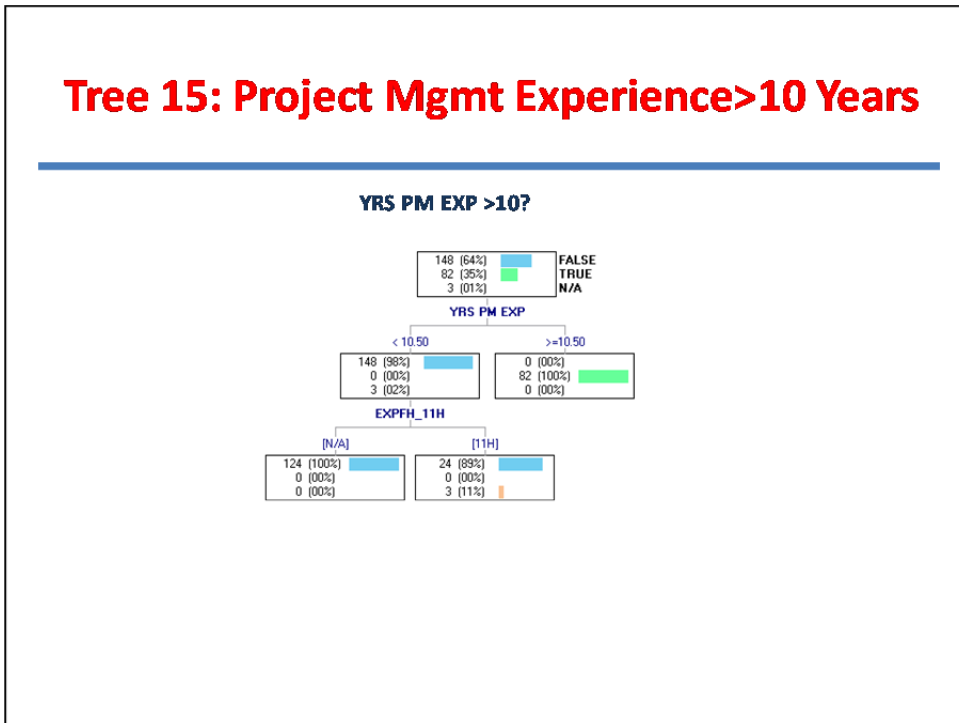


Figure F.16. Data Mining Tree #15

## Tree 16: No. Projects Led as PM > 10

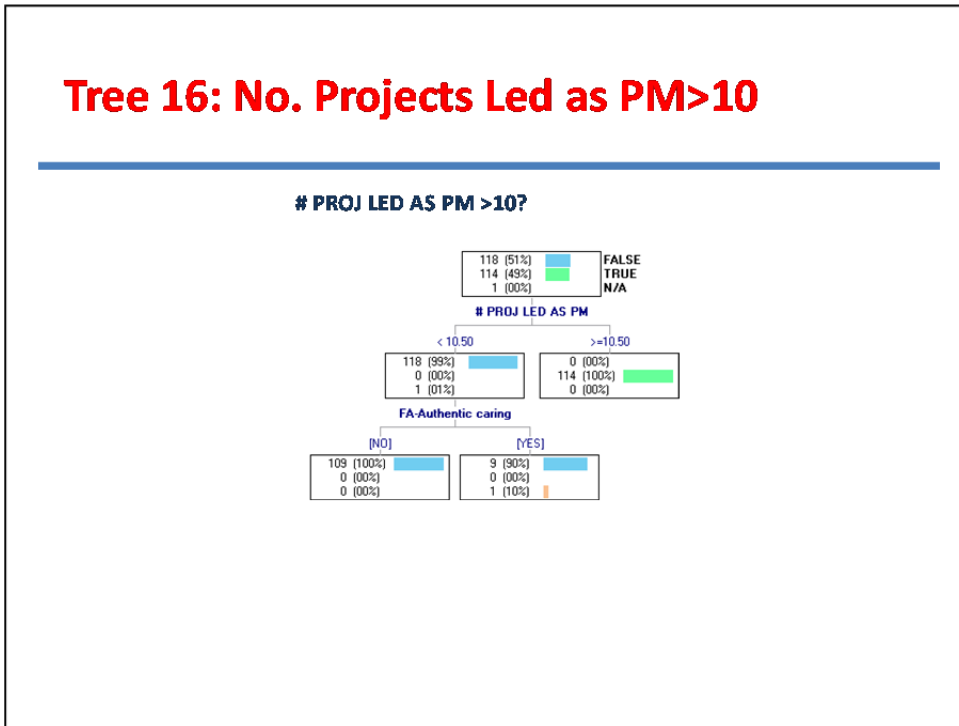


Figure F.17. Data Mining Tree #16

## Tree 17: Role of the Organization

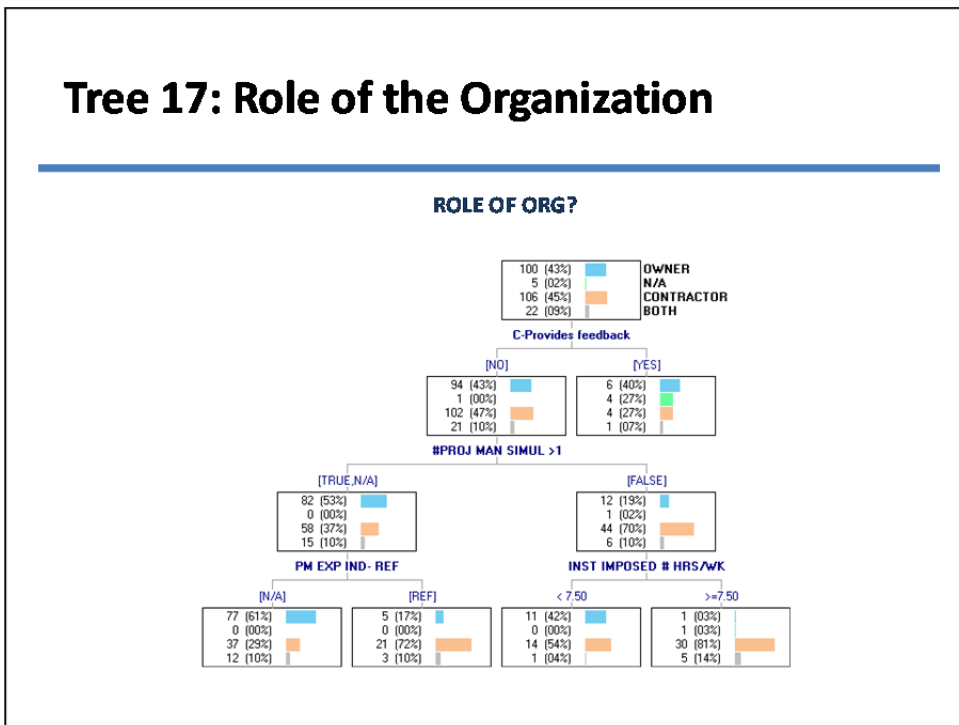


Figure F.18. Data Mining Tree #17

## Tree 18: Organization Sector

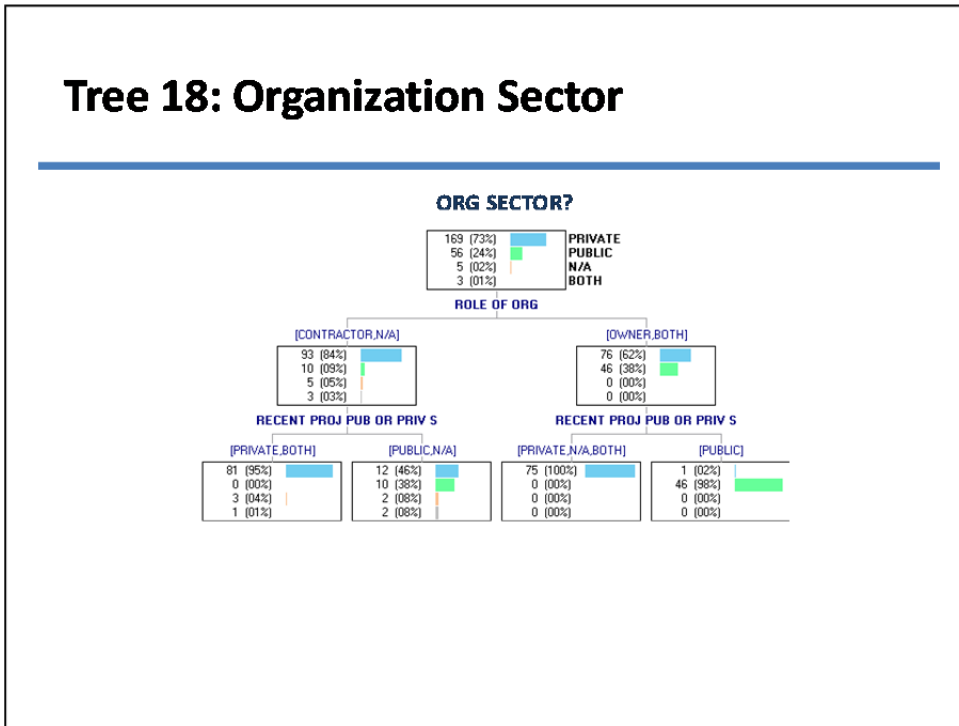


Figure F.19. Data Mining Tree #18

## Tree 19: PM Experience in US

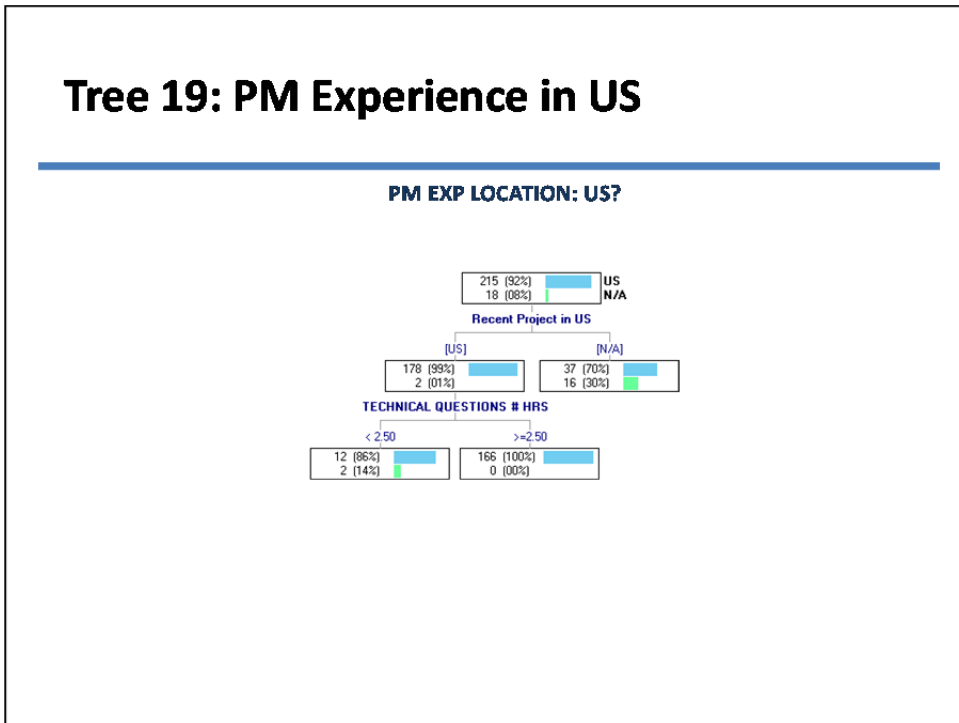


Figure F.20. Data Mining Tree #19



# Tree 20: PM Experience in Canada

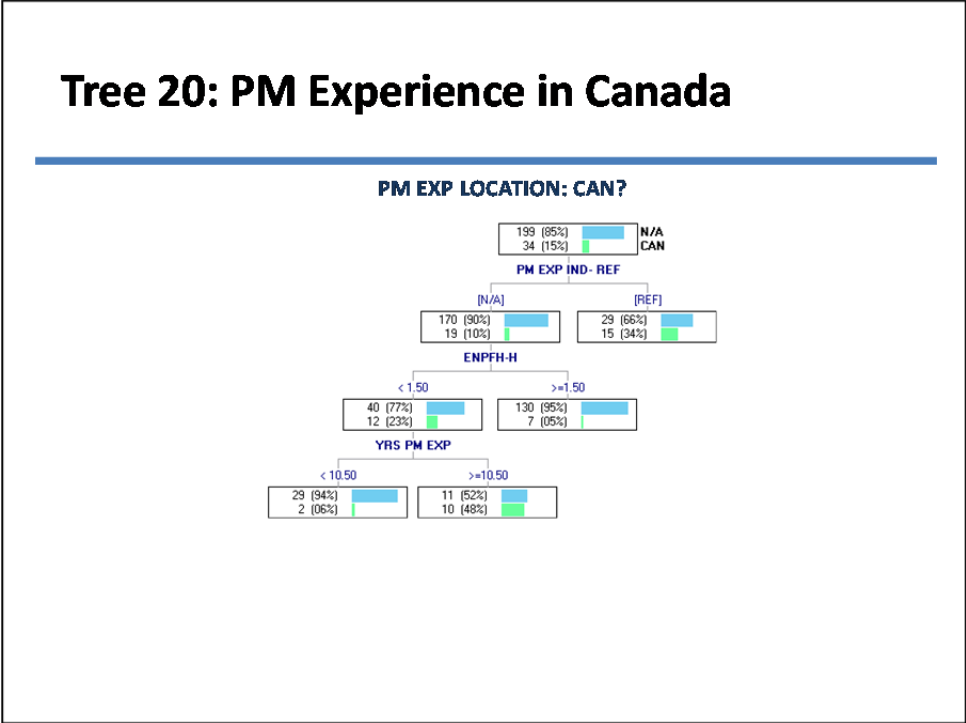


Figure F.21. Data Mining Tree #20

# Tree 21: PM Experience in Europe

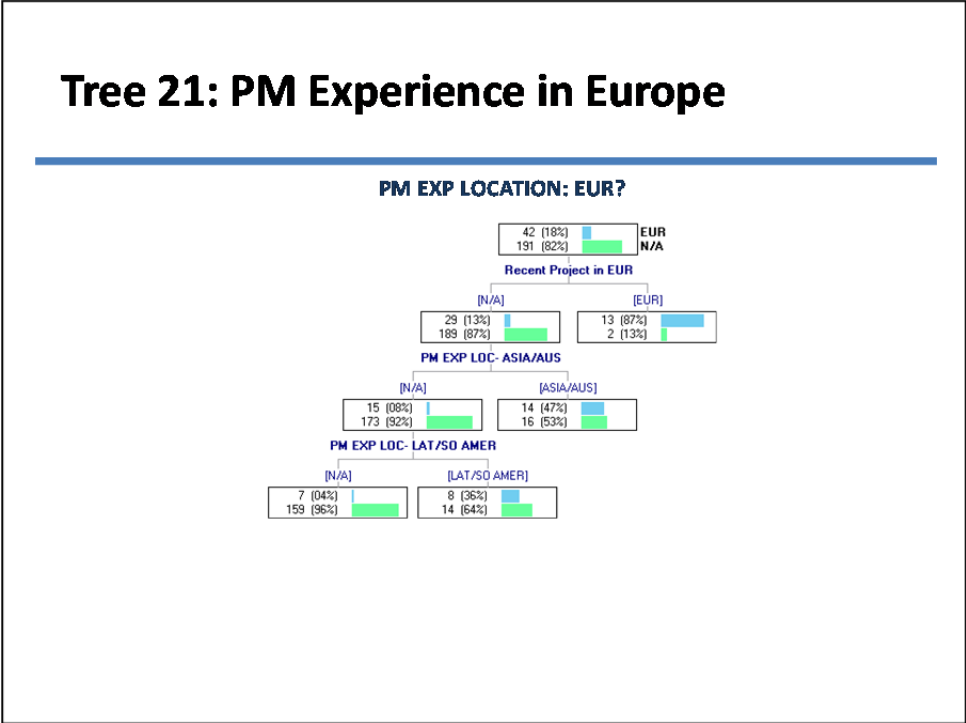


Figure F.22. Data Mining Tree #21

## Tree 22: PM Experience in Asia/Australia

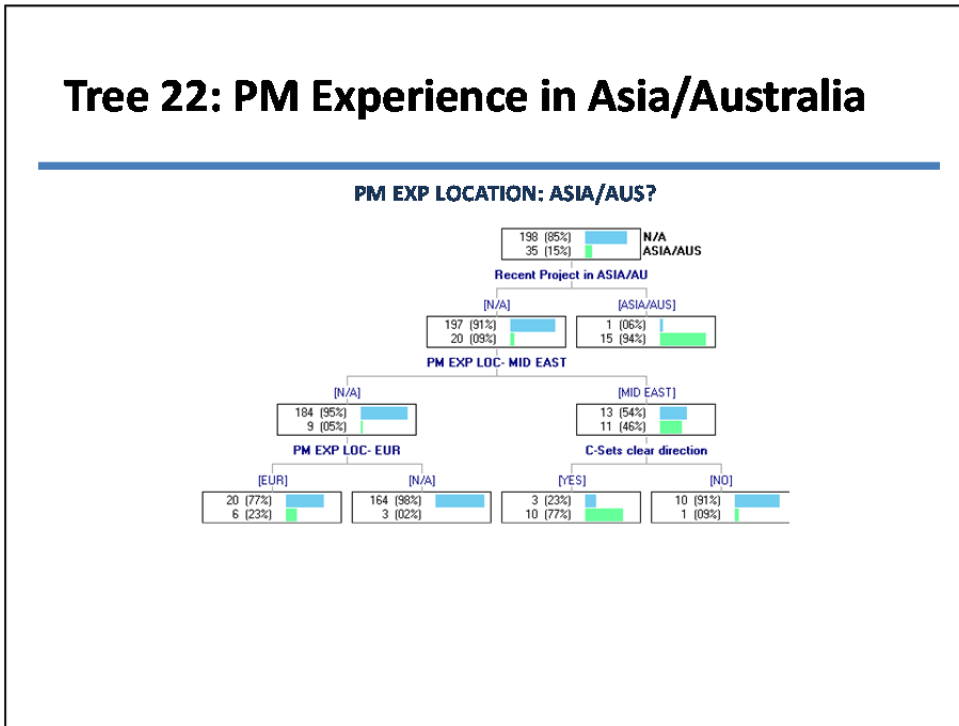


Figure F.23. Data Mining Tree #22

## Tree 23: PM Experience in Latin/So. America

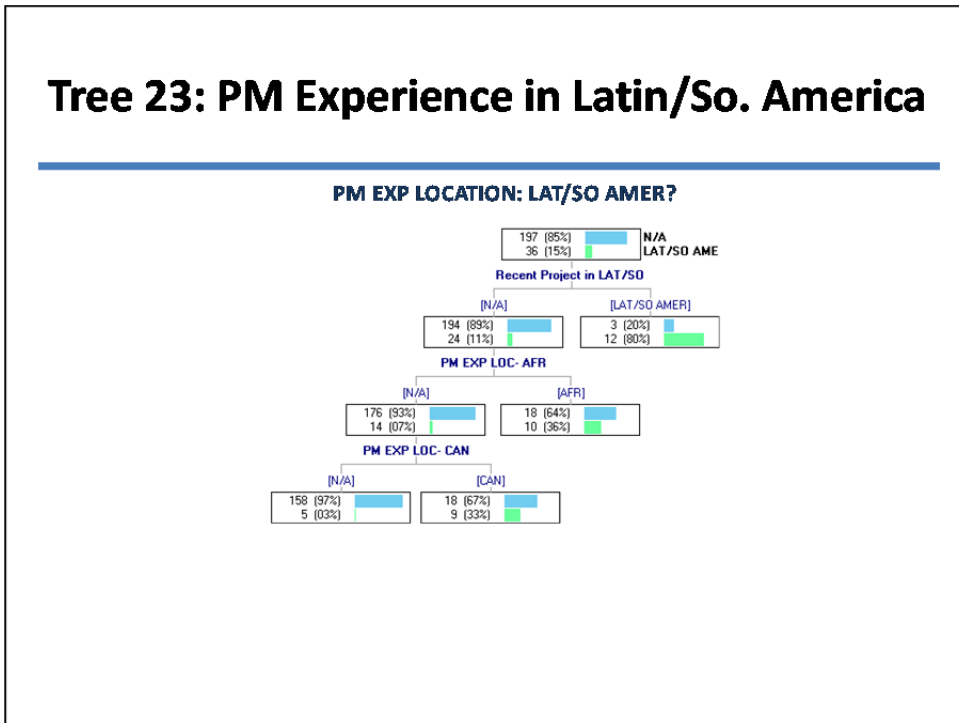


Figure F.24. Data Mining Tree #23

## Tree 24: PM Experience in Middle East

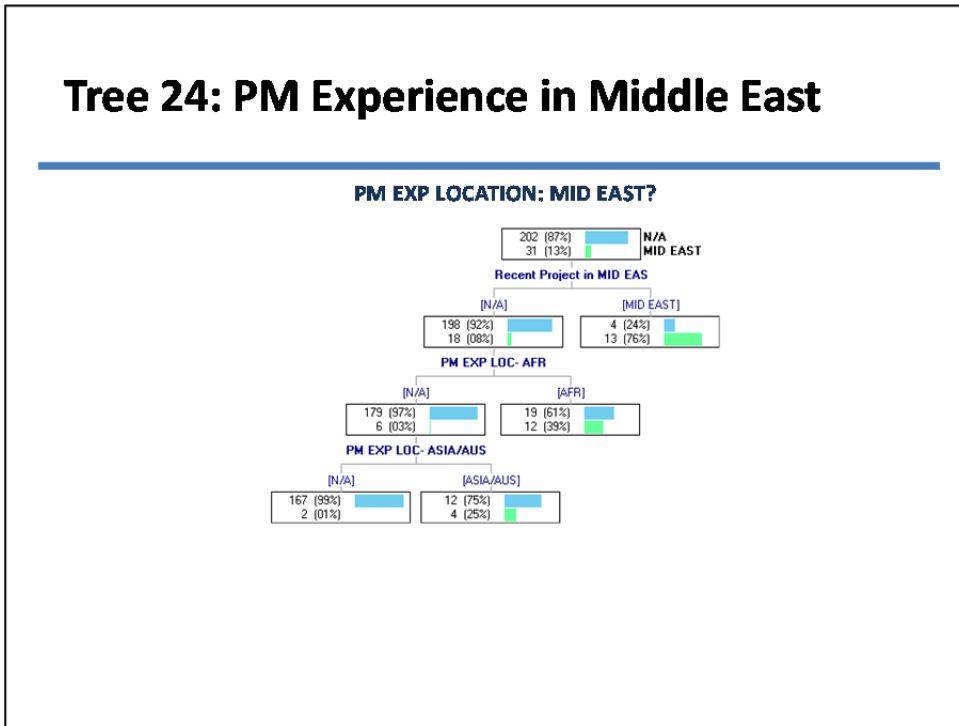


Figure F.25. Data Mining Tree #24

## Tree 25: PM Experience in Caribbean

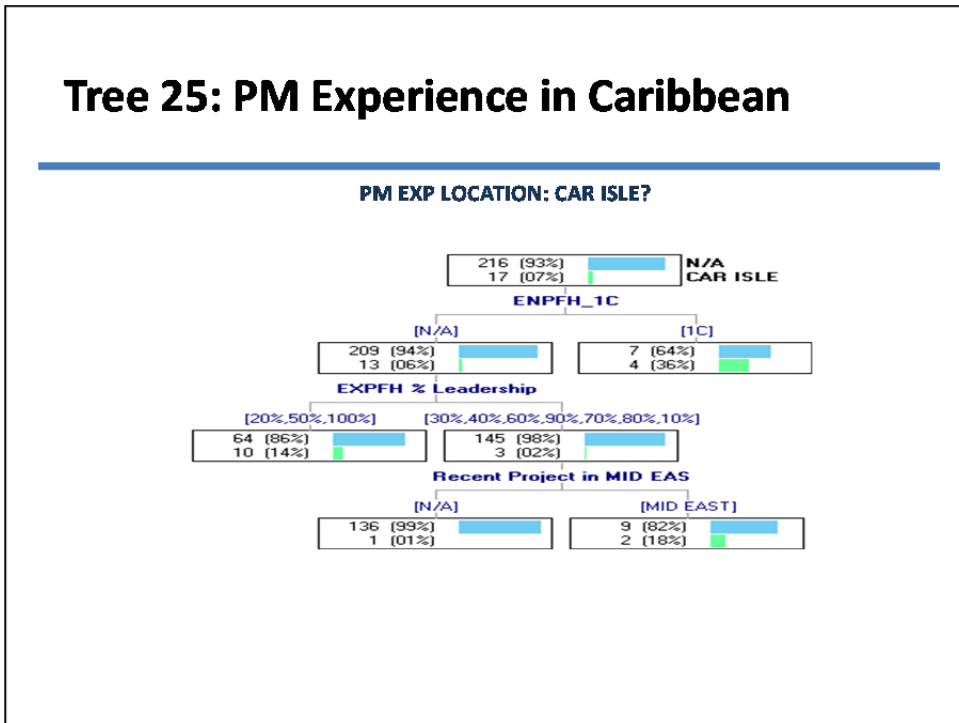


Figure F.26. Data Mining Tree #25

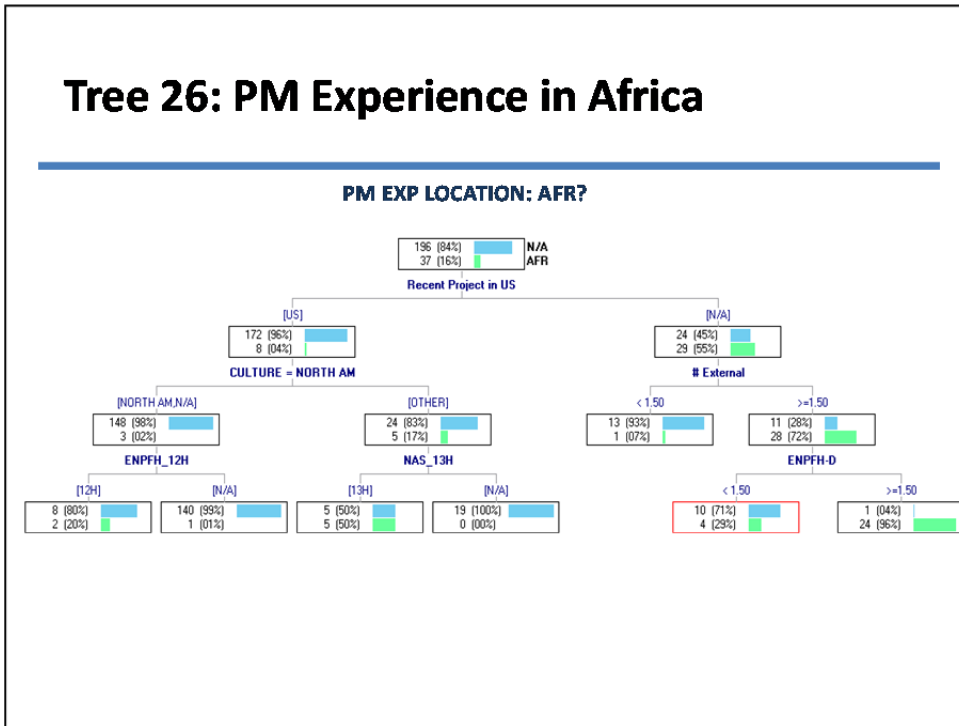


Figure F.27. Data Mining Tree #26

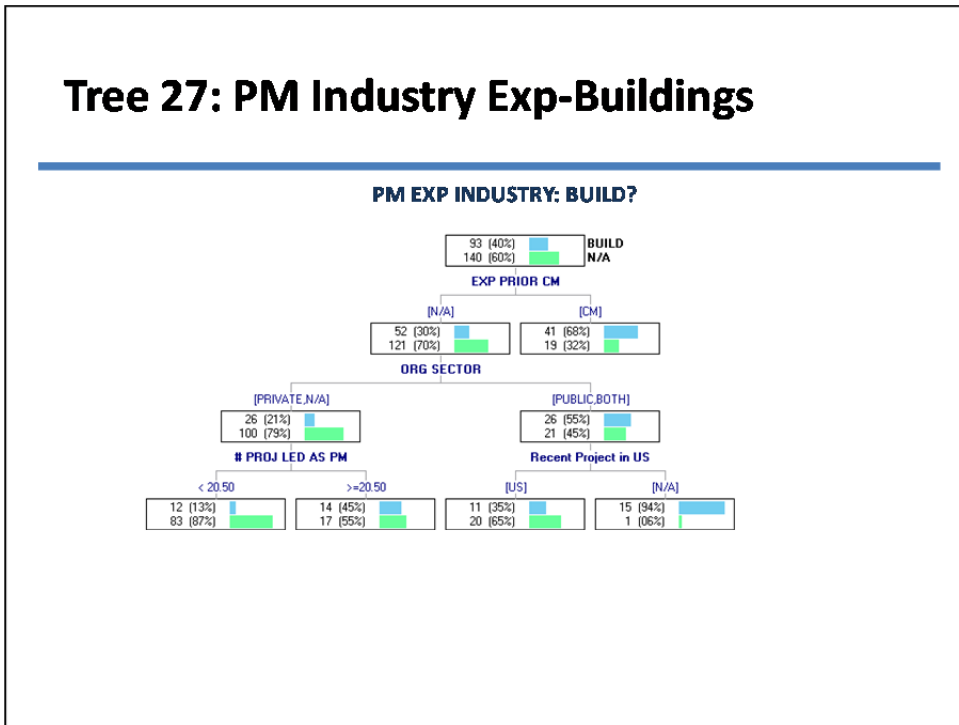


Figure F.28. Data Mining Tree #27

## Tree 28: PM Industry Exp-Energy

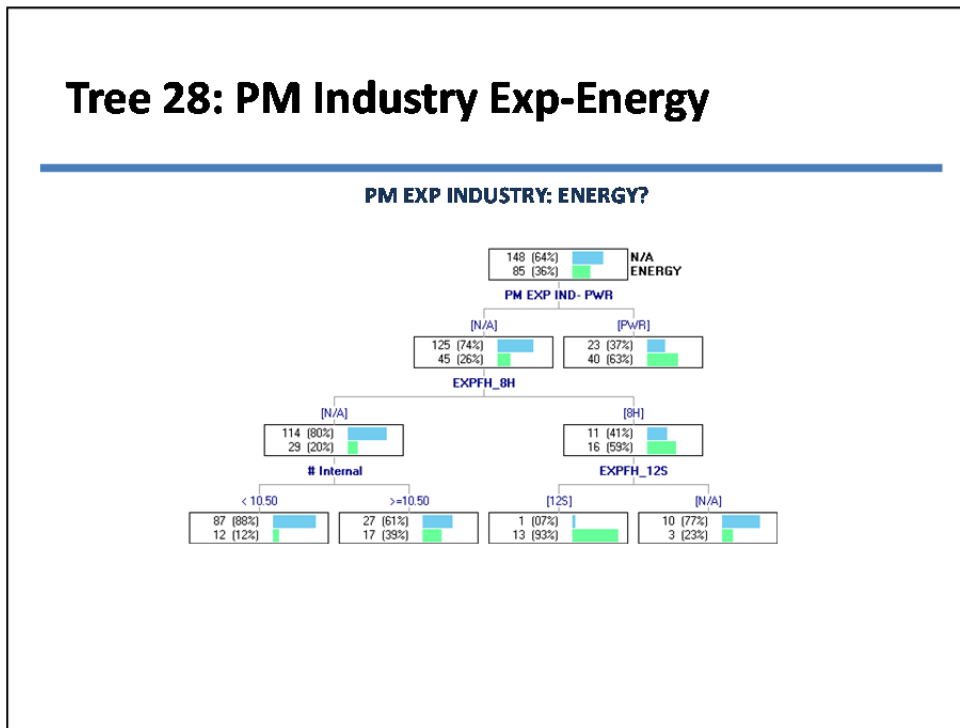


Figure F.29. Data Mining Tree #28

## Tree 29: PM Industry Exp-Refining

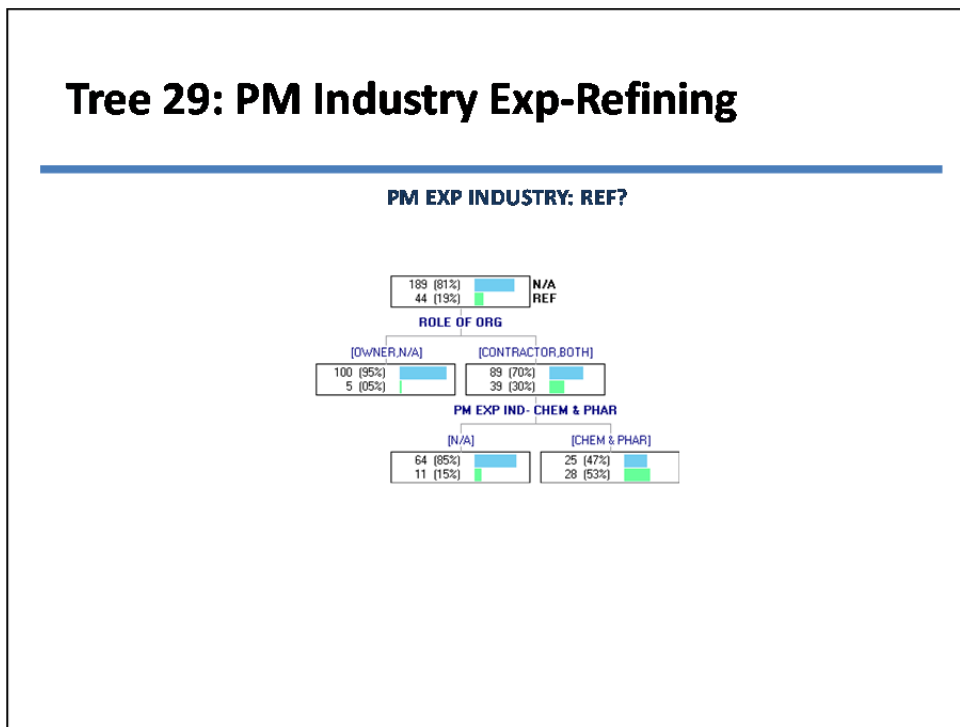


Figure F.30. Data Mining Tree #29

## Tree 30: PM Industry Exp-Chem & Pharma

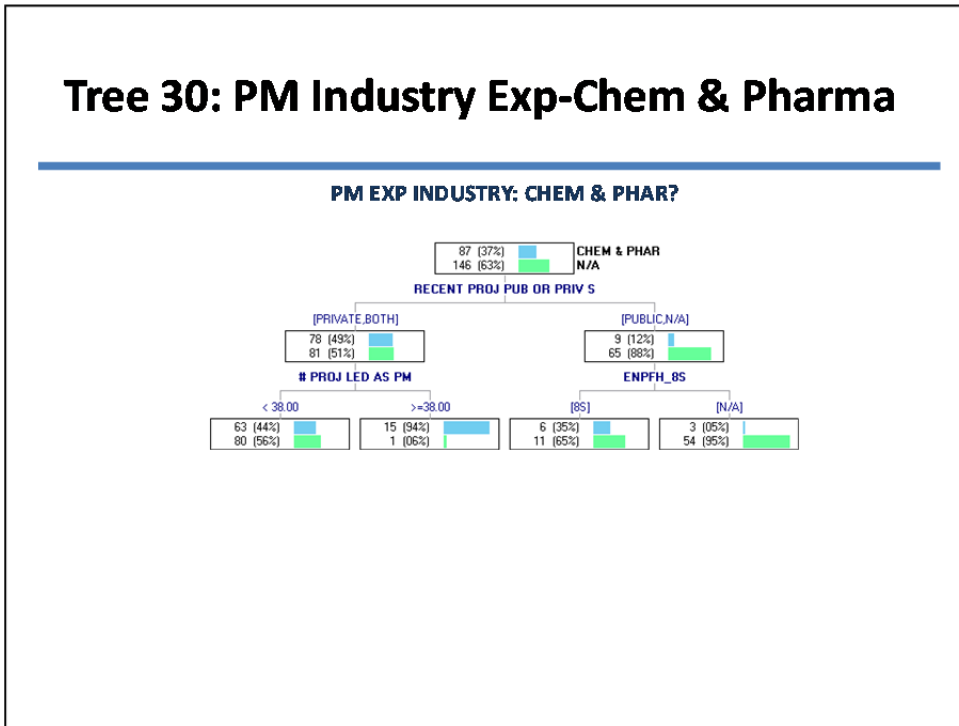


Figure F.31. Data Mining Tree #30

## Tree 31: PM Industry Exp-Manufacturing

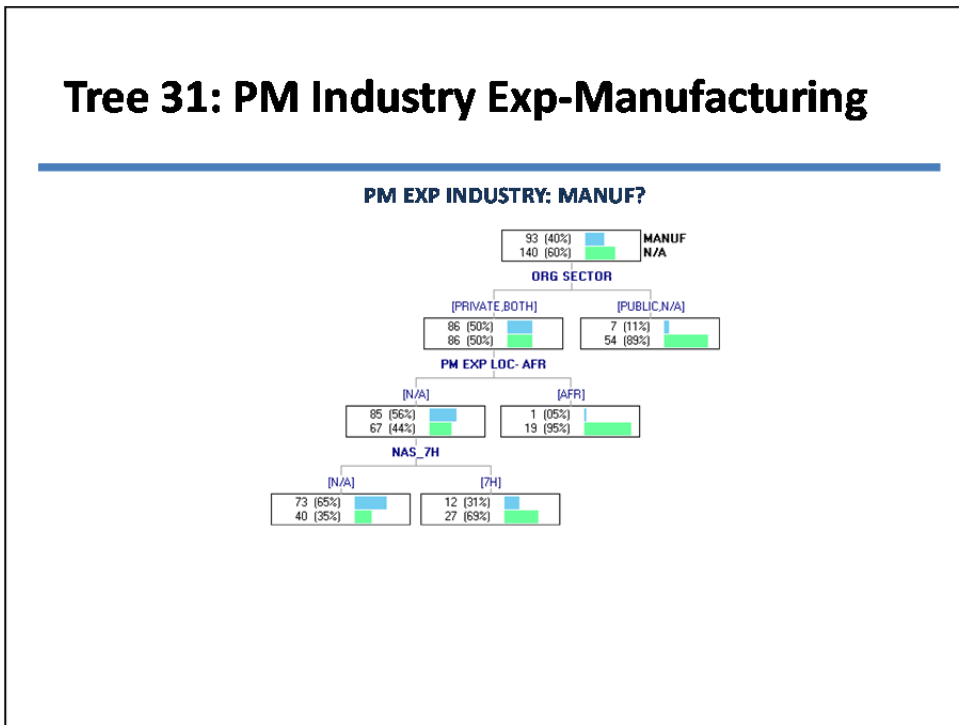


Figure F.32. Data Mining Tree #31

## Tree 32: PM Industry Exp-Water & Sewer

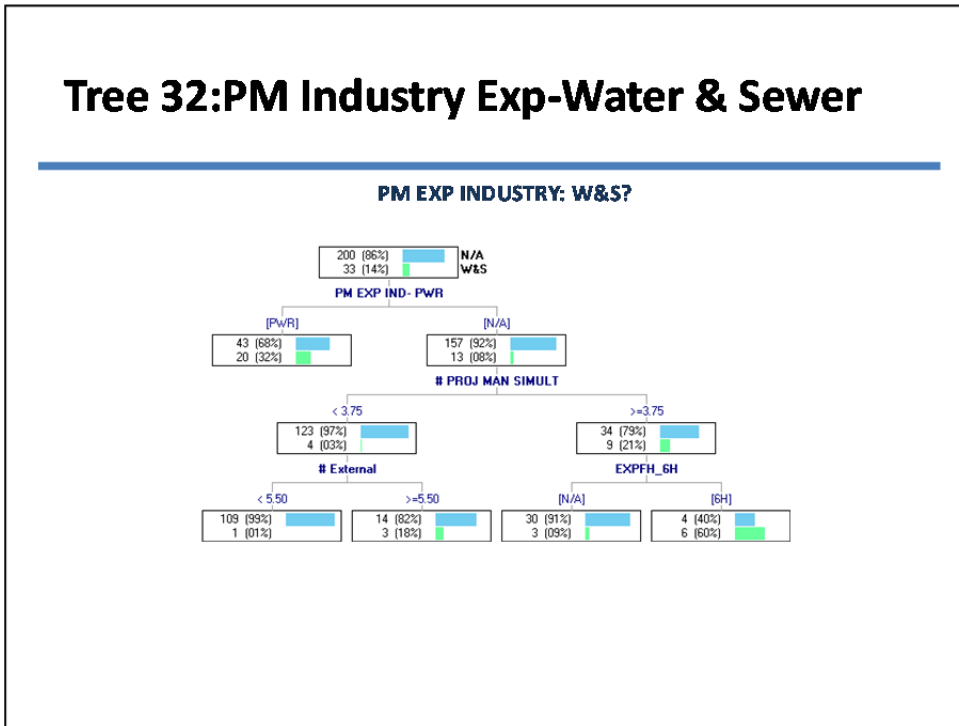


Figure F.33. Data Mining Tree #32

## Tree 33: PM Industry Exp-Transportation

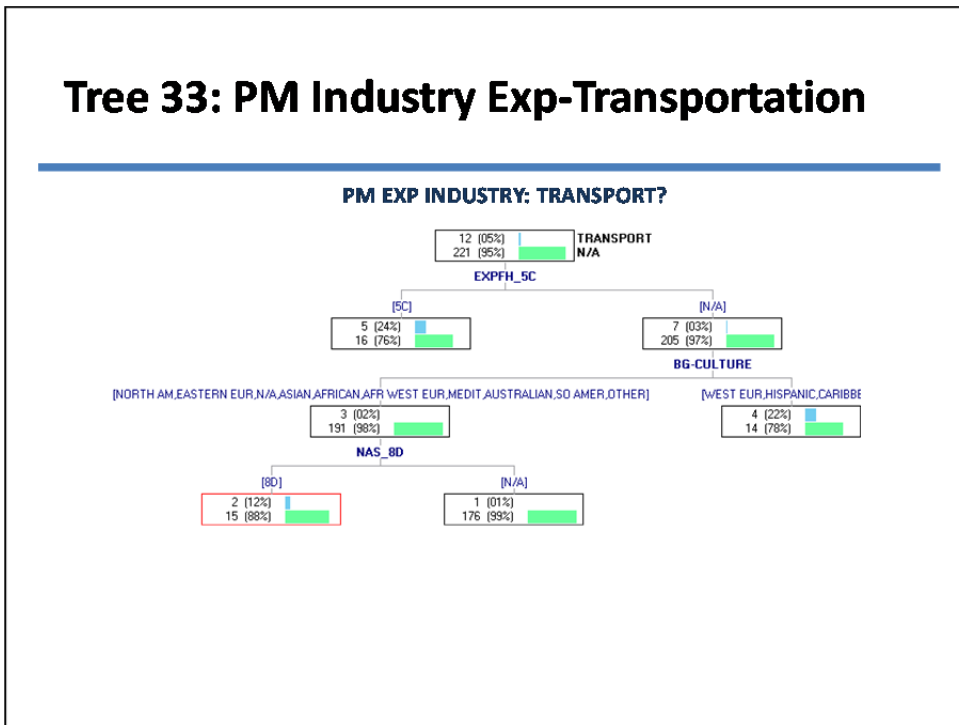


Figure F.34. Data Mining Tree #33

## Tree 34: PM Industry Exp-Hazardous Waste

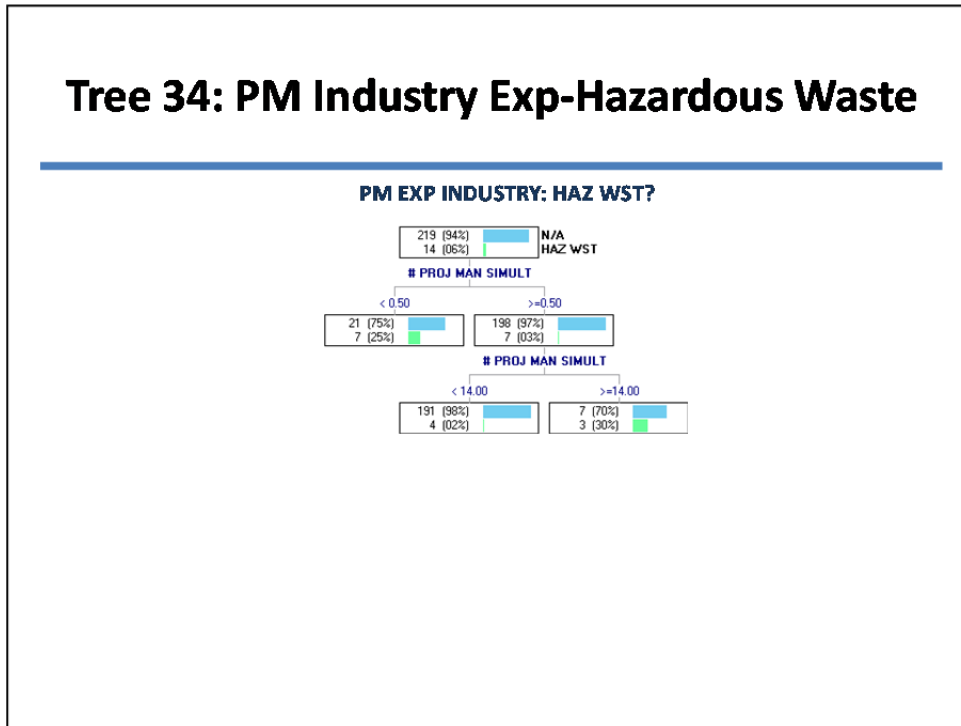


Figure F.35. Data Mining Tree #34

## Tree 35: PM Industry Exp-Power

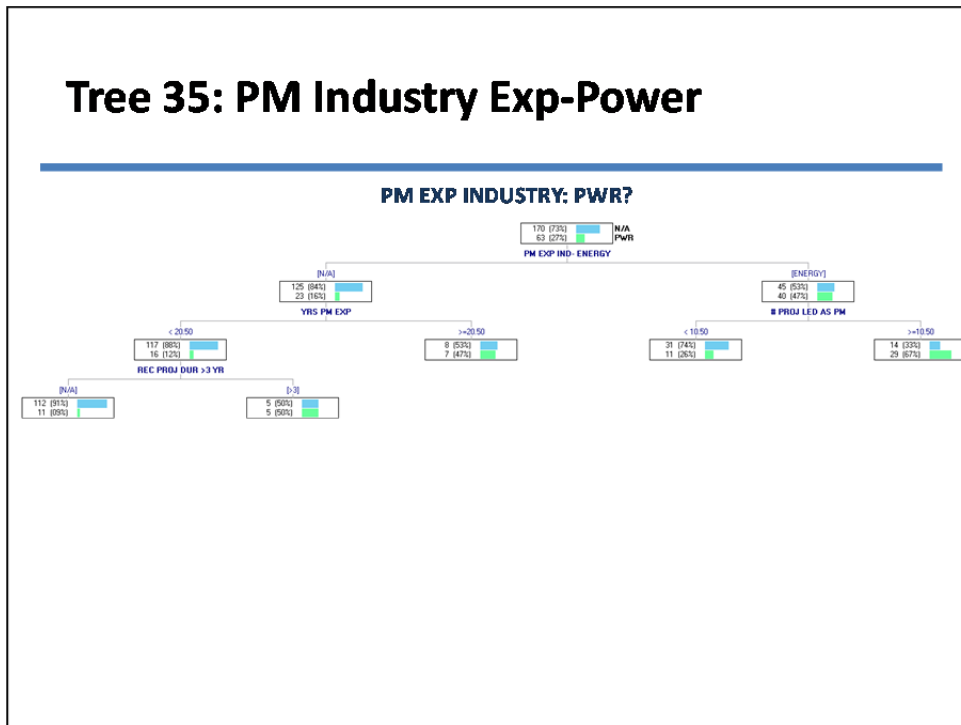


Figure F.36. Data Mining Tree #35



## Tree 36: PM Industry Exp-Telecom

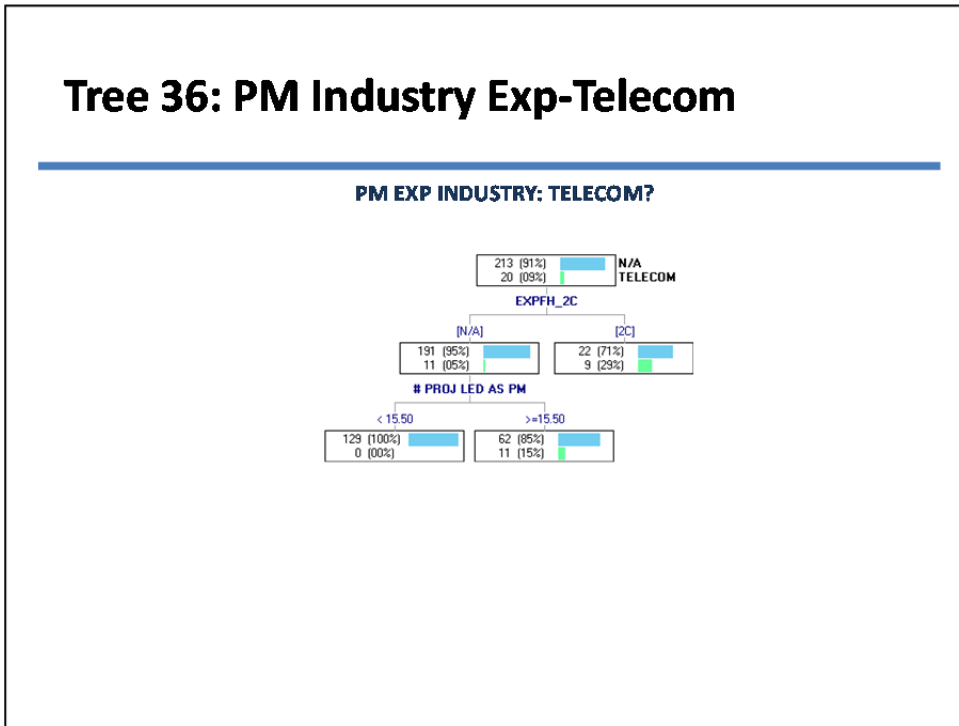


Figure F.37. Data Mining Tree #36

## Tree 37: PM Industry Exp-Other

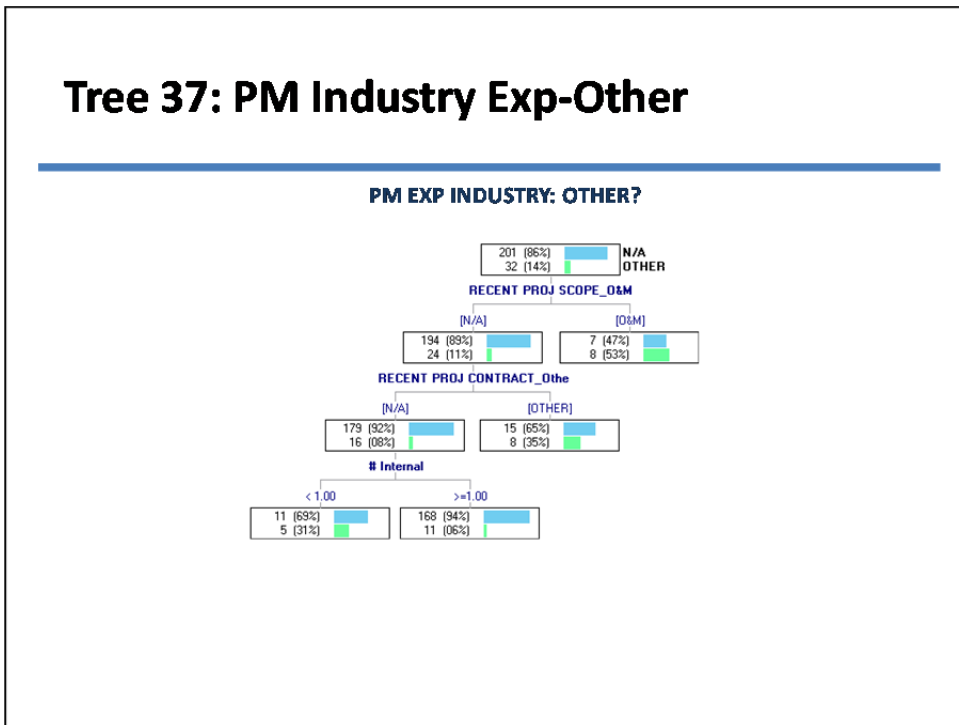


Figure F.38. Data Mining Tree #37

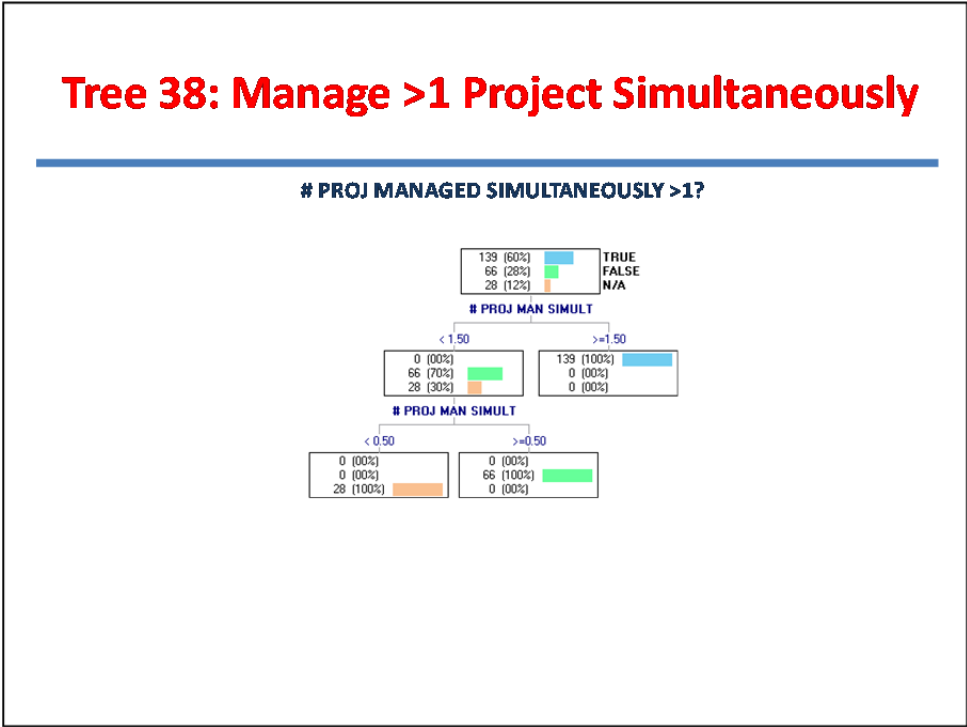


Figure F.39. Data Mining Tree #38

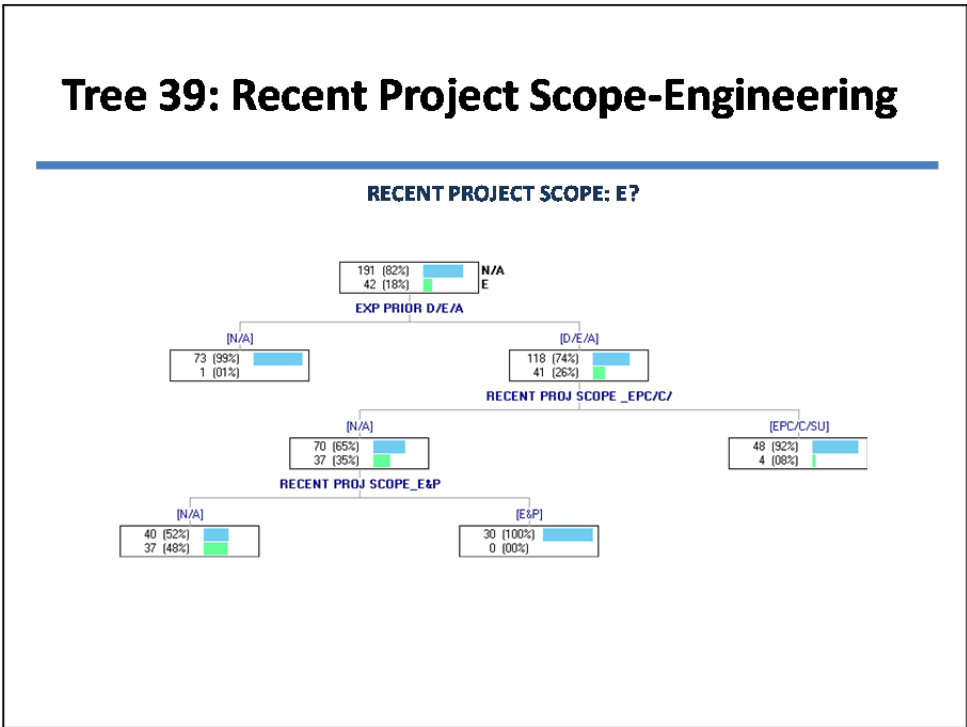


Figure F.40. Data Mining Tree #39

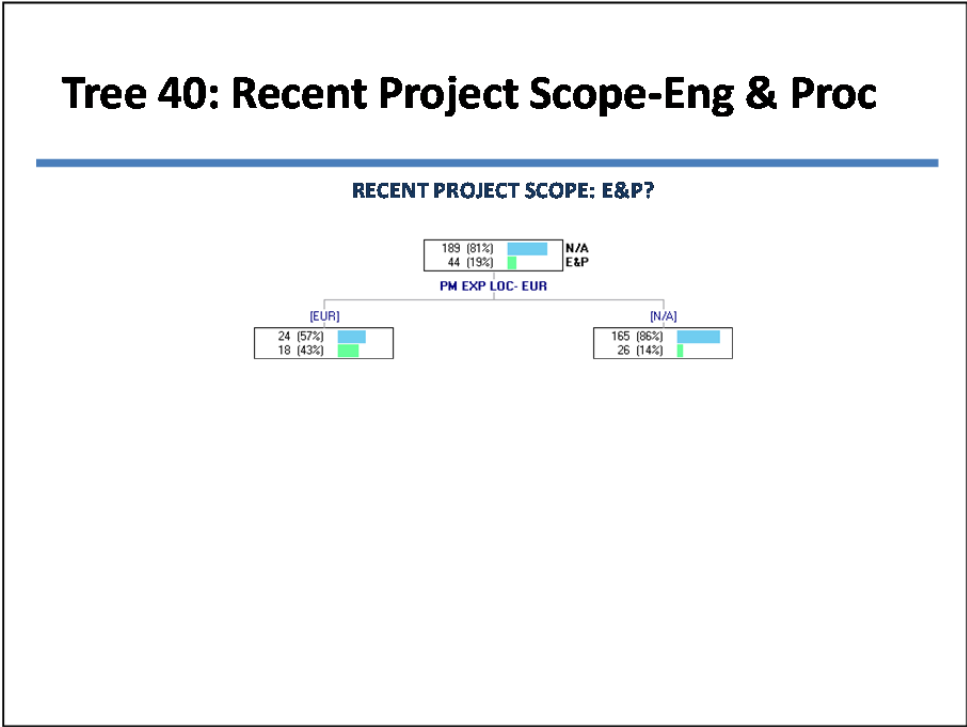


Figure F.41. Data Mining Tree #40

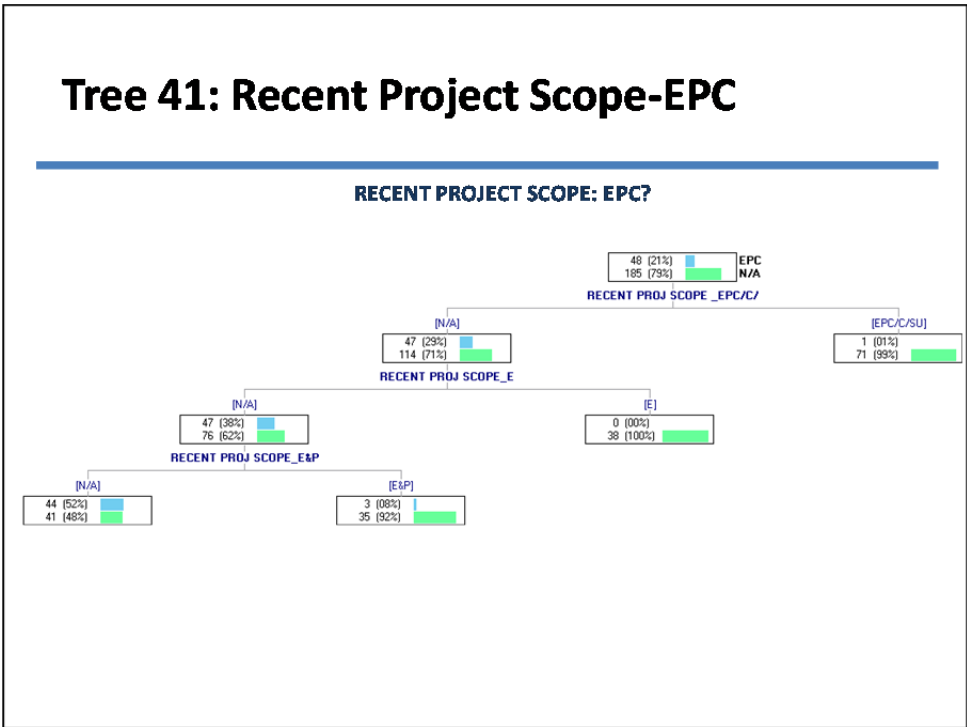


Figure F.42. Data Mining Tree #41

## Tree 42: Recent Project Scope-EPC/Start-up

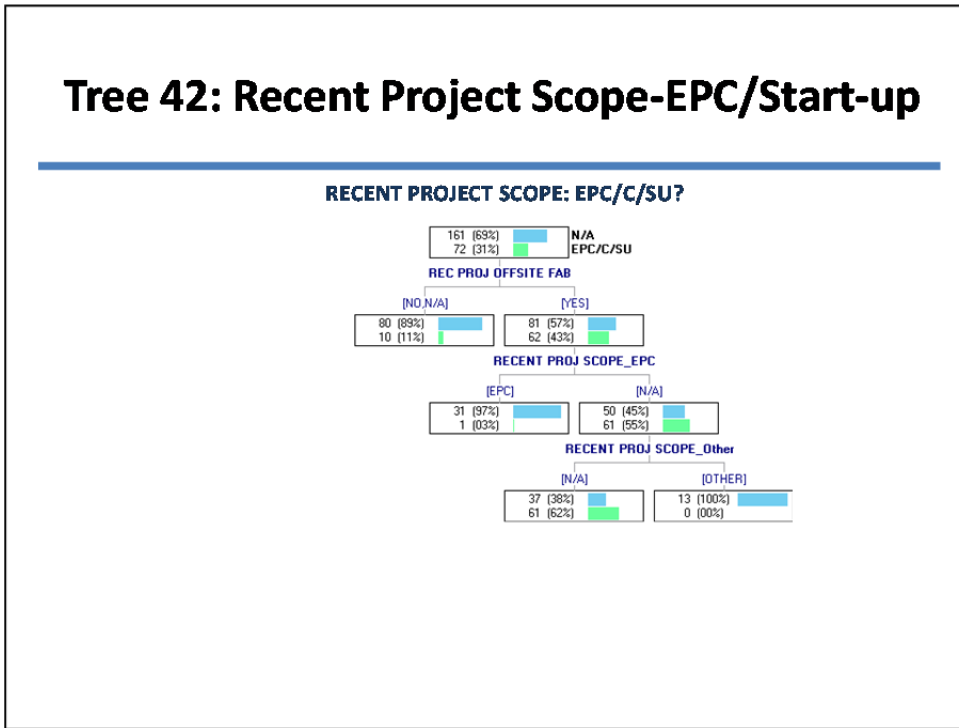


Figure F.43. Data Mining Tree #42

## Tree 43: Recent Project Scope-Ops & Maint

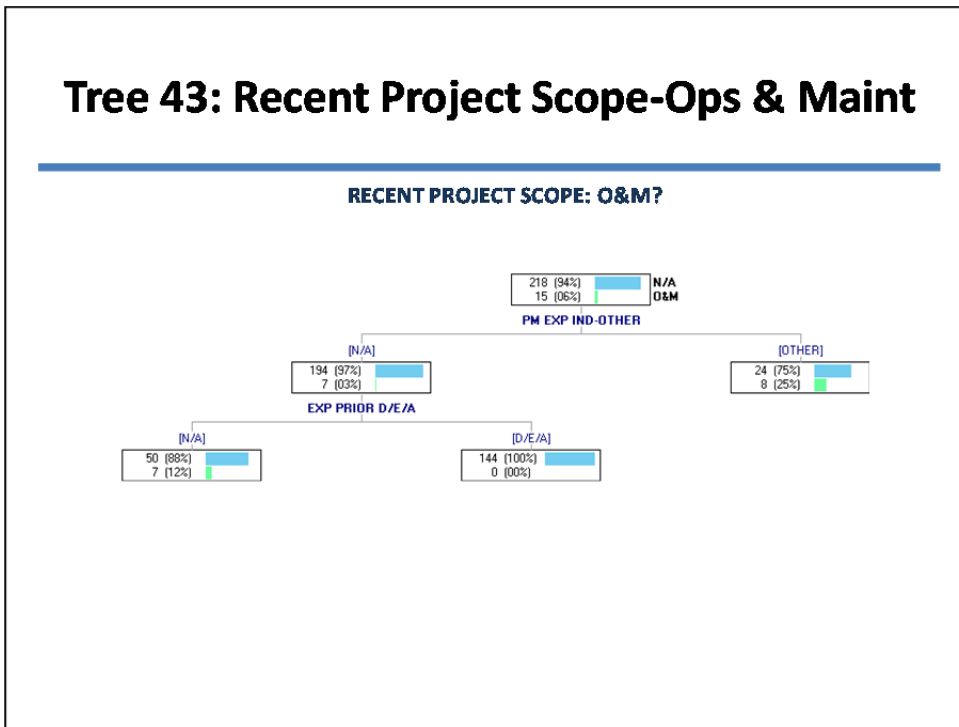


Figure F.44. Data Mining Tree #43

## Tree 44: Recent Project Scope-Maint

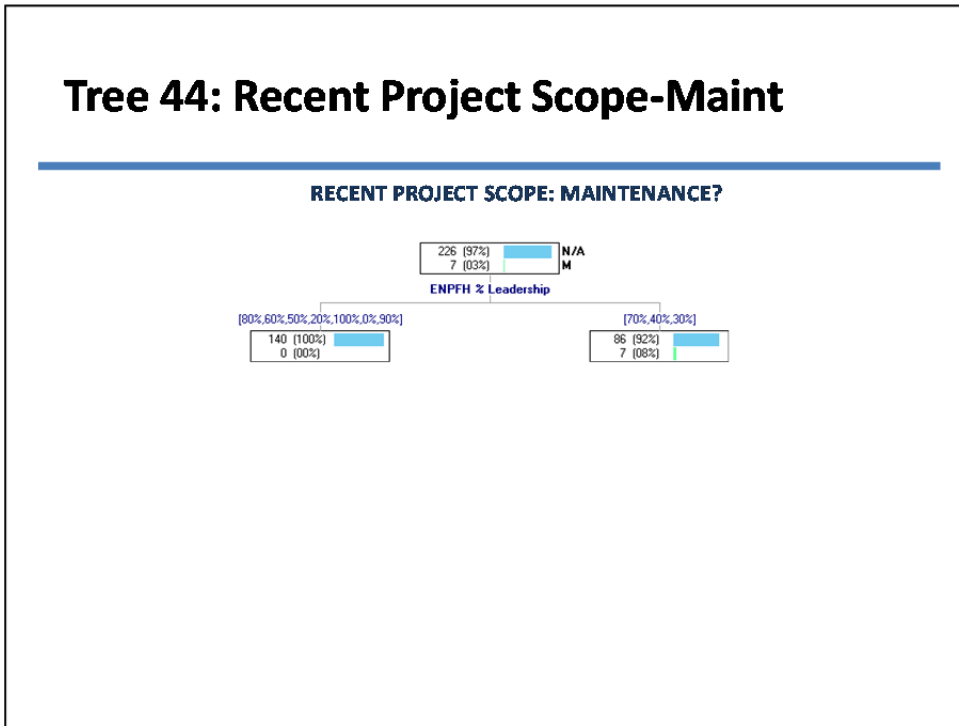


Figure F.45. Data Mining Tree #44

## Tree 45: Recent Project Scope-Other

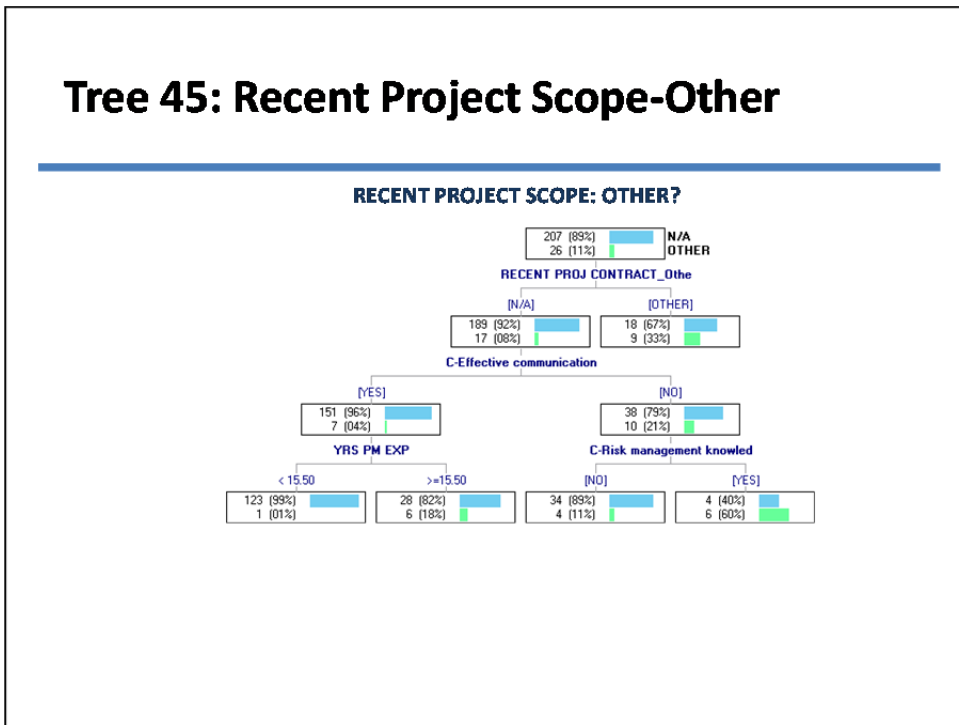


Figure F.46. Data Mining Tree #45

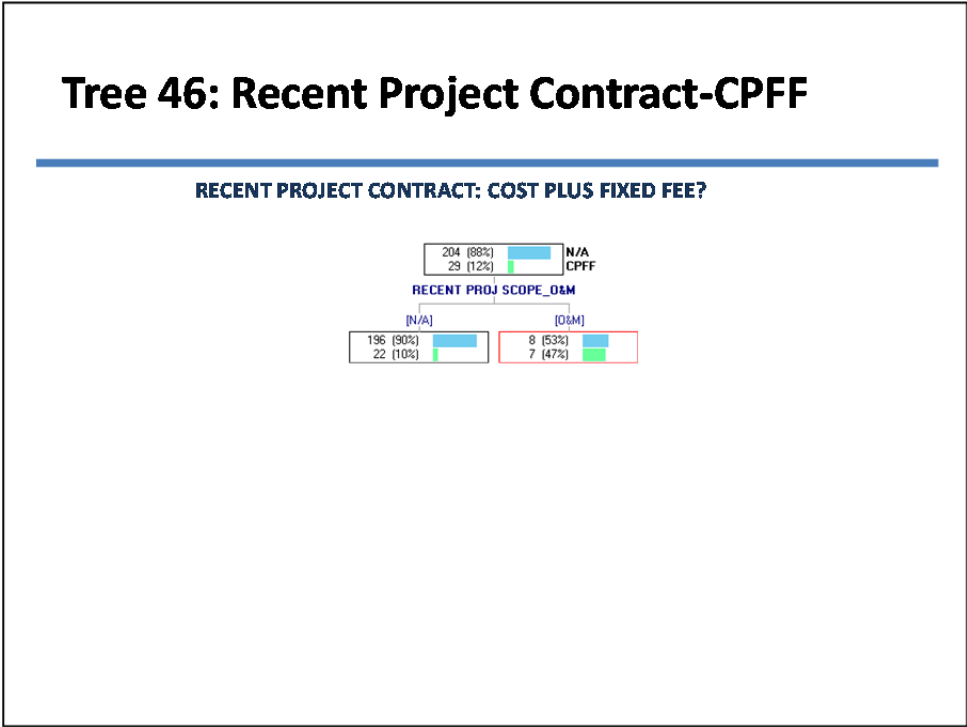


Figure F.47. Data Mining Tree #46

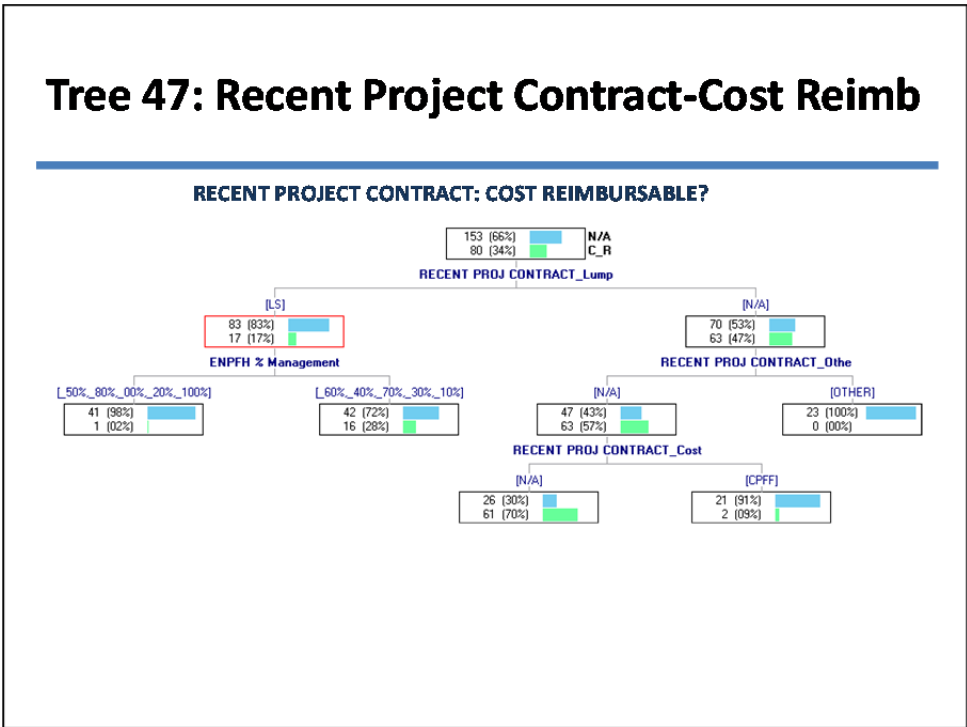


Figure F.48. Data Mining Tree #47

## Tree 48: Recent Project Contract-GMAX

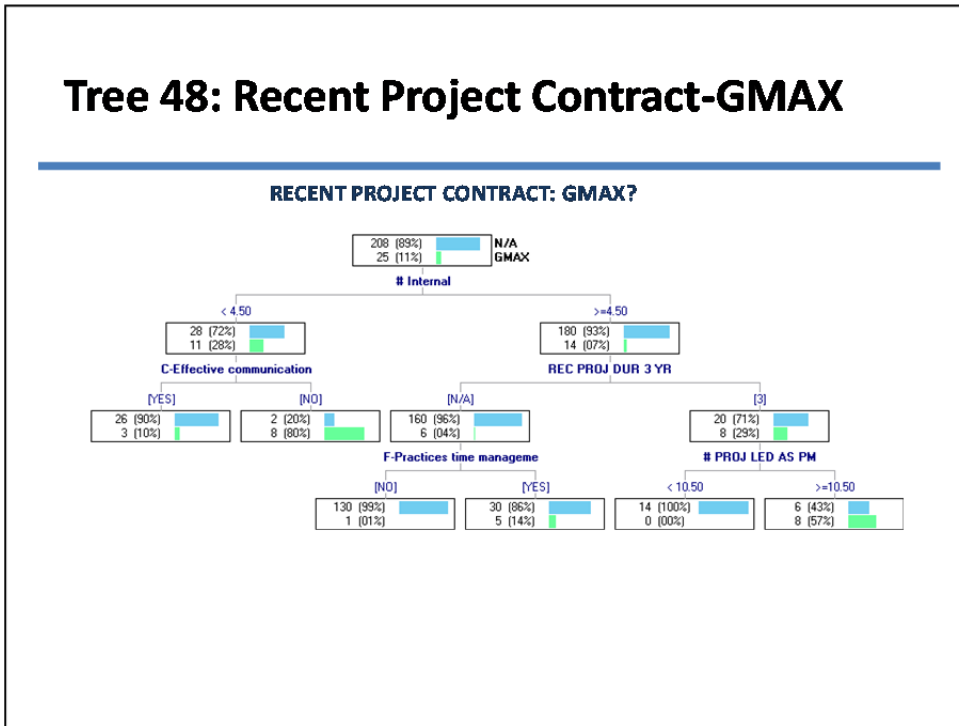


Figure F.49. Data Mining Tree #48

## Tree 49: Recent Project Contract-Lump Sum

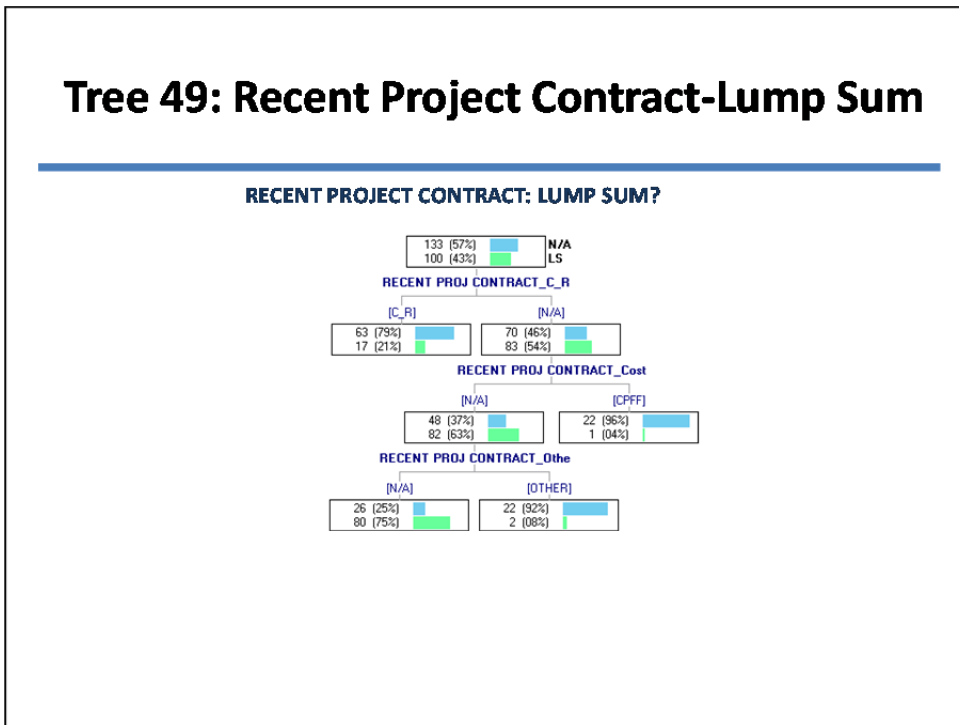


Figure F.50. Data Mining Tree #49

## Tree 50: Recent Project Contract-Other

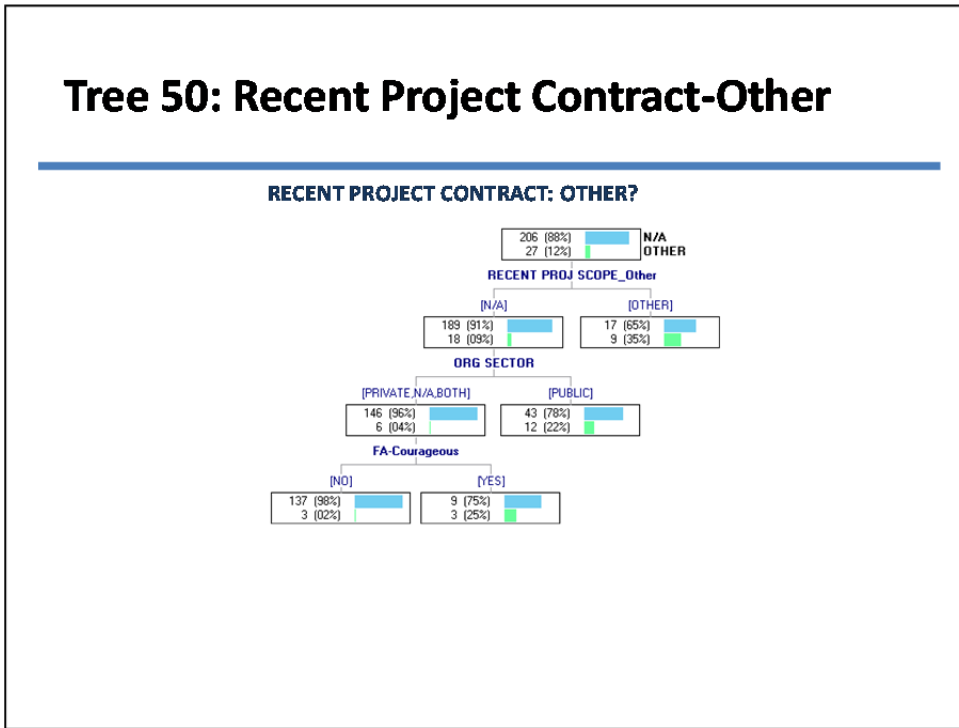


Figure F.51. Data Mining Tree #50

## Tree 51: Recent Project Location-US

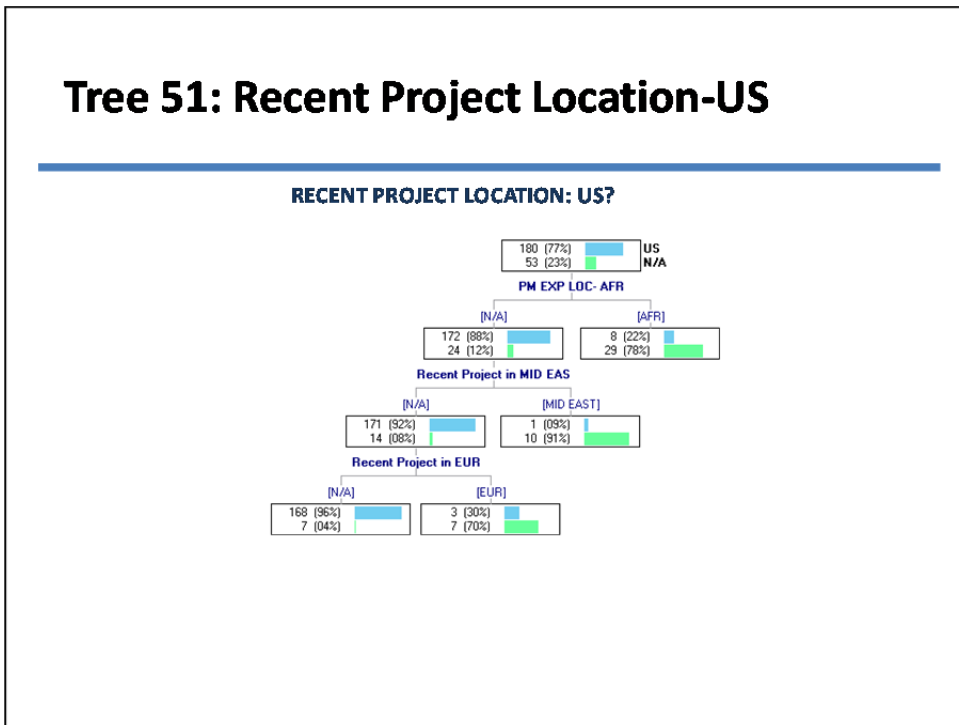


Figure F.52. Data Mining Tree #51



## Tree 52: Recent Project Location-Mid East

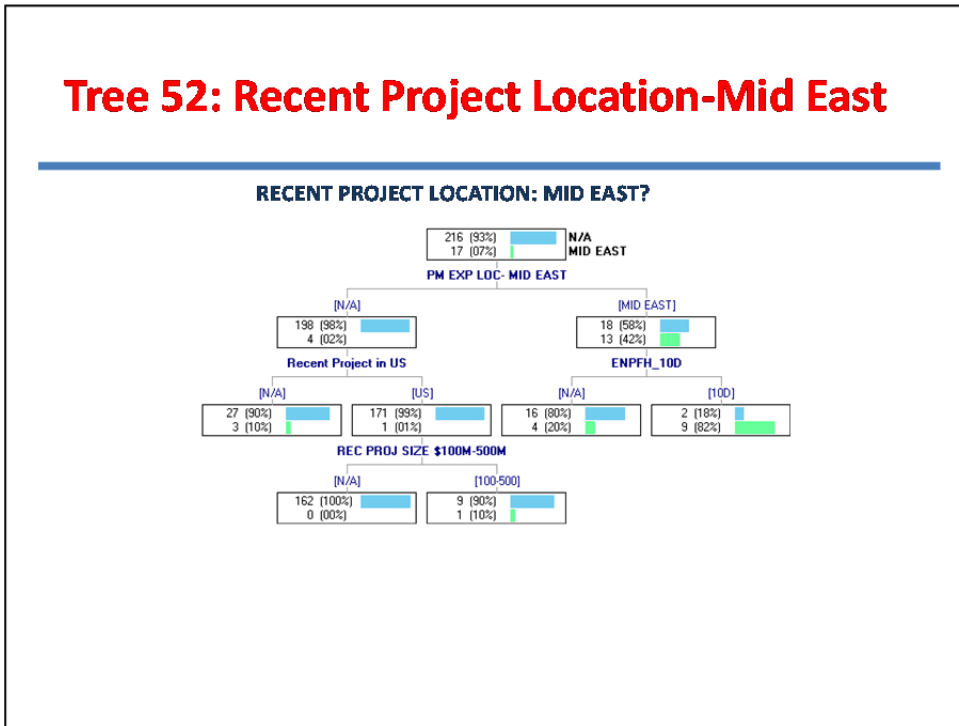


Figure F.53. Data Mining Tree #52

## Tree 53: Recent Project Location-Lat/So Am

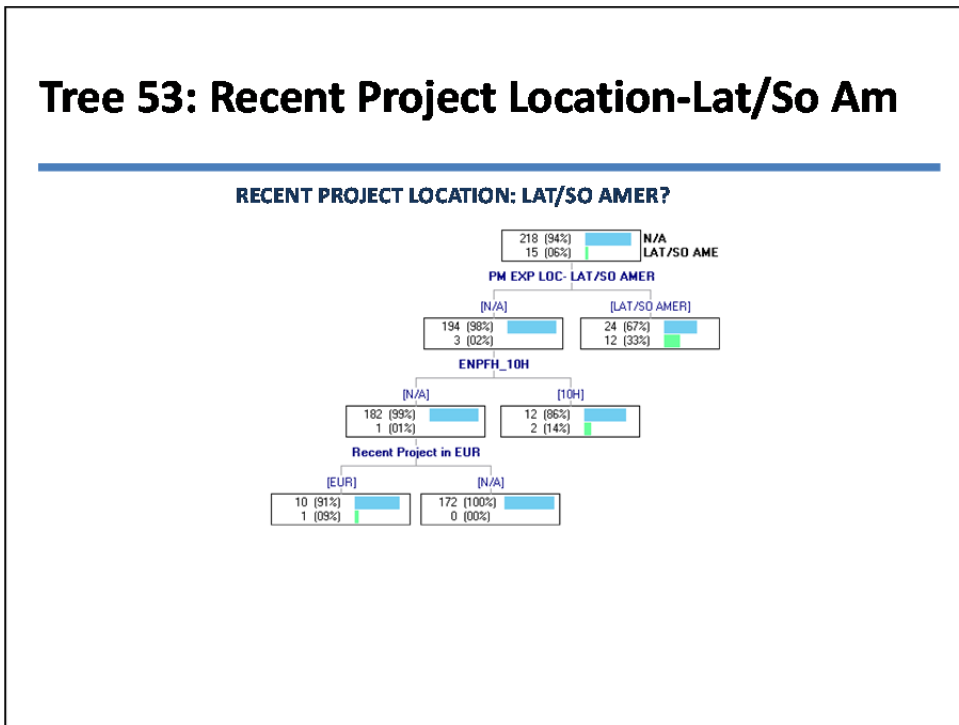


Figure F.54. Data Mining Tree #53

# Tree 54: Recent Project Location-Europe

RECENT PROJECT LOCATION: EUR?

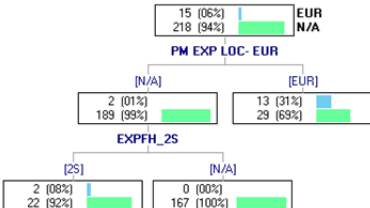


Figure F.55. Data Mining Tree #54

# Tree 55: Recent Project Location-Caribbean

RECENT PROJECT LOCATION: CAR ISLE?

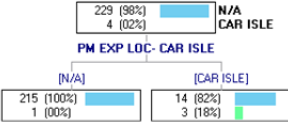


Figure F.56. Data Mining Tree #55

## Tree 56: Recent Project Location-Canada

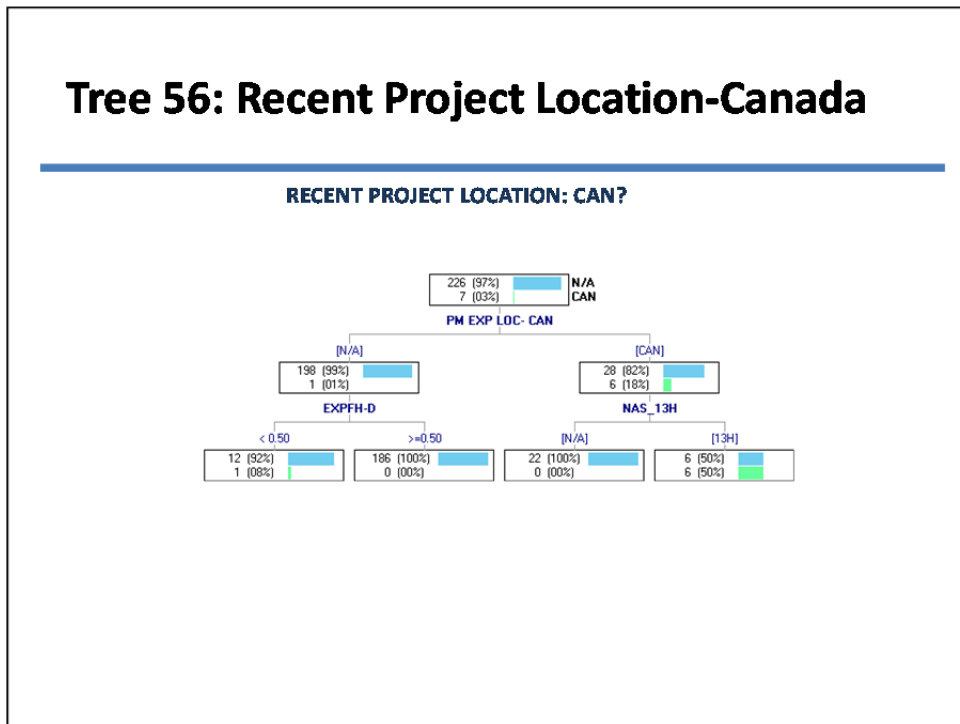


Figure F.57. Data Mining Tree #56

## Tree 57: Recent Project Location-Asia/Aus

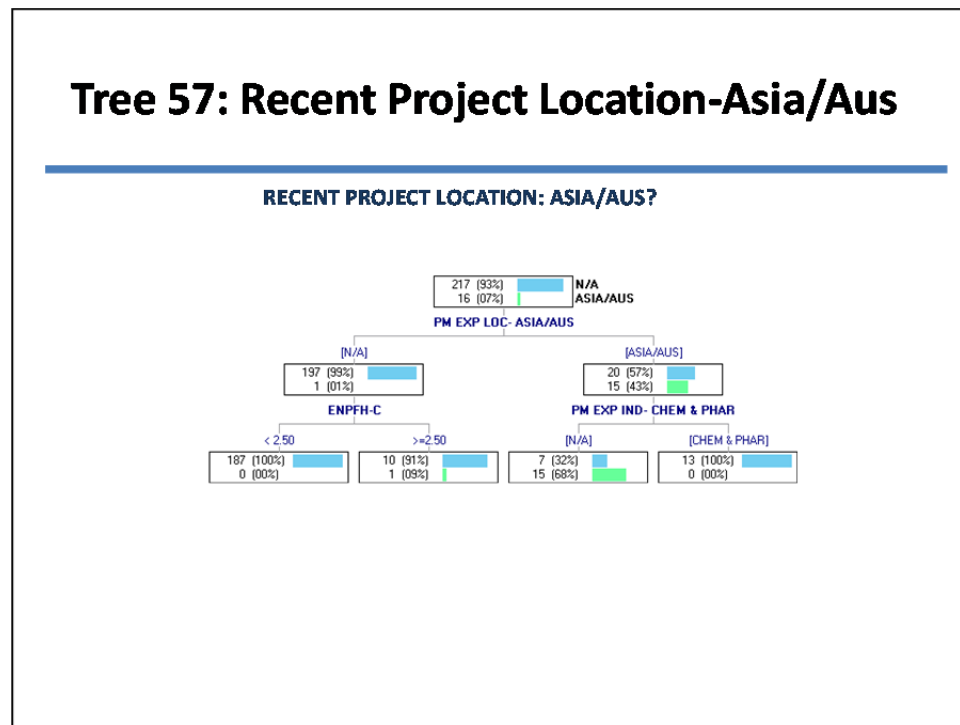


Figure F.58. Data Mining Tree #57

## Tree 58: Recent Project Location-Africa

RECENT PROJECT LOCATION: AFR?

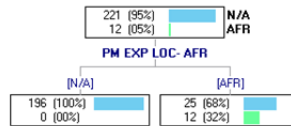


Figure F.59. Data Mining Tree #58

## Tree 59: Recent Project-Sector

RECENT PROJECT PUBLIC OR PRIVATE SECTOR?

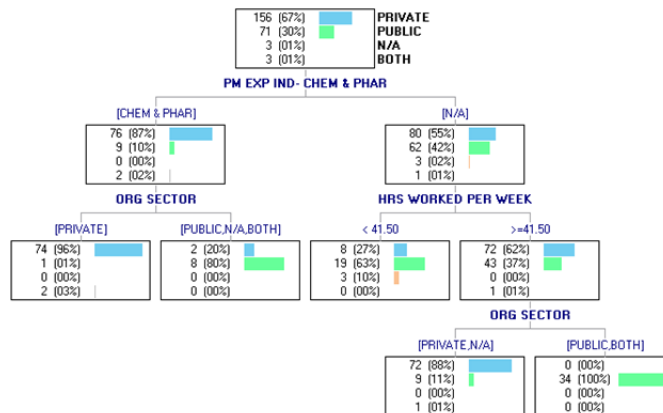


Figure F.60. Data Mining Tree #59

## Tree 60: Recent Project Location-Africa

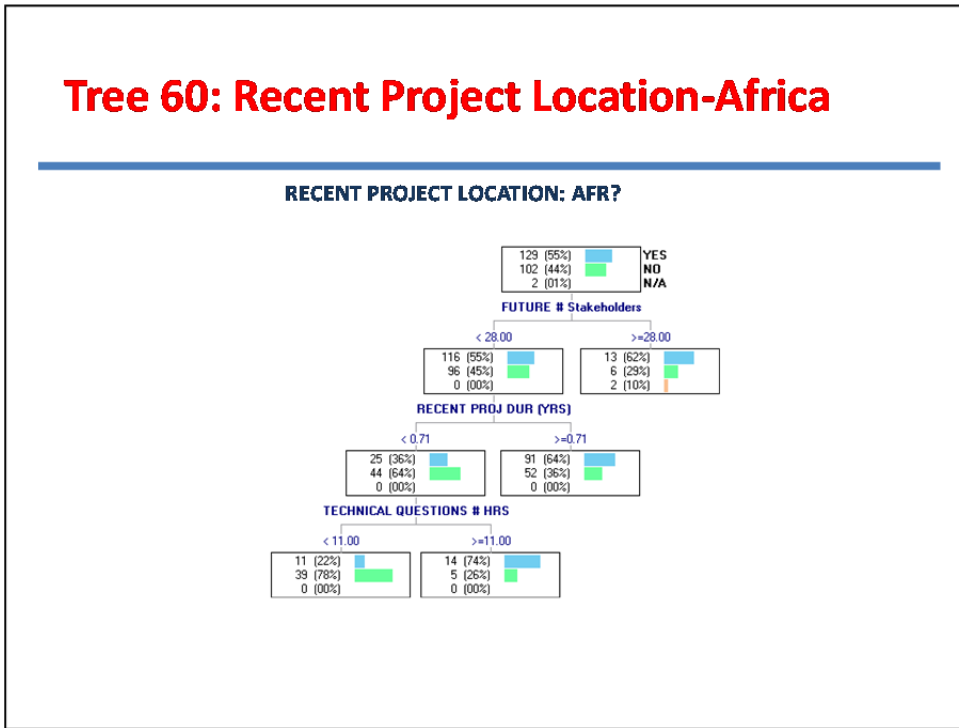


Figure F.61. Data Mining Tree #60

## Tree 61: Recent Project-Offsite Fabrication

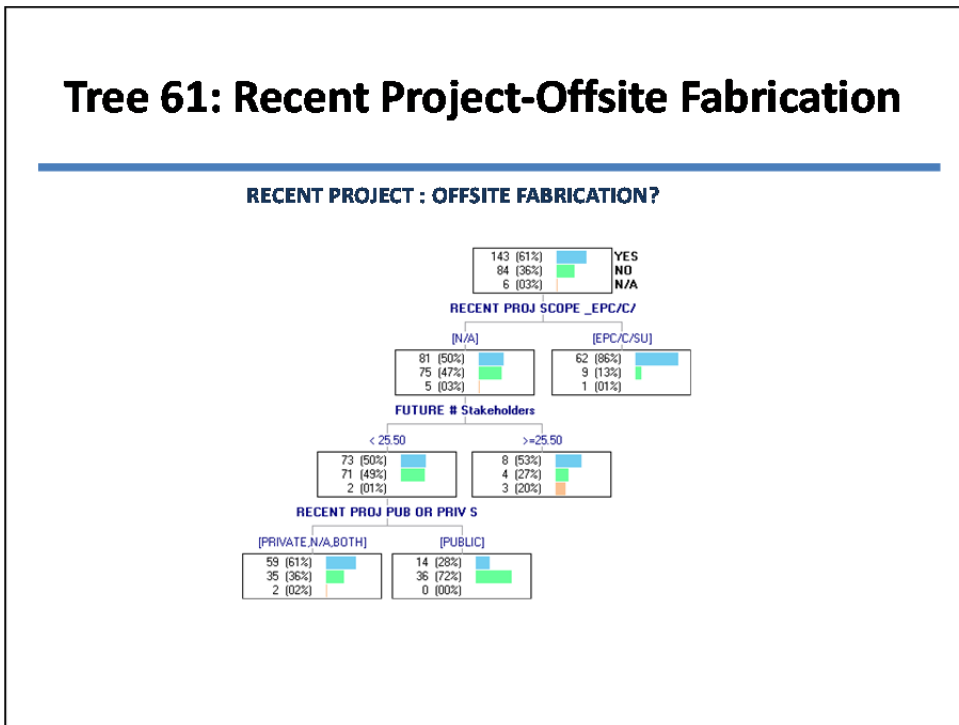


Figure F.62. Data Mining Tree #61

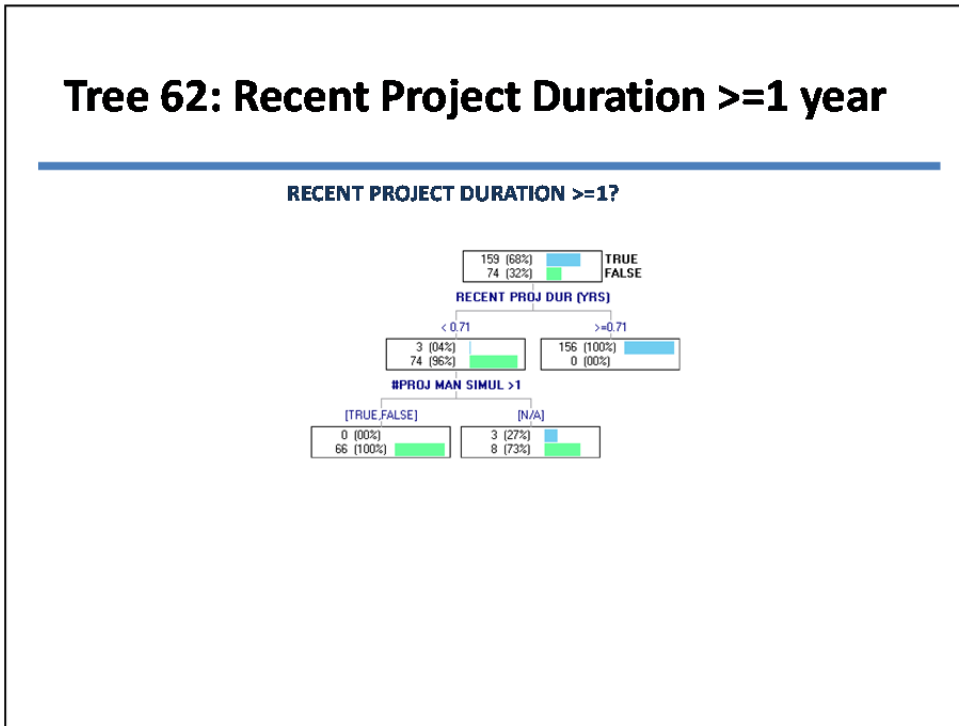


Figure F.63. Data Mining Tree #62

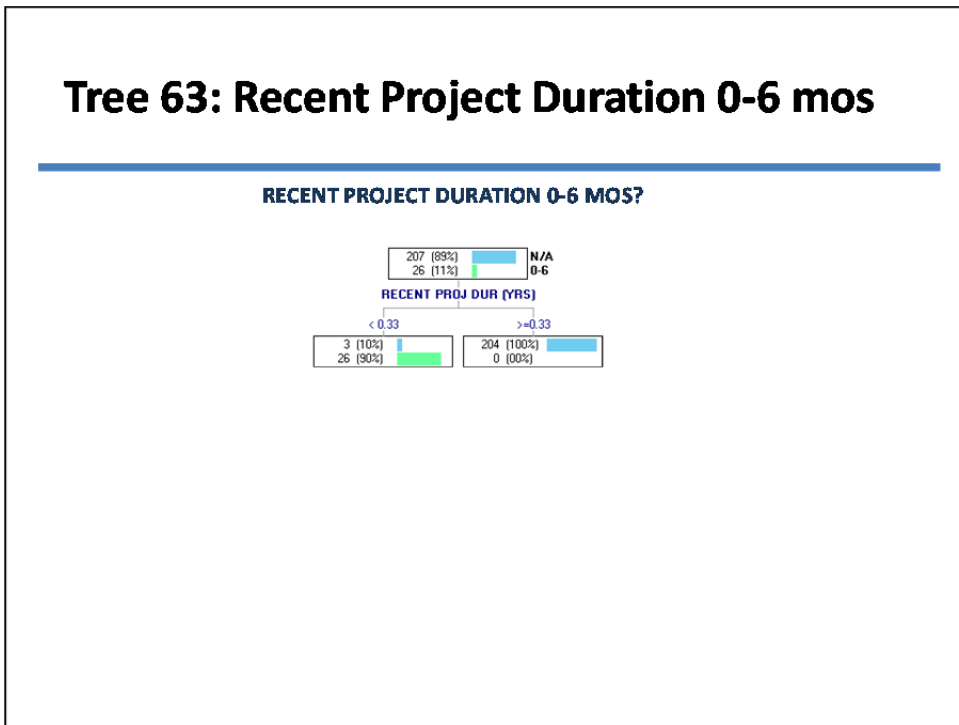


Figure F.64. Data Mining Tree #63

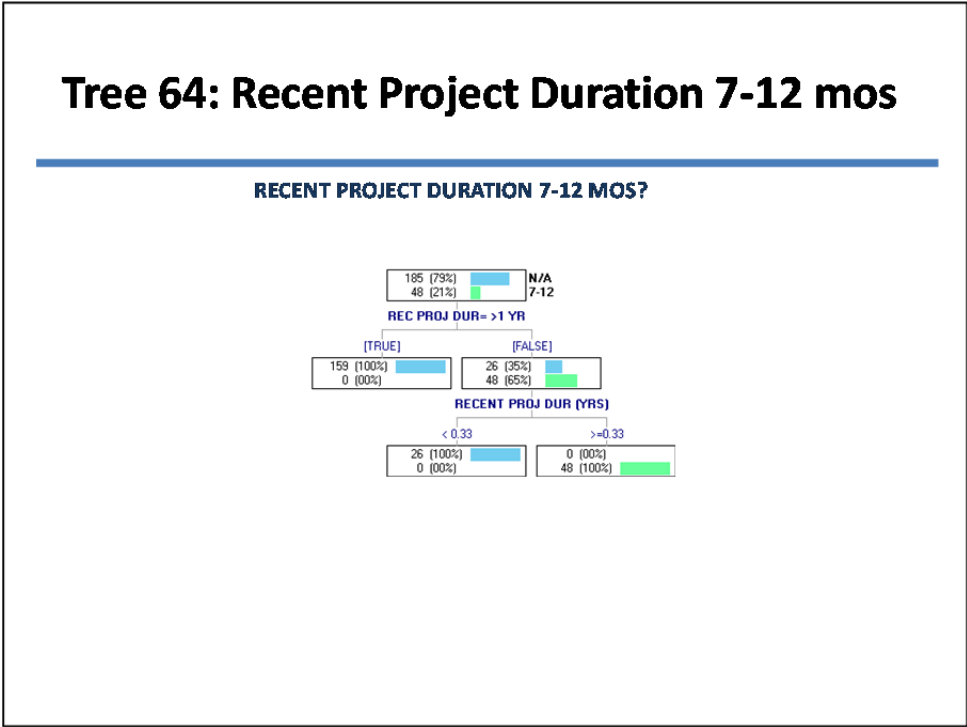


Figure F.65. Data Mining Tree #64

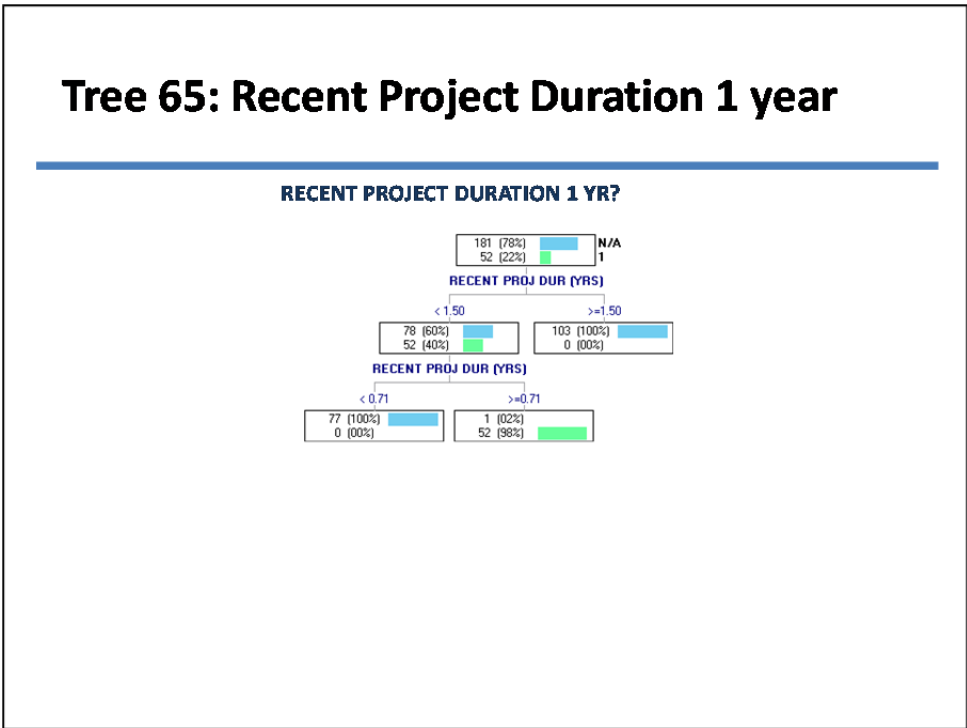


Figure F.66. Data Mining Tree #65

## Tree 66: Recent Project Duration 2 years

### RECENT PROJECT DURATION 2 YRS?

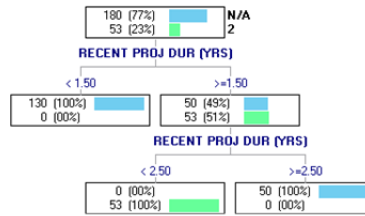


Figure F.67. Data Mining Tree #66

## Tree 67: Recent Project Duration >3 years

### RECENT PROJECT DURATION >3 YR?

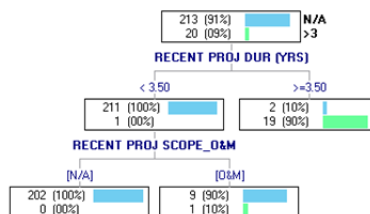


Figure F.68. Data Mining Tree #67



## Tree 68: Recent Project 0-10 Employees

### RECENT PROJECT # EMPLOYEES: 0-10?

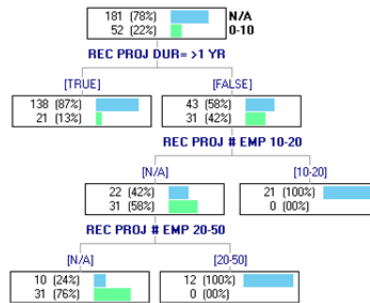


Figure F.69. Data Mining Tree #68

## Tree 69: Recent Project 10-20 Employees

### RECENT PROJECT # EMPLOYEES: 10-20?

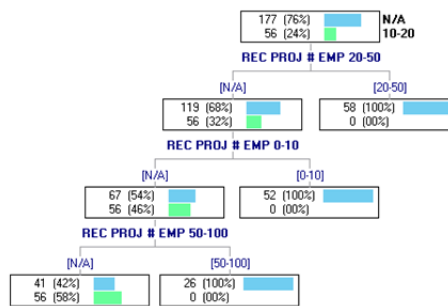


Figure F.70. Data Mining Tree #69

## Tree 70: Recent Project 20-50 Employees

### RECENT PROJECT # EMPLOYEES: 20-50?

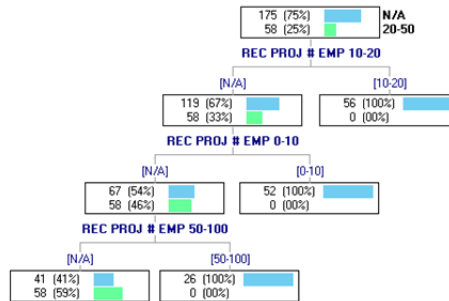


Figure F.71. Data Mining Tree #70

## Tree 71: Recent Project 100-500 Employees

### RECENT PROJECT # EMPLOYEES: 100-500?

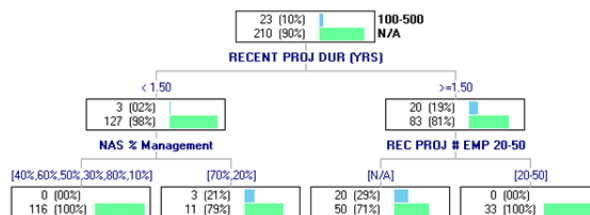


Figure F.72. Data Mining Tree #71

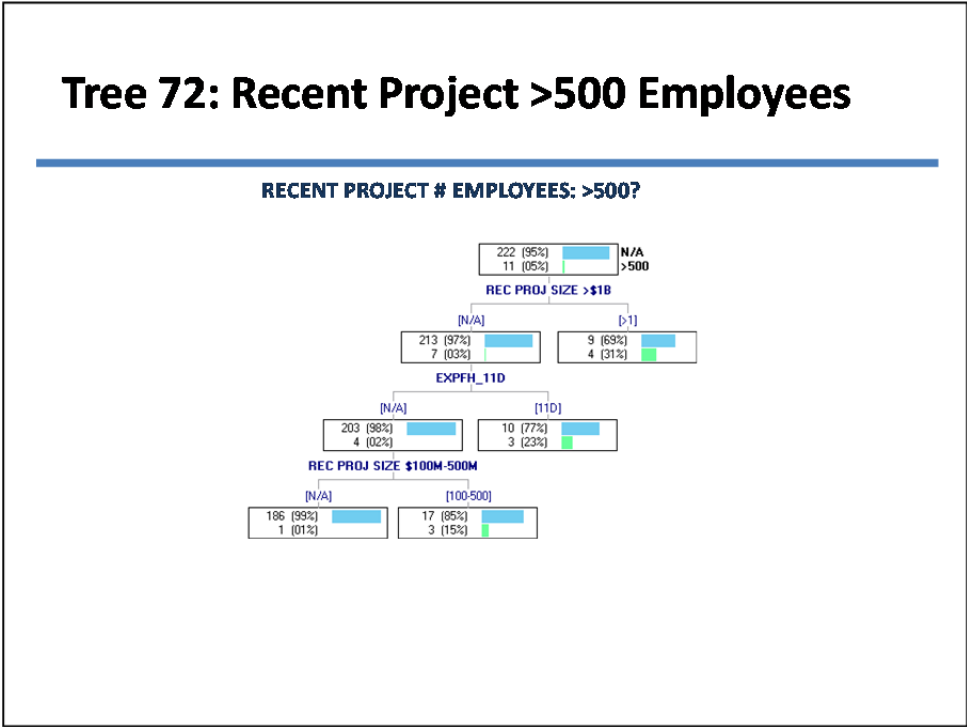


Figure F.73. Data Mining Tree #72

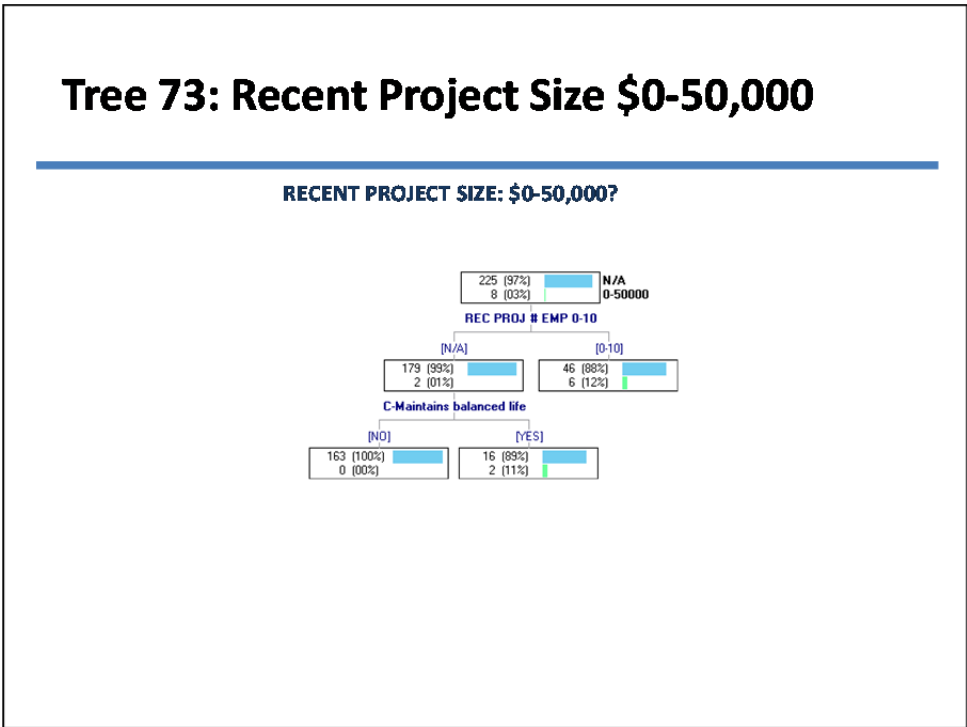


Figure F.74. Data Mining Tree #73

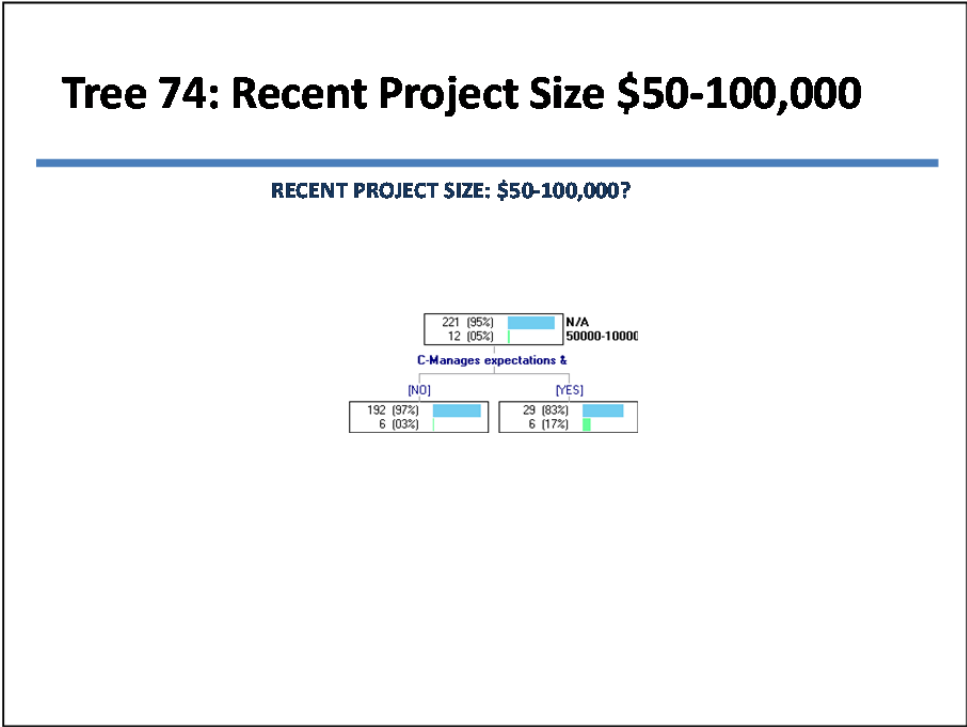


Figure F.75. Data Mining Tree #74

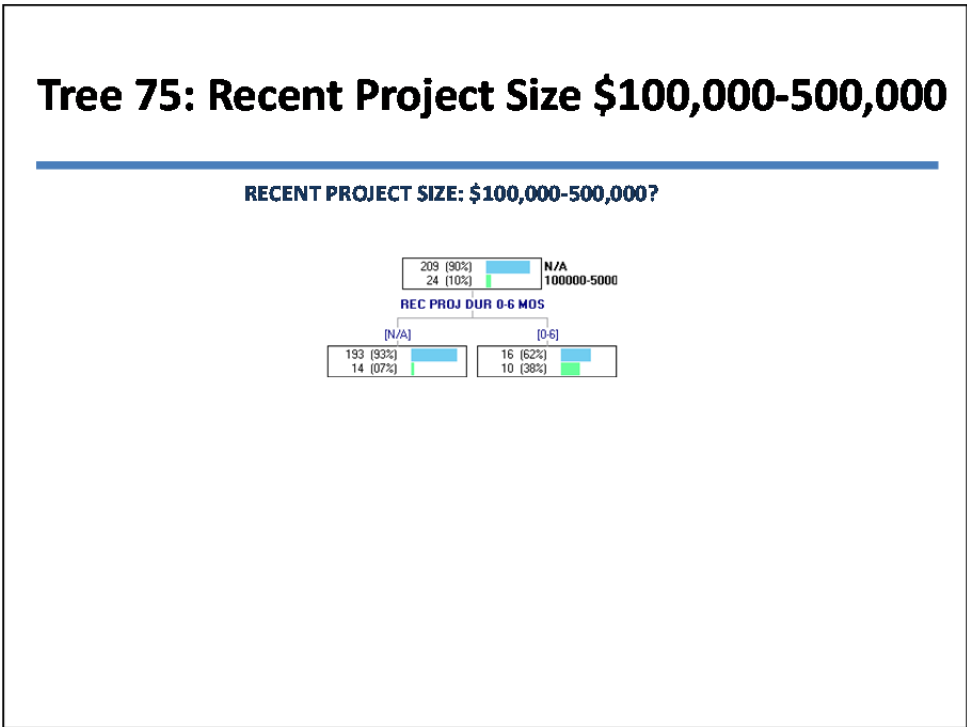


Figure F.76. Data Mining Tree #75

## Tree 76: Recent Project Size \$500,000-\$1M

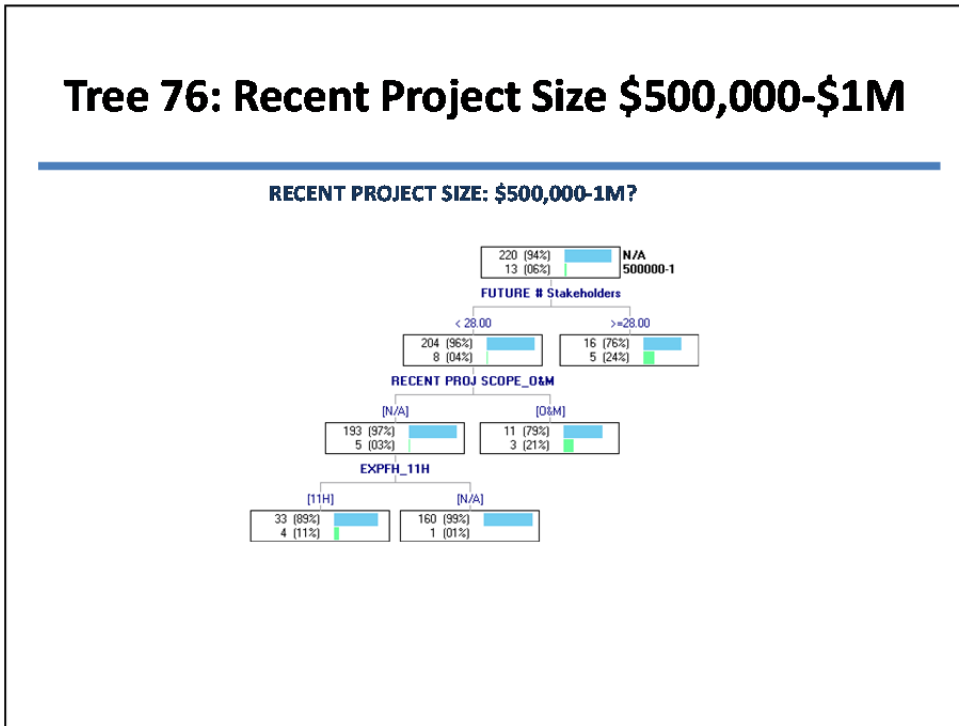


Figure F.77. Data Mining Tree #76

## Tree 77: Recent Project Size \$1M-5M

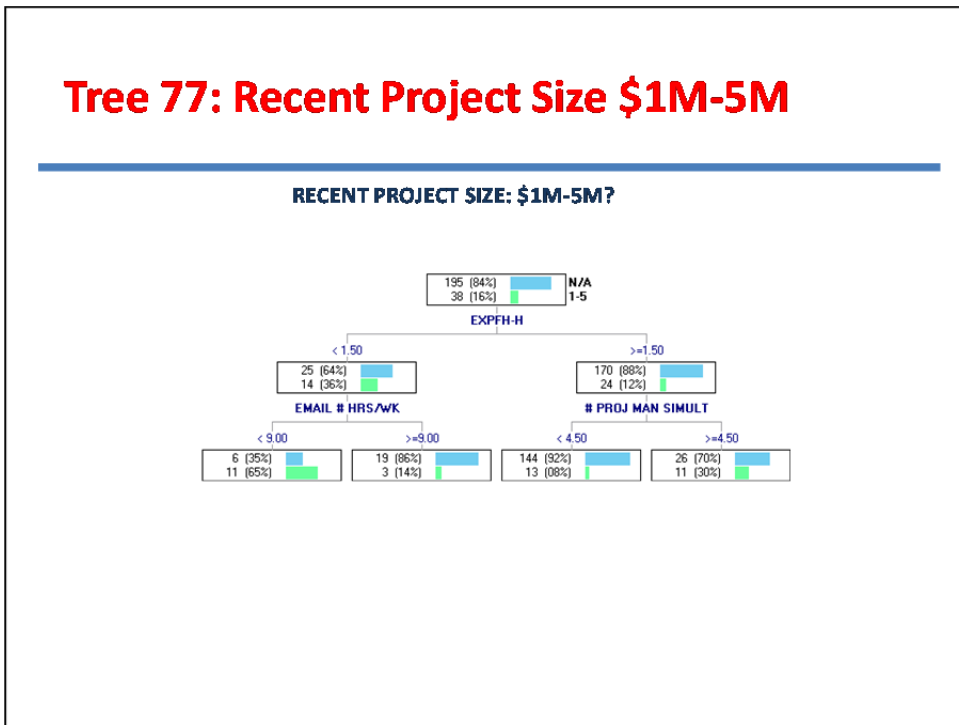


Figure F.78. Data Mining Tree #77

## Tree 78: Recent Project Size \$5M-\$10M

### RECENT PROJECT SIZE: \$5M-10M?

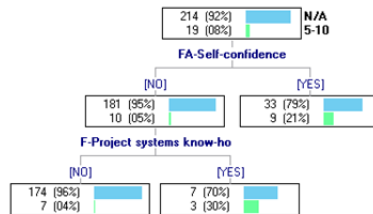


Figure F.79. Data Mining Tree #78

## Tree 79: Recent Project Size \$10M-\$50M

### RECENT PROJECT SIZE: \$10M-50M?

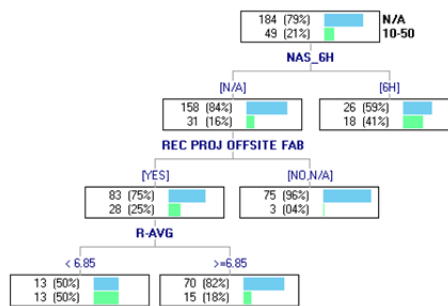


Figure F.80. Data Mining Tree #79

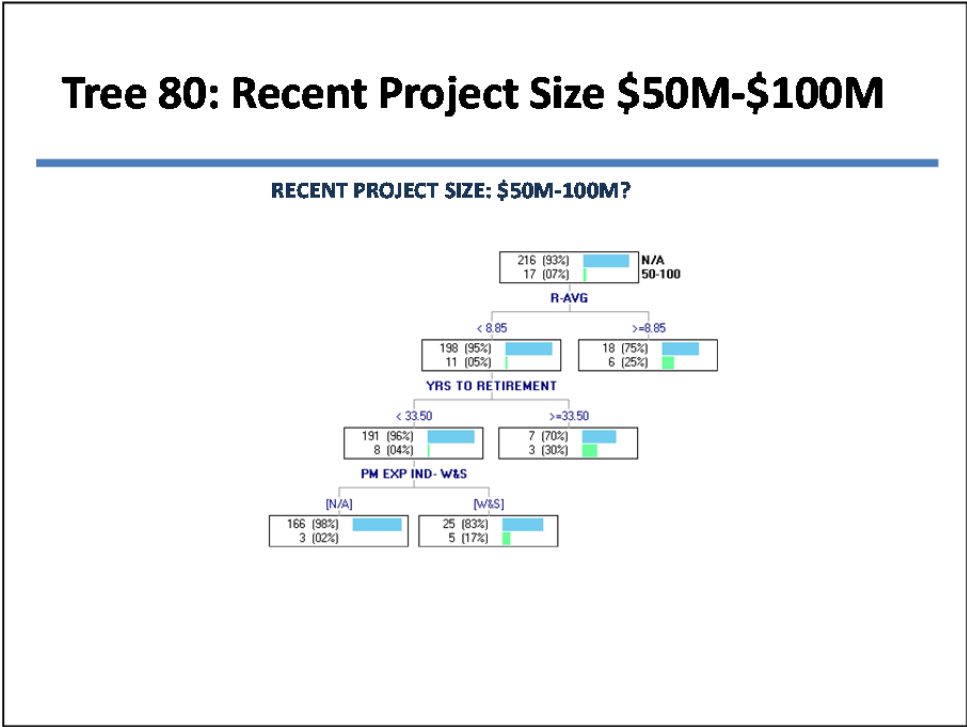


Figure F.81. Data Mining Tree #80

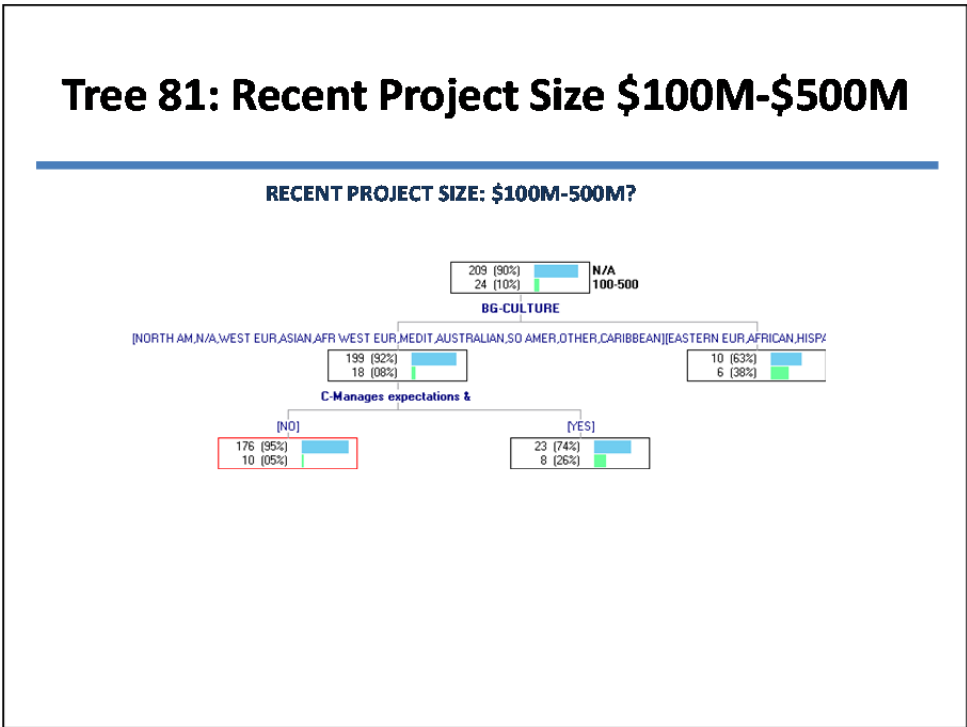


Figure F.82. Data Mining Tree #81

## Tree 82: Recent Project Size \$500M-\$1B

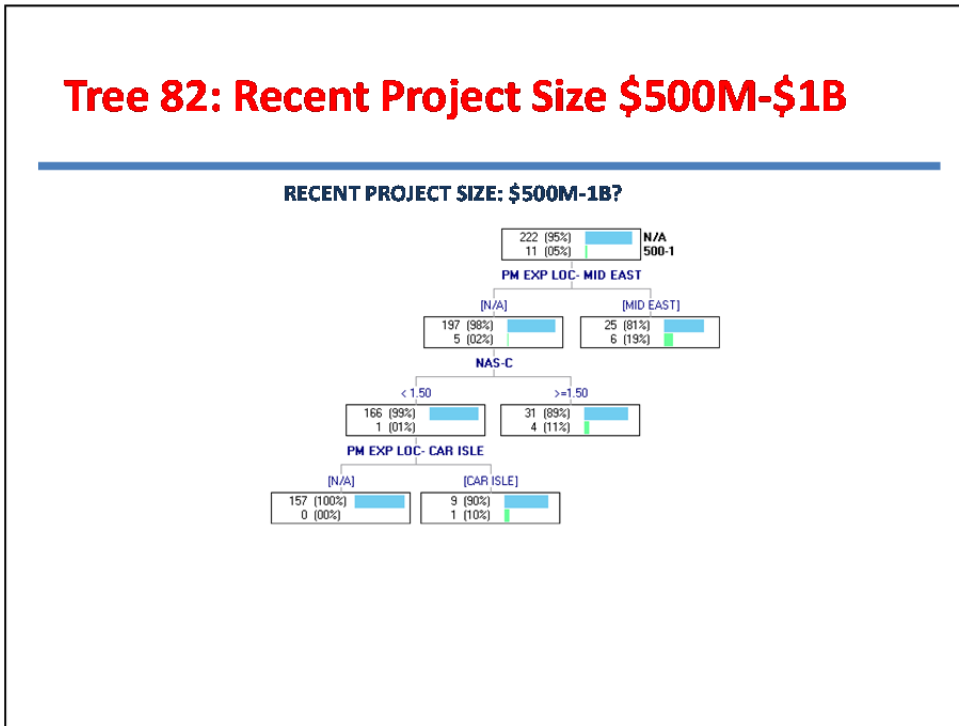


Figure F.83. Data Mining Tree #82

## Tree 83: Recent Project Size >\$1B

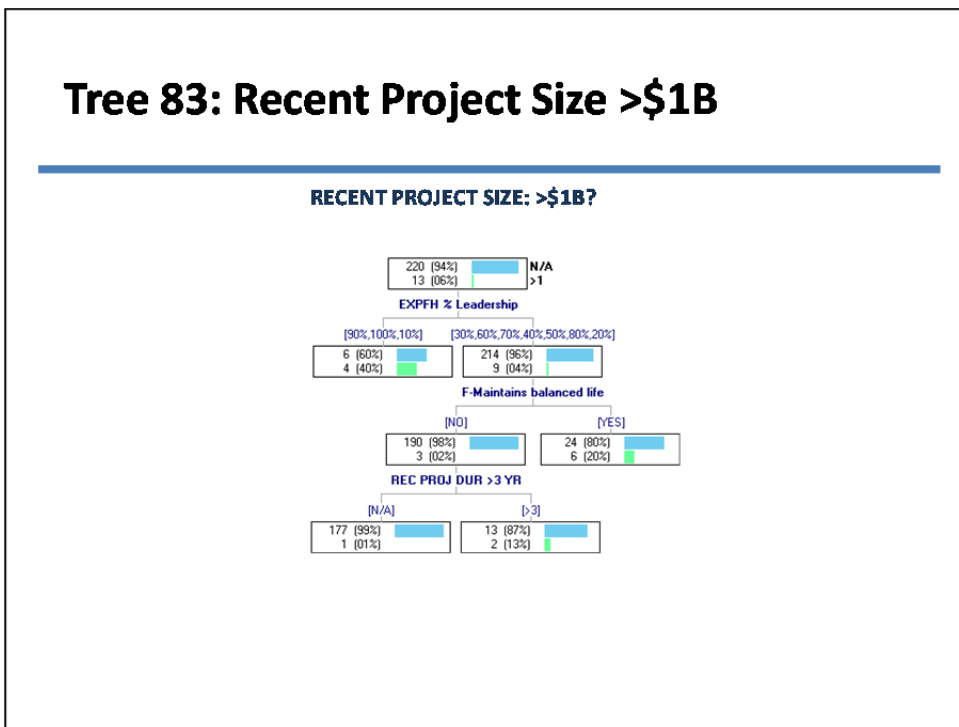


Figure F.84. Data Mining Tree #83



## Tree 84: Additional Responsibilities

### ADDITIONAL RESPONSIBILITIES TO PM?

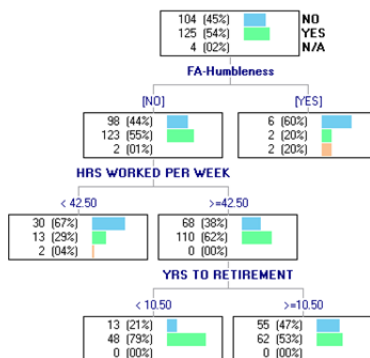


Figure F.85. Data Mining Tree #84

## Tree 85: Hours per Week >40

### HOURS/WEEK >40?

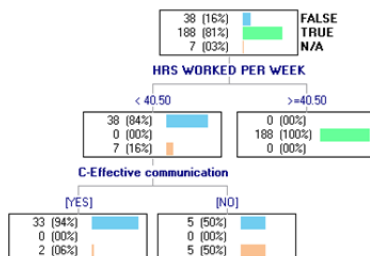


Figure F.86. Data Mining Tree #85

# Tree 86: % Leadership Cards-Entry New Proj

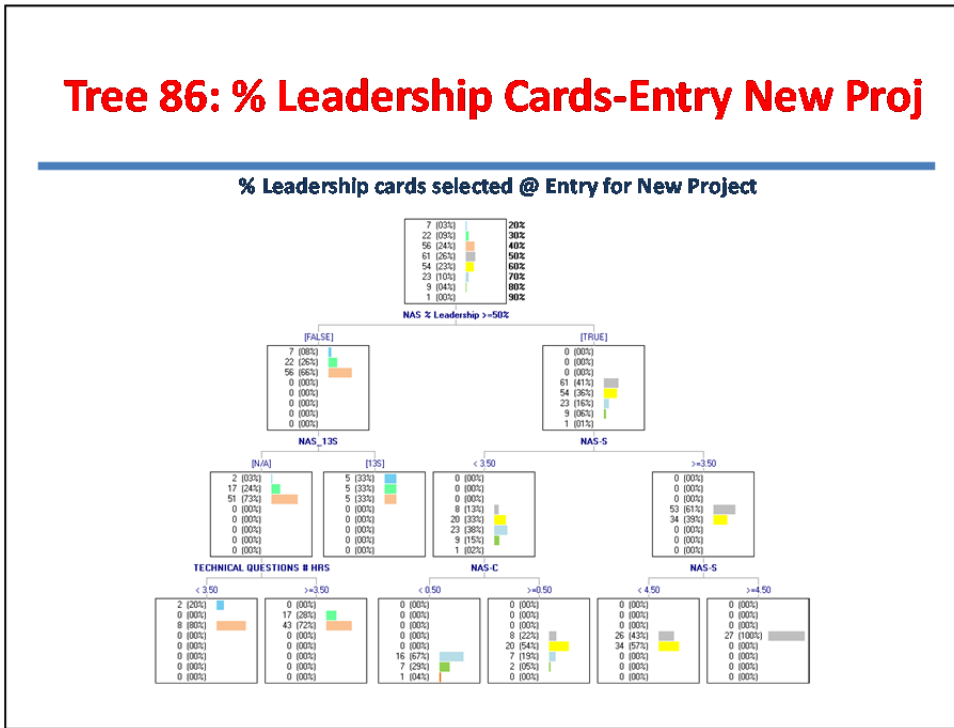


Figure F.87. Data Mining Tree #86

# Tree 87: % Leadership-Entry PFH

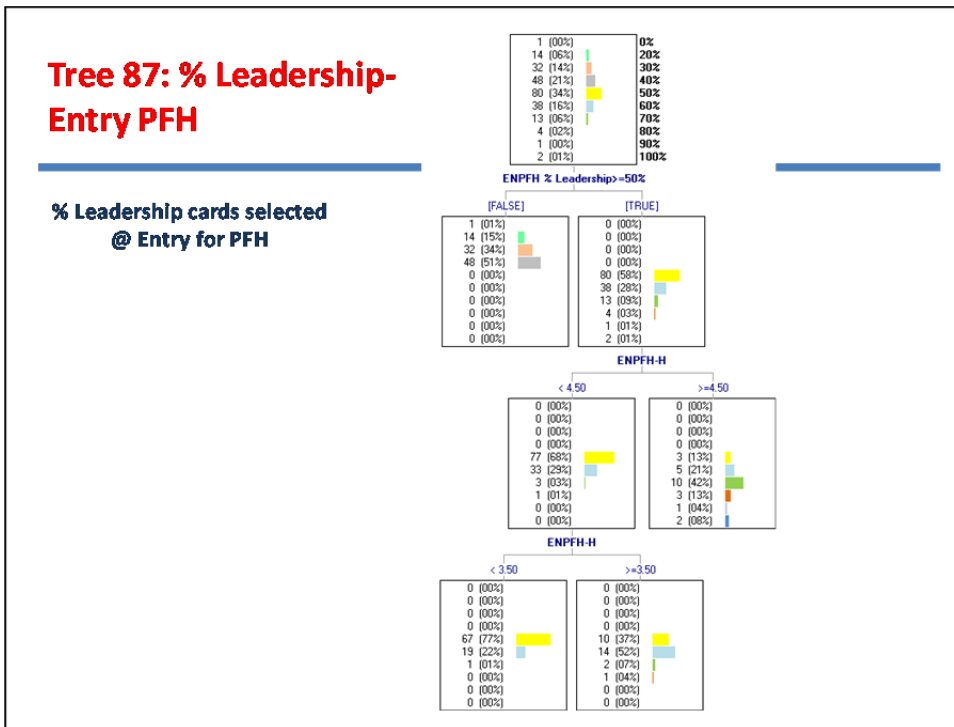


Figure F.88. Data Mining Tree #87

## Tree 88: % Leadership Cards-Exit PFH

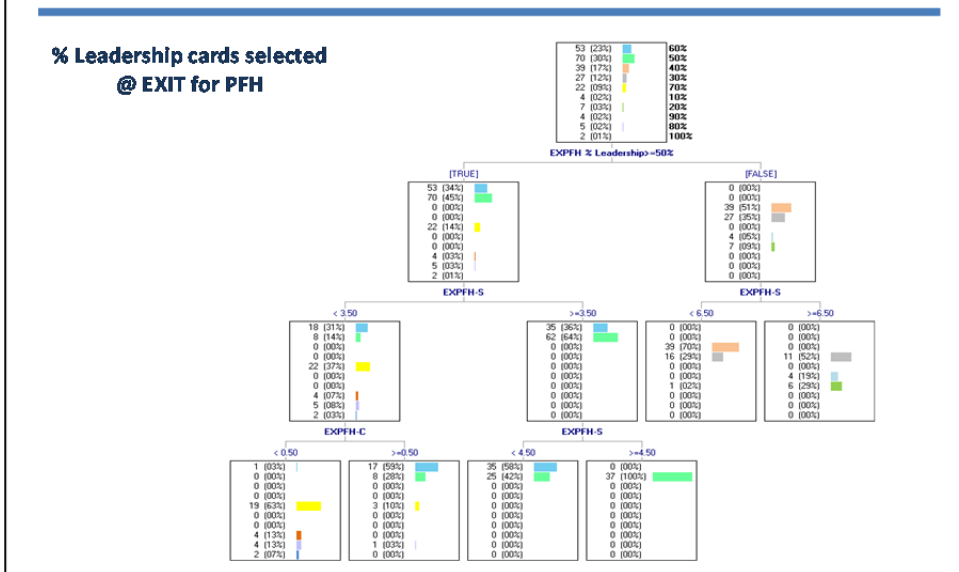


Figure F.89. Data Mining Tree #88

## Tree 89: Future Attribute-Accountable

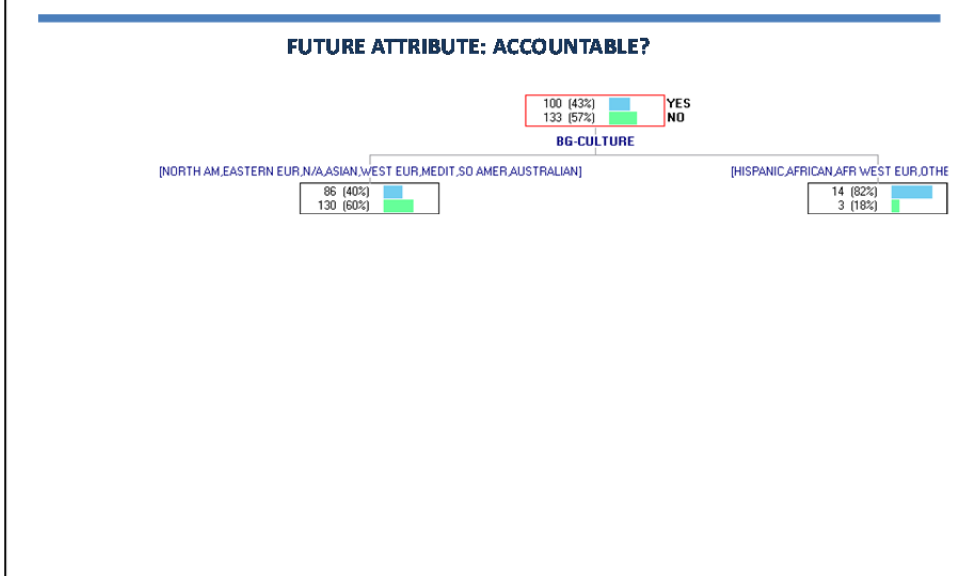


Figure F.90. Data Mining Tree #89

## Tree 90: Future Attribute-Honest & Trustworthy

FUTURE ATTRIBUTE: HONEST & TRUSTWORTHY?

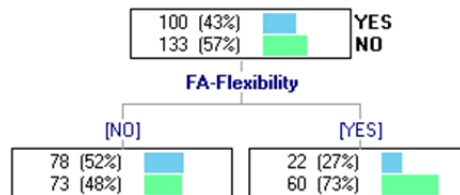


Figure F.91. Data Mining Tree #90

## Tree 91: Future Attribute-Results Driven

FUTURE ATTRIBUTE: RESULTS DRIVEN?

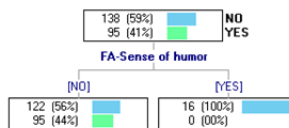


Figure F.92. Data Mining Tree #91

# Tree 92: Future Attribute-Integrity

FUTURE ATTRIBUTE: INTEGRITY?

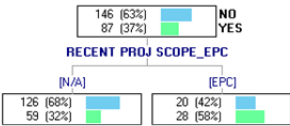


Figure F.93. Data Mining Tree #92

# Tree 93: Future Attribute-Flexibility

FUTURE ATTRIBUTE: FLEXIBILITY?

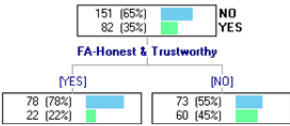


Figure F.94. Data Mining Tree #93

## Tree 94A: Current Competency-Effective Communications

Current competency: Effective communications?

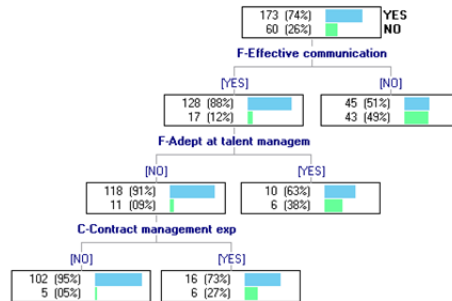
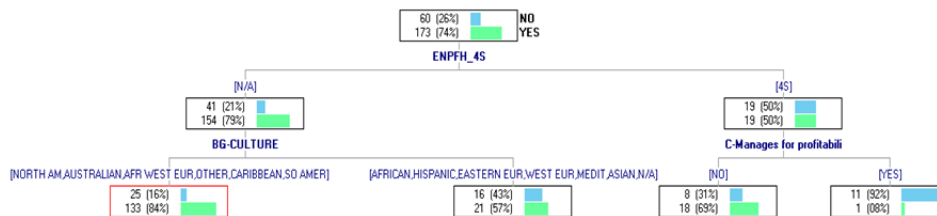


Figure F.95. Data Mining Tree #94A

## Tree 94B\*: Current Competency-Effective Communications

Current competency: Effective communications?



\*Note: excludes "Future competency: Effective Communications" from mining

Figure F.96. Data Mining Tree #94B

## Tree 95A: Current Competency-Delegates & Empowers Others

Current competency: Delegates & empowers others?

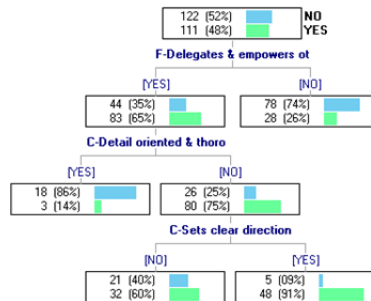
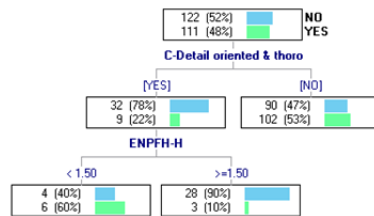


Figure F.97. Data Mining Tree #95A

## Tree 95B\*: Current Competency-Delegates & Empowers Others

Current competency: Delegates & empowers others?



\*Note: excludes "Future competency: Delegates & Empowers Others" from mining

Figure F.98. Data Mining Tree #95B

## Tree 96A: Current Competency-Active Listening & Observation

Current competency: Active listening & observation?

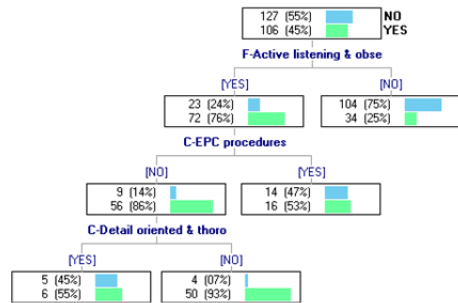
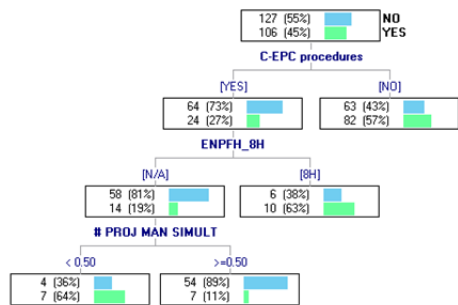


Figure F.99. Data Mining Tree #96A

## Tree 96B\*: Current Competency-Active Listening & Observation

Current competency: Active listening & observation?



\*Note: excludes "Future competency: Active Listening & Observation" from mining

Figure F.100. Data Mining Tree #96B



## Tree 97A: Current Competency-Sets Clear Direction

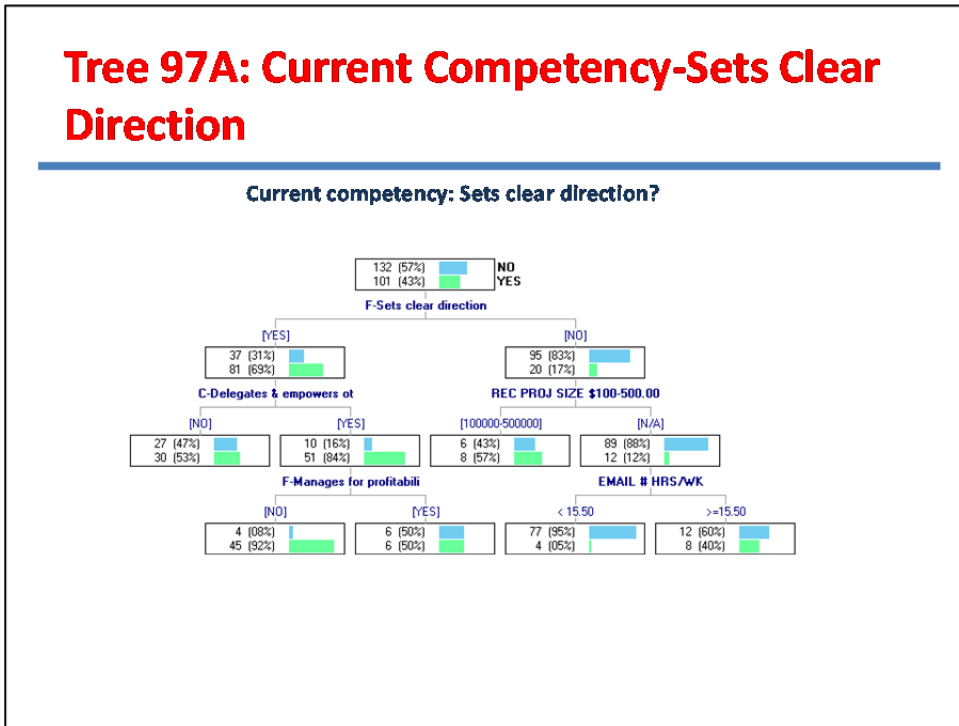


Figure F.101. Data Mining Tree #97A

## Tree 97B\*: Current Competency-Sets Clear Direction

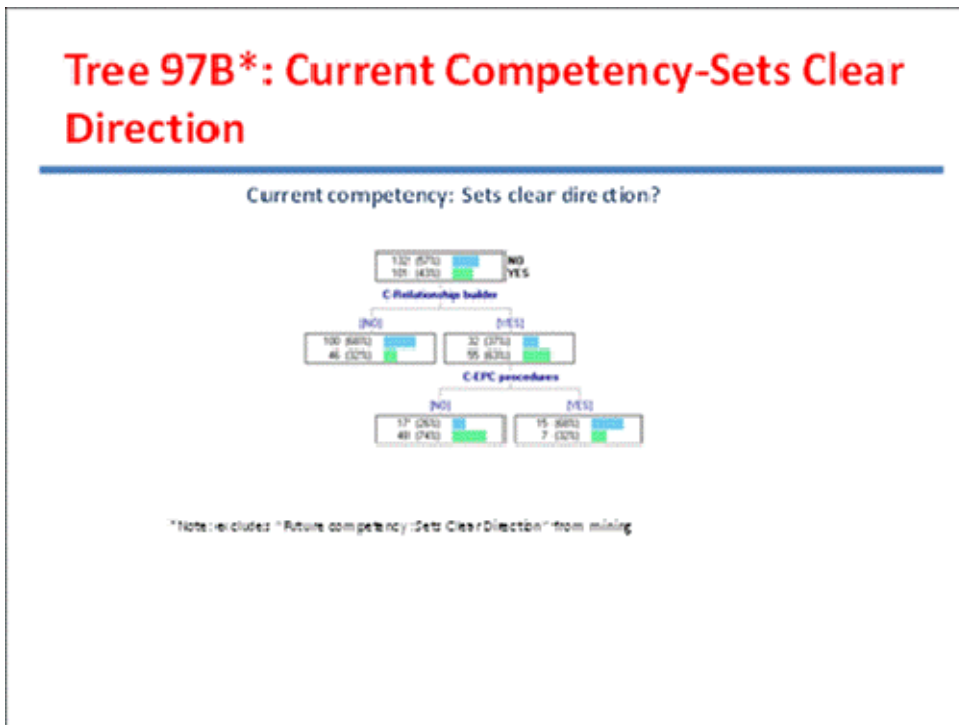


Figure F.102. Data Mining Tree #97B

## Tree 98A: Current Competency-Leads by Example

Current competency: Leads by example?

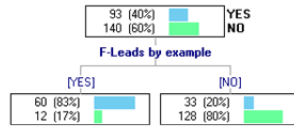
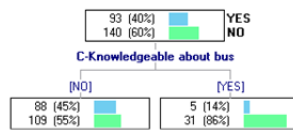


Figure F.103. Data Mining Tree #98A

## Tree 98B\*: Current Competency-Leads by Example

Current competency: Leads by example?



\*Note: excludes "Future competency: Leads by Example" from mining

Figure F.104. Data Mining Tree #98B

# Tree 99A: Current Competency-Cost, Planning, & Scheduling

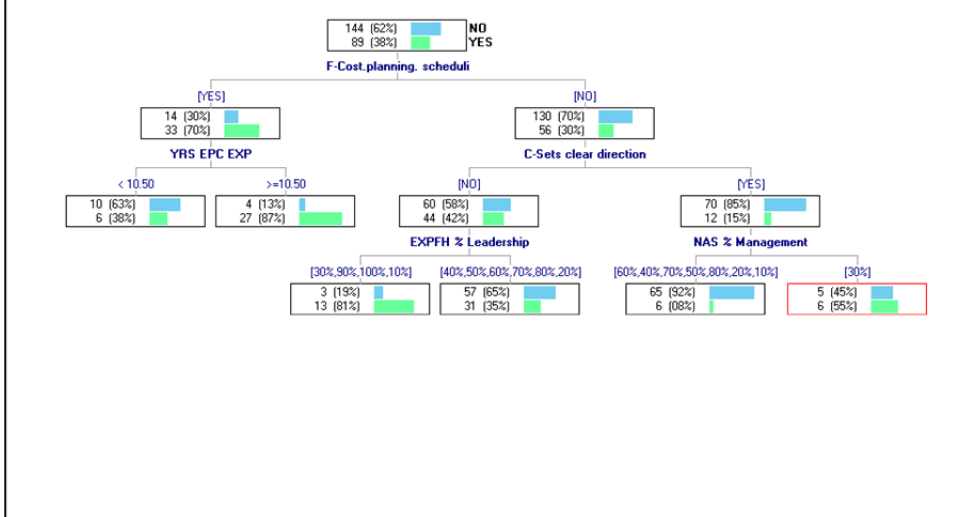
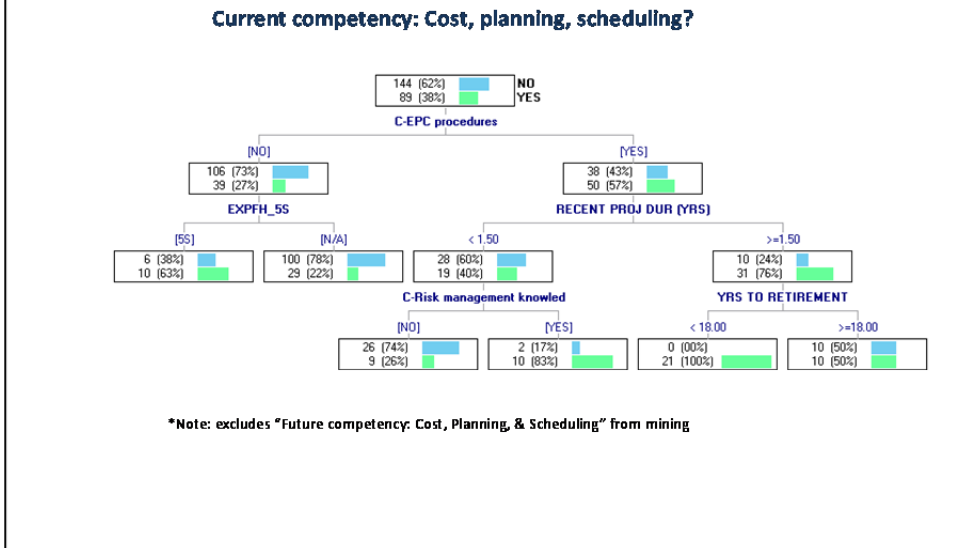


Figure F.105. Data Mining Tree #99A

# Tree 99B\*: Current Competency-Cost, Planning, & Scheduling



\*Note: excludes "Future competency: Cost, Planning, & Scheduling" from mining

Figure F.106. Data Mining Tree #99B

## Tree 100A: Current Competency-EPC Procedures

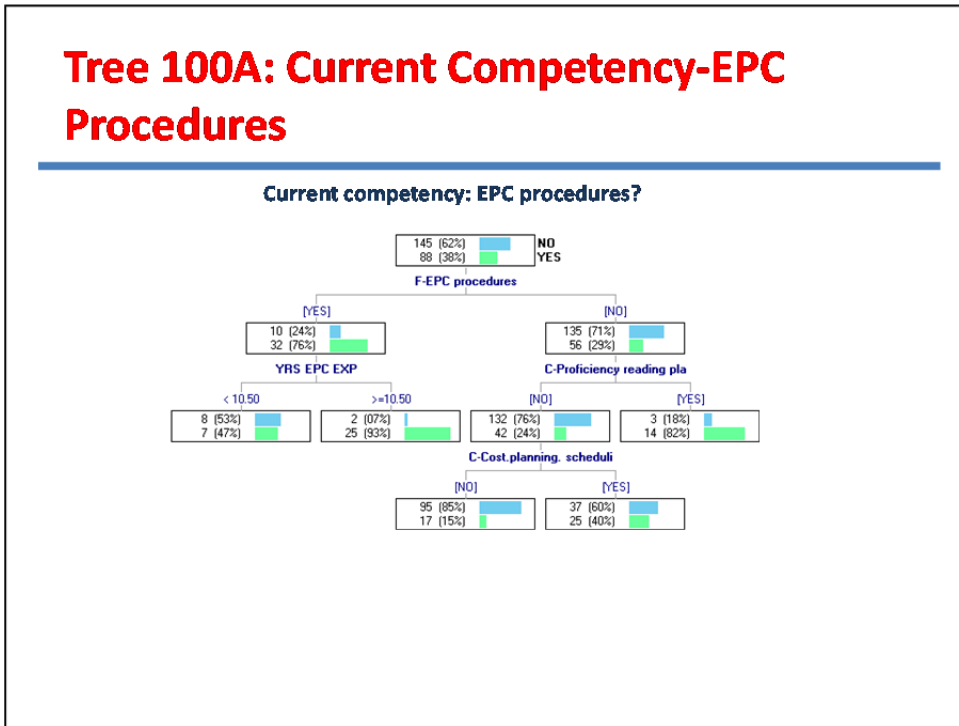


Figure F.107. Data Mining Tree #100A

## Tree 100B\*: Current Competency-EPC Procedures

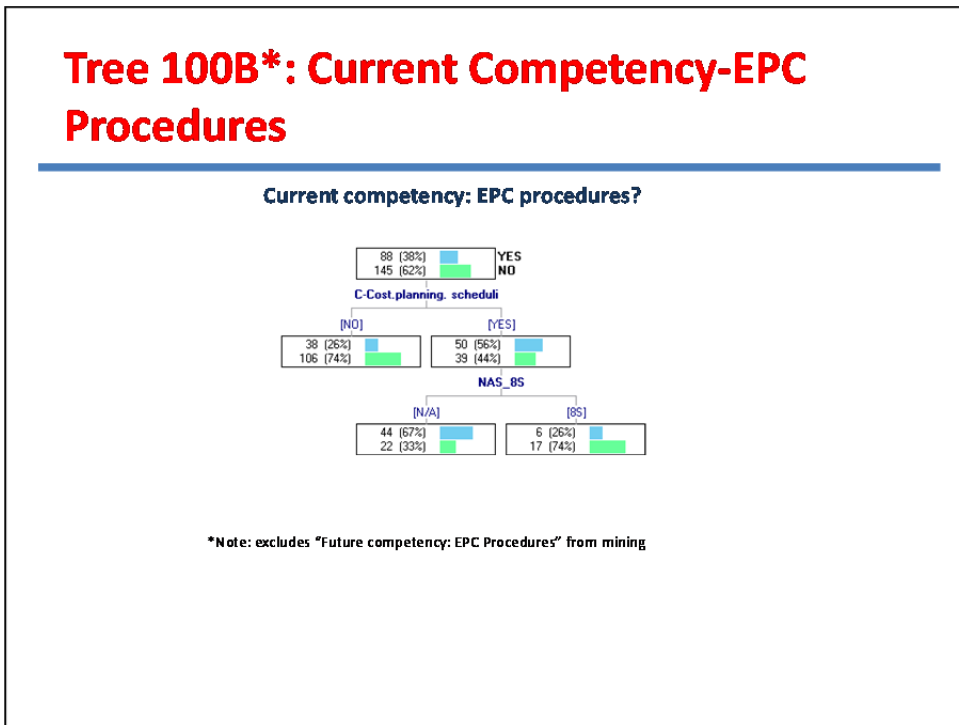


Figure F.108. Data Mining Tree #100B

## Tree 101A: Current Competency-Relationship Builder

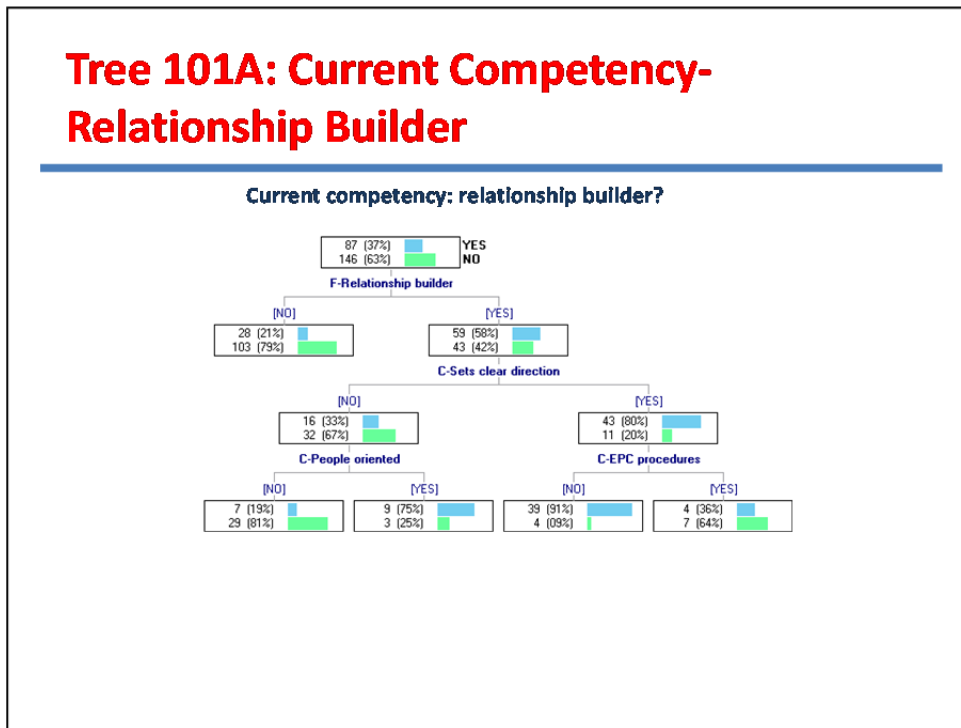


Figure F.109. Data Mining Tree #101A

## Tree 101B\*: Current Competency-Relationship Builder

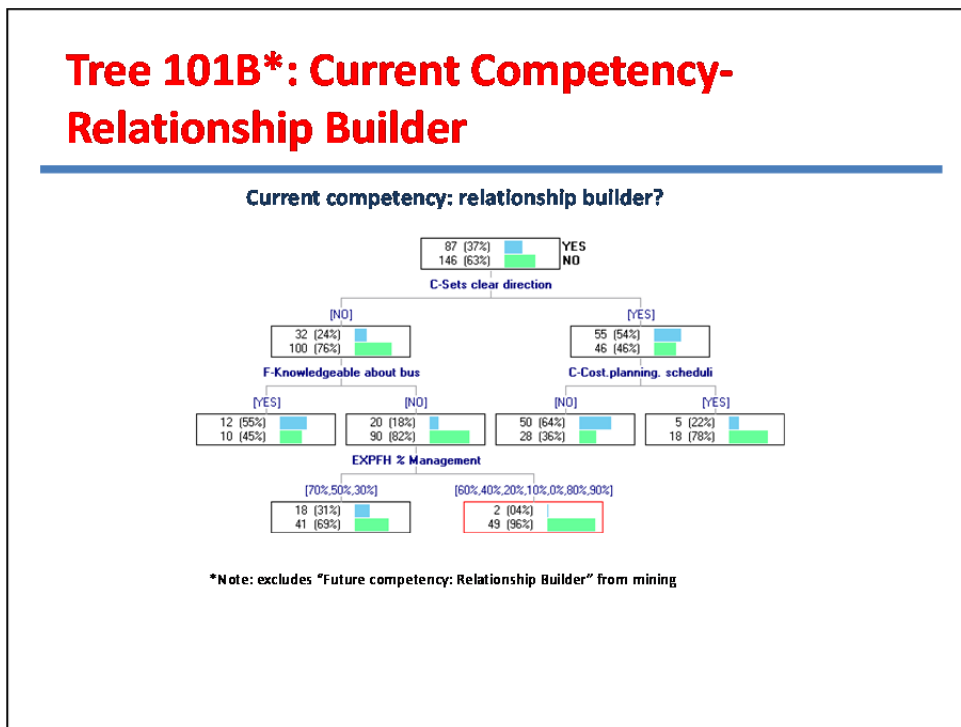


Figure F.110. Data Mining Tree #101B

## Tree 102A: Current Competency-Actively Participates

Current competency: actively participates?

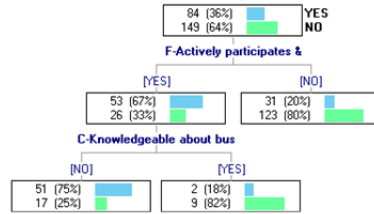
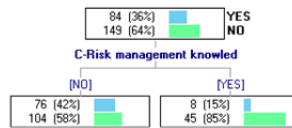


Figure F.111. Data Mining Tree #102A

## Tree 102B\*: Current Competency-Actively Participates

Current competency: actively participates?



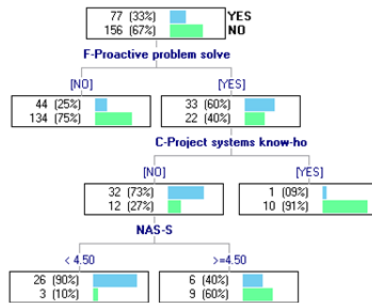
\*Note: excludes "Future competency: Actively Participates" from mining

Figure F.112. Data Mining Tree #102B

## Tree 103A: Current Competency-Proactive Problem Solver

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**Current competency: proactive problem solver?**



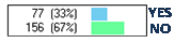
\*Note: excludes "Future competency: Proactive Problem Solver" from mining

Figure F.113. Data Mining Tree #103A

## Tree 103B\*: Current Competency-Proactive Problem Solver

---

**Current competency: proactive problem solver?**



\*Note: excludes "Future competency: Proactive Problem Solver" from mining

Figure F.114. Data Mining Tree #103B

## Tree 104A: Future Competency-Effective Communication

Future competency: effective communication?

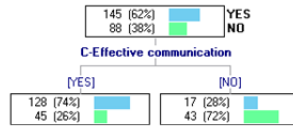
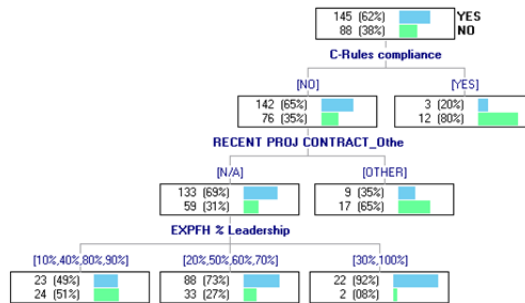


Figure F.115. Data Mining Tree #104A

## Tree 104B\*: Future Competency-Effective Communication

Future competency: effective communication?



\*Note: excludes "Current competency: Effective Communication" from mining

Figure F.116. Data Mining Tree #104B



## Tree 105A: Future Competency-Delegates & Empowers

Future competency: delegates & empowers?

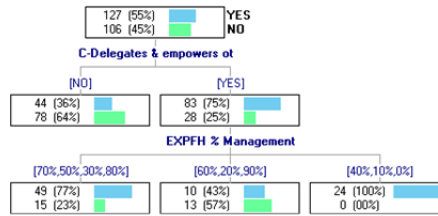
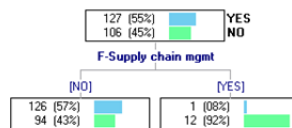


Figure F.117. Data Mining Tree #105A

## Tree 105B\*: Future Competency-Delegates & Empowers

Future competency: delegates & empowers?



\*Note: excludes "Current competency: Delegates & Empowers" from mining

Figure F.118. Data Mining Tree #105B

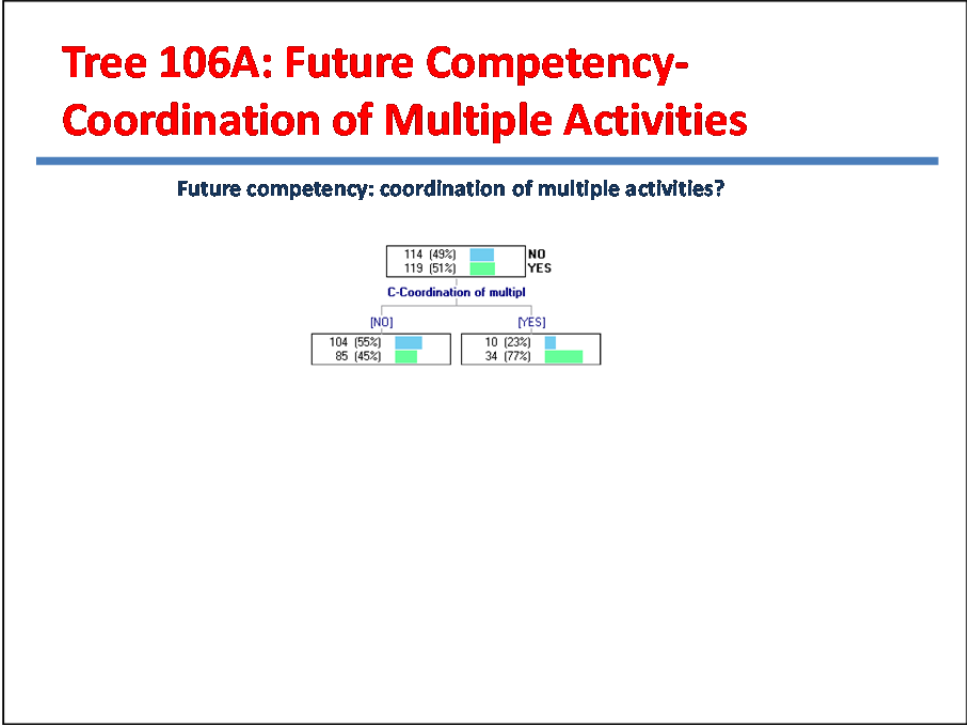


Figure F.119. Data Mining Tree #106A

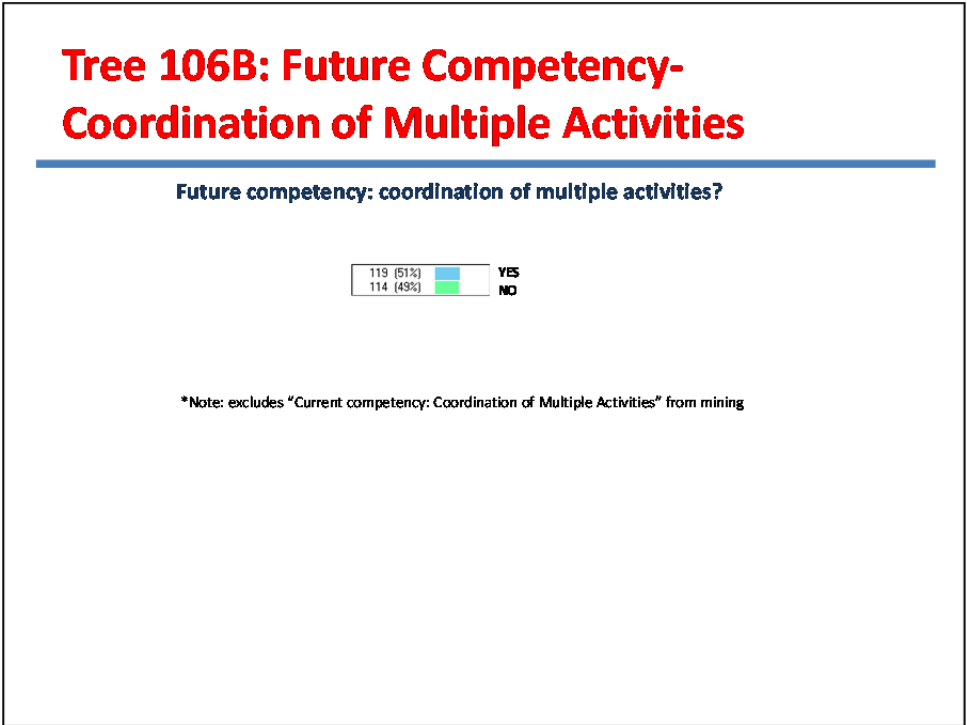


Figure F.120. Data Mining Tree #106B

## Tree 107A: Future Competency-Sets Clear Direction

Future competency: sets clear direction?

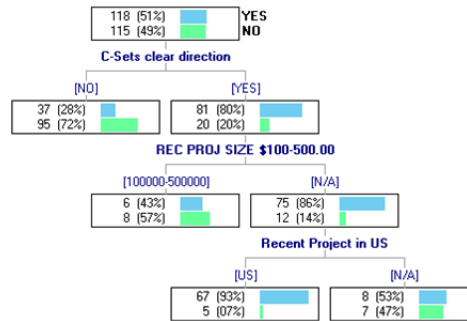
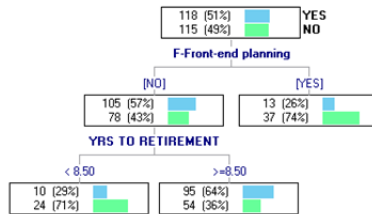


Figure F.121. Data Mining Tree #107A

## Tree 107B\*: Future Competency-Sets Clear Direction

Future competency: sets clear direction?



\*Note: excludes "Current competency: Sets Clear Direction" from mining

Figure F.122. Data Mining Tree #107B

## Tree 108A: Future Competency-Mentors & Grows the Next Generation

Future competency: mentors & grows the next generation?

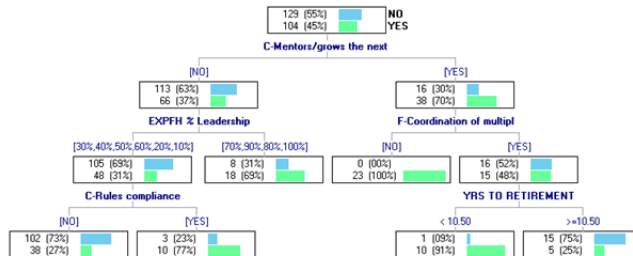
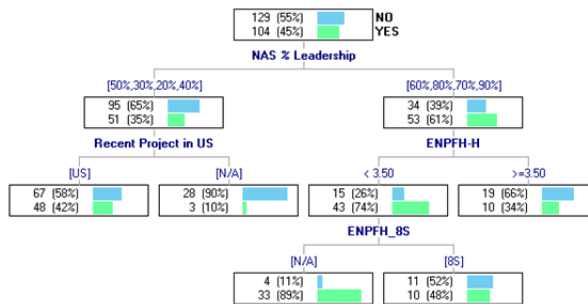


Figure F.123. Data Mining Tree #108A

## Tree 108B\*: Future Competency-Mentors & Grows the Next Generation

Future competency: mentors & grows the next generation?



\*Note: excludes "Current competency: Mentors & Grows the Next Generation" from mining

Figure F.124. Data Mining Tree #108B

## Tree 109A: Future Competency-Relationship Builder

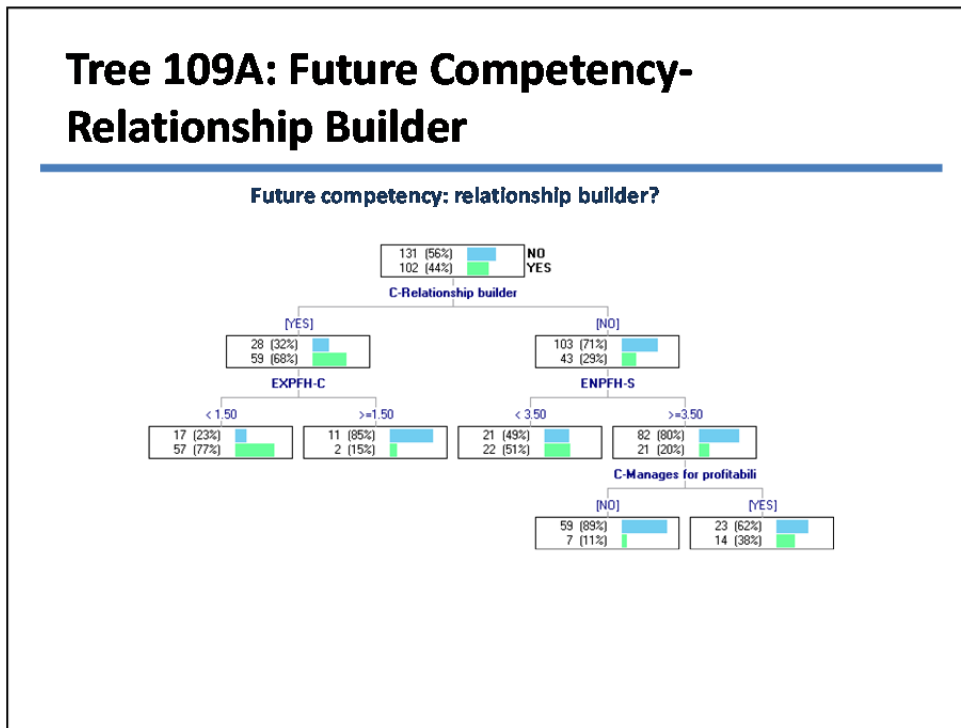


Figure F.125. Data Mining Tree #109A

## Tree 109B\*: Future Competency-Relationship Builder

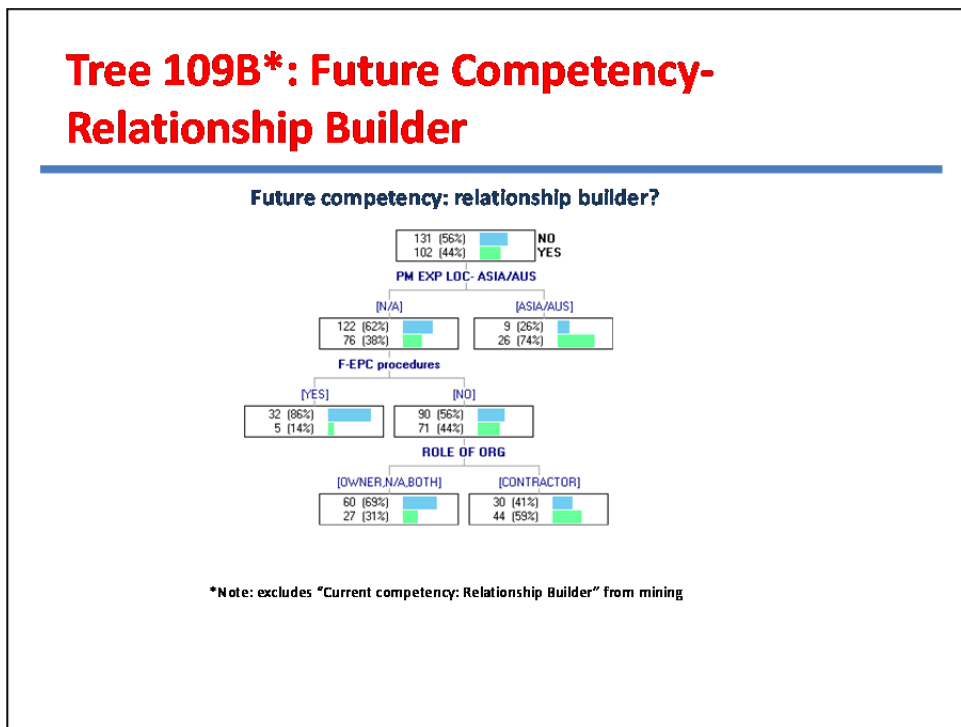


Figure F.126. Data Mining Tree #109B

# Tree 110A: Future Competency-Active Listening

Future competency: active listening?

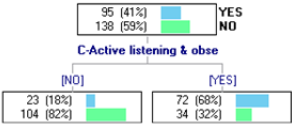


Figure F.127. Data Mining Tree #110A

# Tree 110B\*: Future Competency-Active Listening

Future competency: active listening?



\*Note: excludes "Current competency: Active Listening" from mining

Figure F.128. Data Mining Tree #110B

## Tree 111A: Future Competency-People Oriented

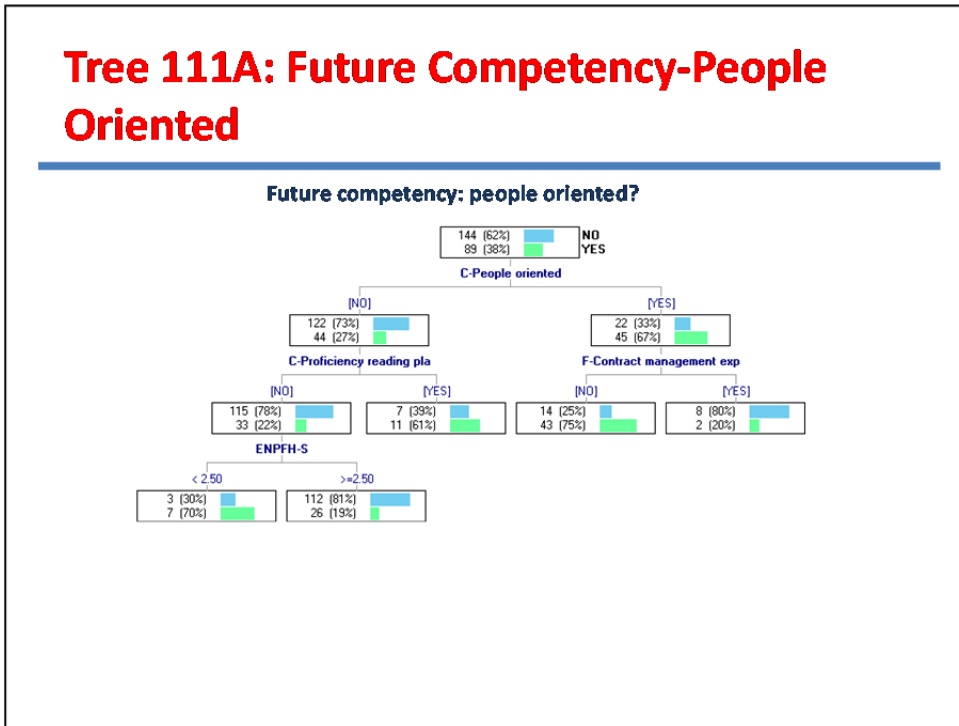


Figure F.129. Data Mining Tree #111A

## Tree 111B\*: Future Competency-People Oriented

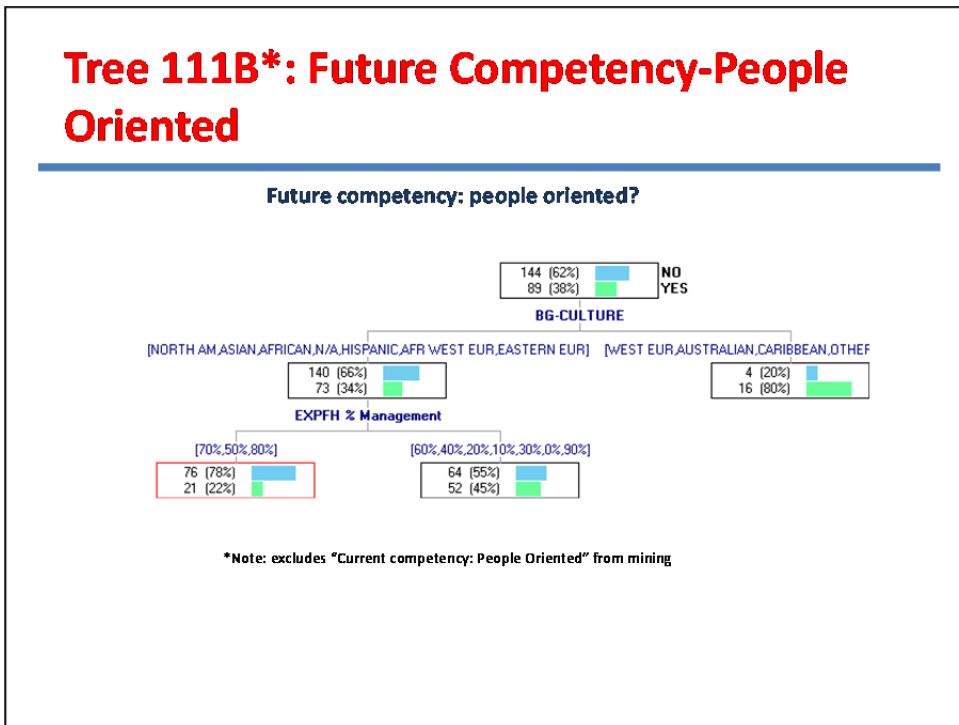


Figure F.130. Data Mining Tree #111B

## Tree 112A: Future Competecy-Actively Participates

Future competency: actively participates?

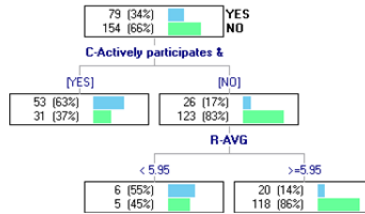
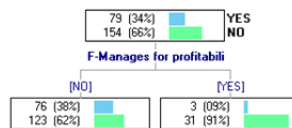


Figure F.131. Data Mining Tree #112A

## Tree 112B\*: Future Competecy-Actively Participates

Future competency: actively participates?



\*Note: excludes "Current competency: Actively Participates" from mining

Figure F.132. Data Mining Tree #112B



## Tree 113A: Future Competency-Leads by Example

Future competency: leads by example?

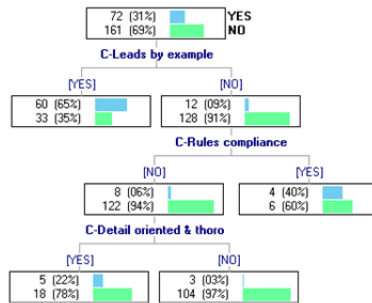
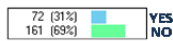


Figure F.133. Data Mining Tree #113A

## Tree 113B\*: Future Competency-Leads by Example

Future competency: leads by example?



\*Note: excludes "Current competency: Actively Participates" from mining

Figure F.134. Data Mining Tree #113B

## Tree 114: Entry New Project-Selected 10 Spades

Entry-new project assignment: selected 10 Spades?

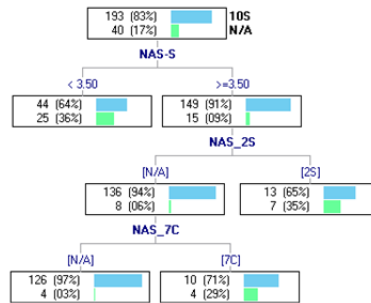


Figure F.135. Data Mining Tree #114

## Tree 115: Entry PFH-Selected 10 Spades

Entry-Project from Hell: selected 10 Spades?

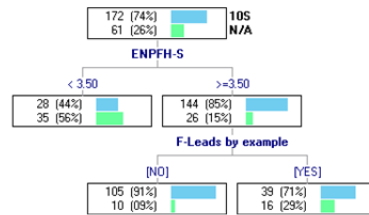


Figure F.136. Data Mining Tree #115

## Tree 116: Exit PFH-Selected 10 Spades

Exit-Project from Hell: selected 10 Spades?

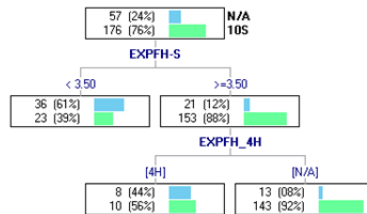


Figure F.137. Data Mining Tree #116

## Tree 117: Entry New Project->= 50% Leadership Cards

Entry- New Assignment: selected >=50% Leadership cards?

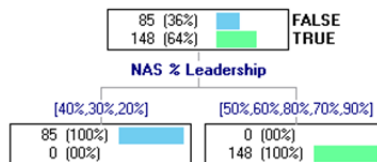


Figure F.138. Data Mining Tree #117

## Tree 118: Entry PFH- >= 50% Leadership Cards

Entry- PFH: selected >=50% Leadership cards?

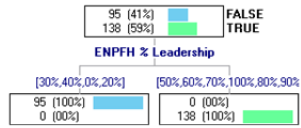


Figure F.139. Data Mining Tree #118

## Tree 119: Entry PFH- >= 50% Leadership Cards

Exit- PFH: selected >=50% Leadership cards?

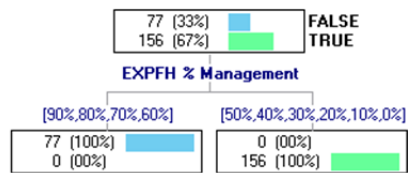


Figure F.140. Data Mining Tree #119

## Tree 120: Entry PFH-Selected 7 Spades

Entry PFH: selected 7 Spades?

"Identify the risk on the project and develop a plan to mitigate those risks."

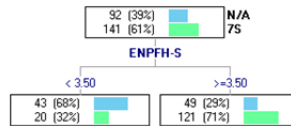


Figure F.141. Data Mining Tree #120

## Tree 121: Entry PFH-Selected Queen of Spades

Entry PFH: selected Queen of Spades?

"Conduct an alignment meeting with all stakeholders."

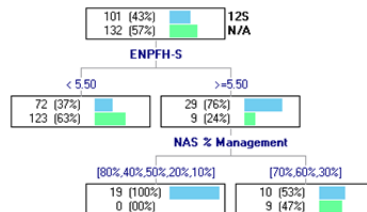


Figure F.142. Data Mining Tree #121

## Tree 122: Entry PFH-Selected 9 of Spades

Entry PFH: selected 9 of Spades?

"Identify and define the problem; combine, unify and coordinate the various processes and project activities necessary to solve it."

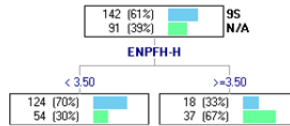


Figure F.143. Data Mining Tree #122

## Tree 123: Entry PFH-Selected 6 of Spades

Entry PFH: selected 6 of Spades?

"Identify problems; set clear and achievable objectives."

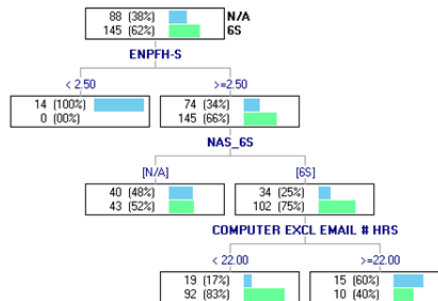


Figure F.144. Data Mining Tree #123

## Tree 124: Entry PFH-Selected 9 of Diamonds

Entry PFH: selected 9 of Diamonds?  
 "Start weekly face-to-face communication with the owner."

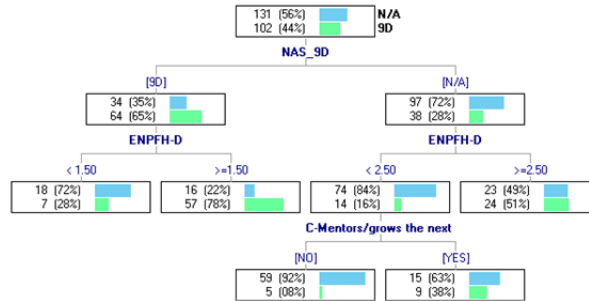


Figure F.145. Data Mining Tree #124

## Tree 125: Entry PFH-Selected Ace of Hearts

Entry PFH: selected Ace of Hearts?  
 "Immediately schedule meetings with all employees to determine their views and their recommendations of the inherent problems."

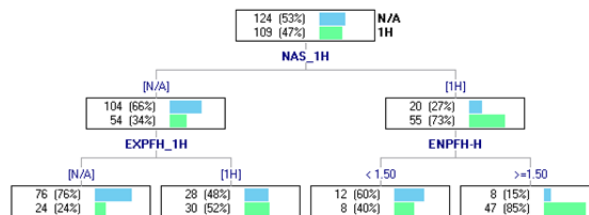


Figure F.146. Data Mining Tree #125

## Tree 126: Entry PFH-Selected 10 of Diamonds

Entry PFH: selected 10 of Diamonds?

“Practice complete openness by meeting with the owners’ representatives and explain problem, constraints, and what to expect.”

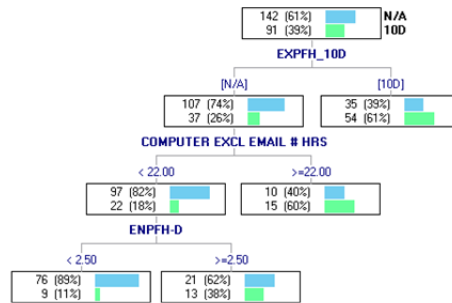


Figure F.147. Data Mining Tree #126

## Tree 127: Entry PFH-Selected 6 of Diamonds

Entry PFH: selected 6 of Diamonds?

“Create a performance measurement system with simple measurements that are directly connected to goals of the organization, hold employees accountable, and provide immediate feedback.”

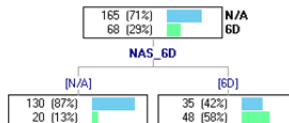


Figure F.148. Data Mining Tree #127



## Tree 128: Entry PFH-Selected 8 of Spades

**Entry PFH: selected 8 of Spades?**  
**“Organize a cyclical process of Plan, Do, Check, Act, and Implement, into the project team.”**

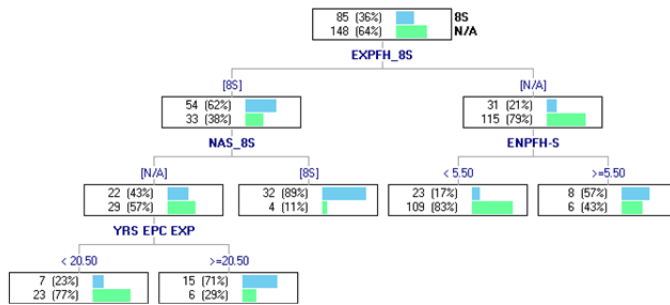


Figure F.149. Data Mining Tree #128

## Tree 129: Recent Project-Multiple Engineering Offices

**Recent Project: Multiple engineering offices?**

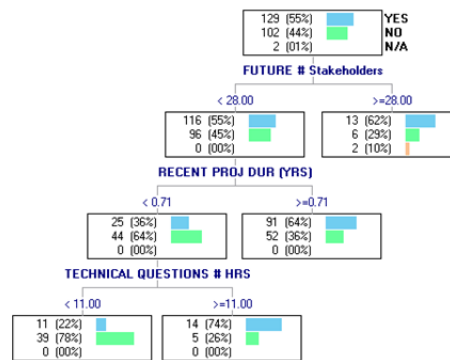


Figure F.150. Data Mining Tree #129

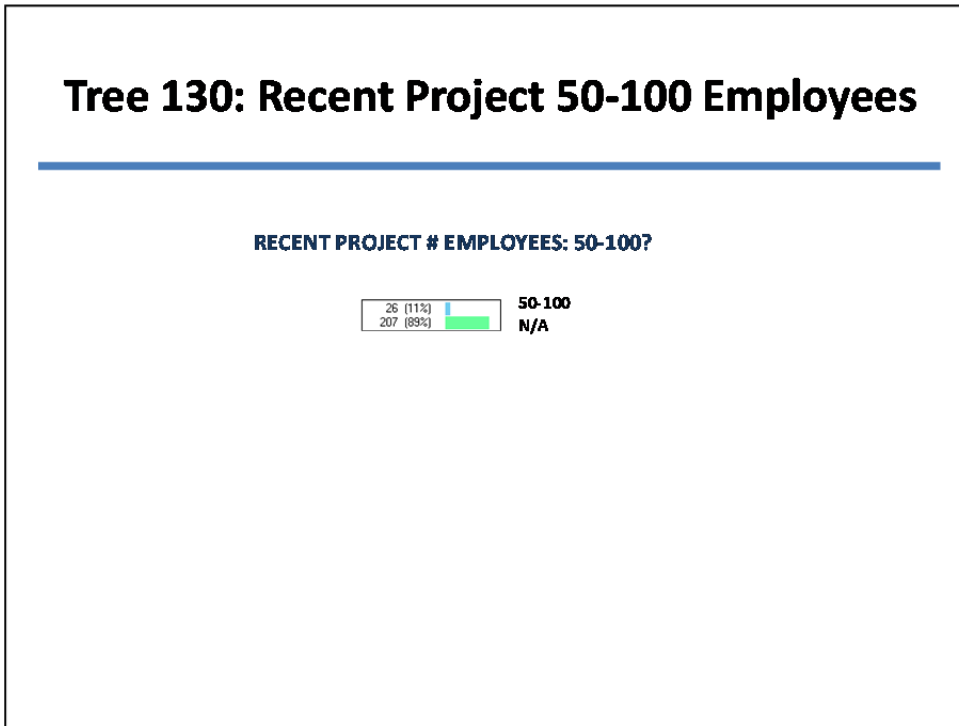


Figure F.151. Data Mining Tree #130

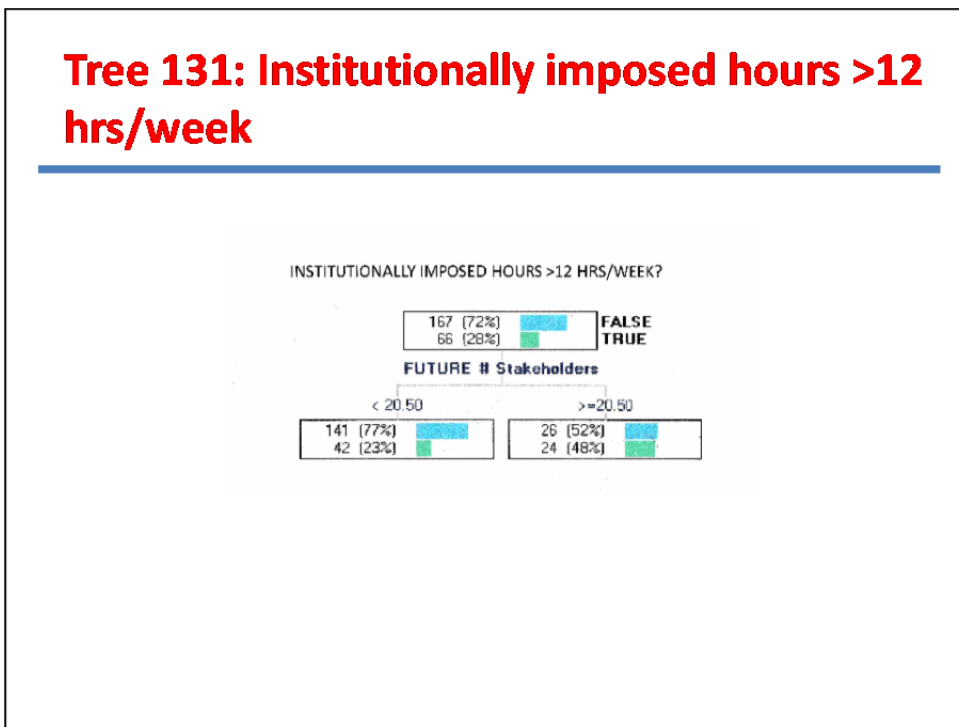


Figure F.152. Data Mining Tree #131

## Tree 132: Future Stakeholders>22

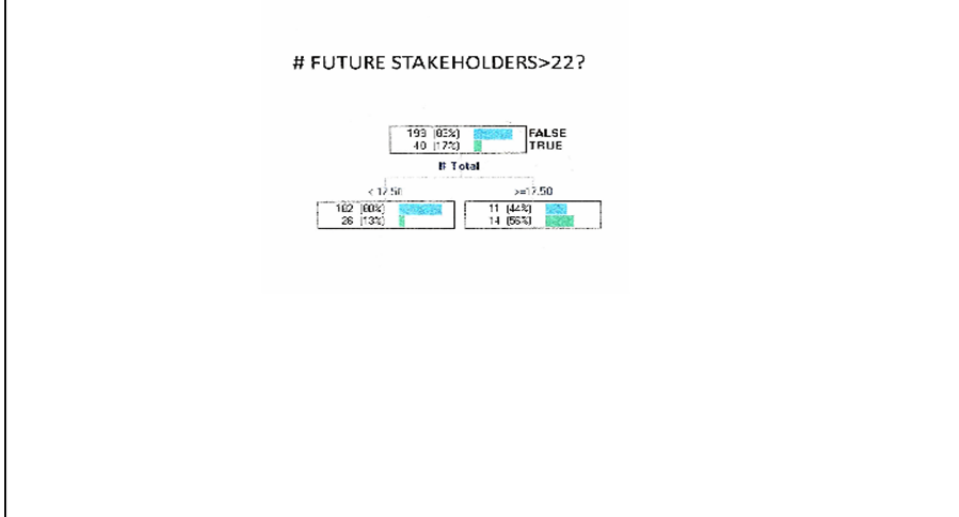


Figure F.153. Data Mining Tree #132

## Tree 133: Years EPC Experience >10 Years

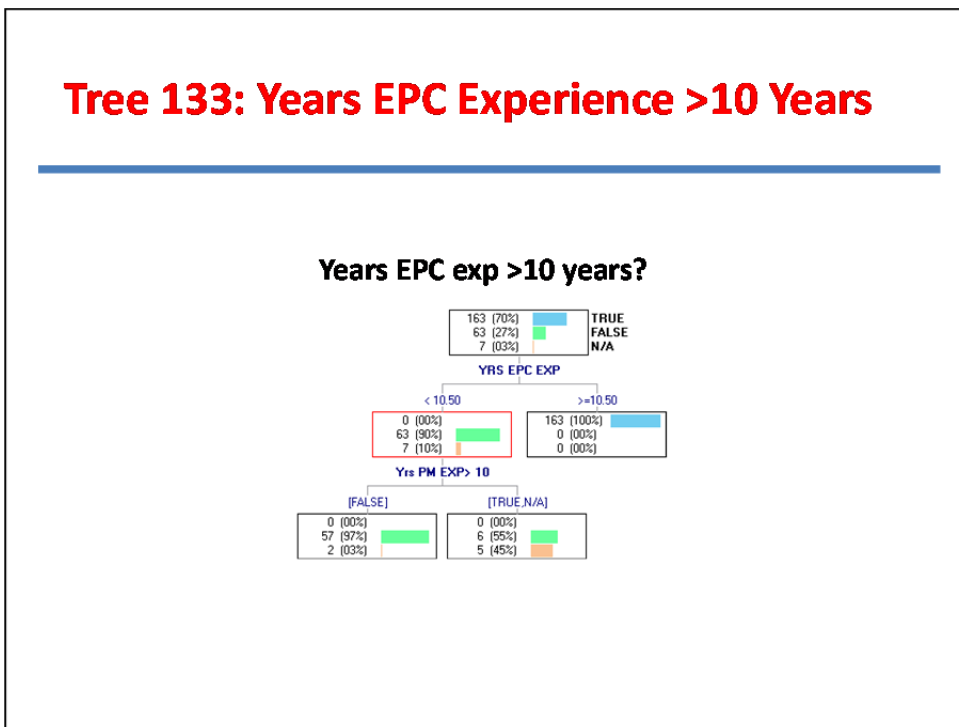


Figure F.154. Data Mining Tree #133

APPENDIX G:  
PM META TOOL

## Meta-Tool: Project Manager Competency Development Tool Selection Guide

INSTRUCTIONS: (1) Hold this sheet in portrait orientation so that the red "START" arrow points downwards towards the 19 challenges. (2) Following the direction of the START arrow, checkmark those challenges that will be relevant in your future. Use the checkbox at the left of each challenge for this purpose. (3) For each challenge you selected, mark each of the checkmarks in the row of that challenge. Leave the rows of the unselected challenges unmarked. (4) Turn the page to landscape mode so that the "SELECT" arrow points downwards, towards the 14 competencies. (5) Count the checkmarks in each row and write the result in column "COUNT". Each of these numbers represents the importance of the particular competency. (6) Select the competencies that will be most important in the future and circle the values of the Learning Tools in the columns to the right of those competencies. (7) Sum up the values you circled for each column in the Learning Tools area. (8) The sums indicate the effectiveness of each learning tool for the challenges and competencies you selected. Assemble a study program based on the effectiveness of the learning tools and the time you can dedicate.

DISRUPTIVE TRENDS										COMPETENCIES															
GLOBALIZATION					WORK FORCE	TECHNOLOGY				NEW AND CHANGING ORGANIZATIONS					COUNT	<i>Definitions can be found on the other side</i> SELECT									
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Technically multi-disciplined	1	2	2	1	2				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Practical understanding of technology	1	1	1	1	2				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Possesses keen business insight	1	2	2	2	3				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Understands project management	2	2	3	2	3				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Builds knowledge networks	1	2	2	3	4				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Monitors risk continually	1	2	2	2	2				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Makes complex decisions	1	3	3	3	3				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Displays emotional maturity	1	2	3	2	3				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Communicates effectively	1	2	2	2	3				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Leverages diverse thinking	3	2	2	3	3				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Builds relationships	1	2	3	3	4				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Engages others	1	2	3	3	4				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Mentors people	1	1	2	3	2				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Builds trust	1	2	2	3	3				
<b>SUM</b>																									

**CHALLENGES**

- Project in areas with difficult conditions
- Safety issues and training beyond traditional areas
- Prior, concurrent resource pressure and time constraints
- Global supply chains
- Relationship building at multiple locations
- Balance traditional success factors with sustainability, diversity and compliance
- More oversight and regulation
- Workforce diversity, dynamics, and styles
- 24/7/365 access from all directions
- Information collected faster than resources can manage and analyze
- Information for decision-making will change in minutes
- Constantly evolving project methods, systems, and software tools
- More work done off-site
- Global, virtual teams
- Increase in number of stakeholders with competing agendas
- Increase in number of non-fulfills/contract employees
- Shifts in risk/bearing models (more JV, etc.)
- Low concentration centers with more capabilities
- Increase probability of unexpected (black swan) projects

**LEARNING TOOLS**

Decisionary of Terms (2h)	1	2	2	1	2
Issue Exercise (2h)	1	1	1	1	2
PM Magic Deck of Action Cards Game (2h)	1	2	2	2	3
"Who's on Your Molecule?" Diagnostic Tool (2h)	2	2	3	2	3
CI Executive Leadership Program (80h)	1	2	2	3	4
	1	2	2	2	2
	1	3	3	3	3
	1	2	3	2	3
	1	2	2	2	3
	3	2	2	3	3
	1	2	3	3	4
	1	2	3	3	4
	1	1	2	3	2
	1	2	2	3	3

**Assemble Study Program**

Scale for effectiveness of learning tool:  
 0 - Minimal influence on the competencies  
 1 - Some influence on the competencies  
 2 - Improves competencies  
 3 - Strongly improves thinking (competency)  
 4 - Changes thinking (competency)

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**RT281**  
 www.leadershipinpractice.com  
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Figure G.1. PM Meta Tool