

Risk-Based Transportation Asset Management:

*Achieving Policy Objectives
by Managing Risks*

REPORT 3: RISKS TO ASSET MANAGEMENT POLICIES



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NOTE FROM THE DIRECTOR

The Federal Highway Administration (FHWA) continuously seeks innovative ways to improve the management of the nation's highway infrastructure. The Office of Asset Management offers this series of reports on risk management as another means by which transportation agencies can better understand and manage their highway assets.

The use of risk management among U.S. transportation agencies largely is limited to managing risk at the project level generally focused during construction. Risk management at the project level helps to identify threats and opportunities to projects' cost, scope and schedule. However, we at the FHWA along with our partners at state and local transportation agencies recognize the growing need for a better understanding of risk management at program and organizational levels.

Today, the leading international transportation, banking and insurance organizations have explored the benefits of risk management at the program and enterprise level and use it as a tool to protect their investments. Based on those practices, the Office of Asset Management is offering this series of reports on how risk management can be scaled up to asset management programs, and to the entire enterprise of a transportation agency.

It's important for highway agency officials to consider incorporating risk management in the decision-making process for several reasons. First, they have seen the benefits of risk management at the project level. Second, they have heard from their international colleagues that risk management can pay dividends when used at the broader program and enterprise level, particularly when agencies don't have enough funding to address their priorities. Third, managing risk is an

integral step in following a comprehensive asset management framework as described in the “AASHTO Asset Management Guide—A Focus on Implementation.” Finally, the U.S. Congress has required that states develop “risk-based transportation asset management plans.” These factors convinced the Office of Asset Management to offer this series of reports.

We believe you will find these reports helpful as you develop your asset management program and make investment decisions. This series of reports will help the transportation agencies to meet the increasingly complex challenges involved in making decisions and communicating them effectively to the public

Sincerely,



Butch Wlaschin
Director of the Office of Asset Management

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Introduction

Dealing with risks to key strategic objectives is not new to transportation executives. They do it every day. What is relatively new is formal risk management as a transparent framework for identifying risks to strategic objectives, mitigating them and communicating their likelihood. The earlier risk management reports provided an overview of risk management and its practice at the agency, program or project level. This report examines a subset of agency risk management, that is strategic risk management, or the management of risks to key agency objectives and policies. In particular, this report examines risks to transportation asset management (TAM) policies and objectives.

Managing Risks to Policies

One author notes that senior leaders either engage in strategic risk management or they routinely engage in crisis management.⁽ⁱ⁾ Strategic risk management causes the senior leaders to comprehensively anticipate threats to their strategic objectives and to prepare scenarios and strategies to minimize them. Another author notes that ignoring threats to strategic objectives doesn't make them disappear, it just deprives the executive of the opportunity to consciously prepare for them.⁽ⁱⁱ⁾ A third author says that "managing risks is management's job."⁽ⁱⁱⁱ⁾ As such, risk management is not a technical function performed in isolation by specialists. Rather, it is a dynamic, executive function performed continuously by agency leadership.

Although uncommon among transportation agencies, strategic risk management is viewed in many leading industries as the central role of senior leaders. "My job is to figure out how to grow (the company) and manage risk and volatility at the same time," said Jeffrey Immelt, chief executive officer (CEO) of General Electric.^(iv)

Immelt's comments reflect the duality of modern management. Executives are expected to ensure reliable, predictable performance to routinely meet agency and public objectives. At the same time, they are expected to anticipate the unexpected, and to be prepared when it occurs. Enterprise risk management—or the practice of risk management at all levels of an organization—is a tool that helps leadership provide stable operations in an unstable environment.

Both in the private and the public sector, stakeholders value predictability. Regarding transportation asset management, stakeholders want the pavements to be smooth, the bridges to be sound, the signs and pavement markings to be legible and for work zones to flow smoothly. The public also expects that transportation agencies will accomplish this while achieving other policy objectives such as operating efficiently without new revenues, reducing emissions, respecting the environment, conserving energy, abiding by purchasing and contracting regulations, respecting diversity in hiring and promptly responding to public complaints. When these functions do not reliably and predictably occur, the public's confidence in the agency suffers. In fact, the very definition of "quality" has been defined by the degree of reliability and predictability in products.^(v)

However, the world is often unreliable and unpredictable. Unexpected external events and complex internal ones can impede an agency's predictable march to its asset management policy objectives. Risk management creates a framework for identifying the hard-to-predict threats to asset management policies and creates contingencies to react to them. The active managing of risks to asset management policies and objectives also plays a key reporting function. It demonstrates to the public and to key stakeholders that the agency is anticipatory, prepared and realistic about what can go wrong as it manages a diverse, aging and underfunded asset inventory.

By anticipating the negative or unexpected, risk management serves as a complement to the disciplines of performance management and asset management. Those management frameworks create predictable, cyclical on-going processes that seek to make high-quality performance routine. Risk management serves to address that which is less predictable, and which can present threats, as well as opportunities. Asset management and performance management work like a drive train to propel an agency forward. Risk management serves as both a crash-avoidance system and a suspension system that softens the bumps and potholes of the unexpected.

What Are Asset Management Policy or Strategic Risks?

Policy or strategic risks are ones that could affect mission-critical objectives, cut across an organization, are often external and are not in the control of lower-level staff. As a result, they are "owned" by the senior executives or by the agency's commission. These reports have reiterated that U.S. transportation agencies routinely practice risk management at the project level. There, it helps to safeguard against threats to cost, scope and schedule while evaluating opportunities to capitalize on risks. When risk management is scaled up and practiced at every level of an organization, it is called enterprise risk management. Enterprise risk management in these reports is considered to be the comprehensive practice of risk management at three levels, the agency, the program and project levels. The nuance between agency risk management and strategic risk management is a fine one. In fact, many authors who write about risk management in the corporate world don't use the term "agency risk management" but instead refer to "strategic risk management" as the management of risks to key strategic objectives. In these reports, "agency risk" management is the practice of risk

management to key agency strategic objectives. This report will focus upon a subset of agency risk management, that is the management of risks related specifically to Transportation Asset Management objectives.

The issue of risk-based asset management rose in importance when both houses of Congress considered legislation to require states to develop risk-based asset management plans for the National Highway System (NHS.) For agency leaders, the evolution to a risk-based asset management approach means they are likely to assume responsibility for ensuring that risks to the NHS assets are identified, prioritized and managed. They also are likely to become responsible for ensuring that asset management policies for the NHS are carried out, and that risks to those policy objectives are effectively managed. As a result, risk management is likely to become a new minimum competency which transportation executives are expected to master.

The strategic asset management risks for which agency leaders may be responsible in a risk-based environment include that:

- ▶ The agency reduces risks to achieving its asset condition targets;
- ▶ The agency has reduced the risk of poor investment decisions by adopting an organization-wide asset management framework;
- ▶ The agency has realistically anticipated its asset investment needs and contrasted them to a realistic forecast of revenues;
- ▶ The agency has reduced risks to the value or condition of its assets;

- ▶ The agency has developed accurate asset inventories and asset management systems to enable it to conduct robust asset-condition scenario forecasting;
- ▶ The agency has anticipated external risks to its assets including natural disasters, major economic downturns or political changes.

Agency or strategic risk management is a formal process of identifying threats and opportunities across an organization and deciding how to manage them. Its formal, documented practice is common among some international agencies, and is widely adopted in the corporate world. When agency or strategic risk management is first explained to agency executives, they often respond, “but we already do that.” In part, this is true. They routinely deal with risk. What is much less common in the U.S. is for the risk to be formally identified, prioritized, strategized, communicated and then tracked. Such steps may occur in the thoughts of an executive or in discussions within the senior staff, but agency or strategic risk management involves the formal documentation, communication and tracking of the risks and the strategies to address them. Transportation agencies with mature risk management processes can document the risks to their asset management policies, can document the mitigation strategies and can document how those strategies have reduced the risks that the agency will not achieve its asset management objectives.

Advanced Examples of Strategic Risk Management

To better understand risk management as applied to asset management objectives, it helps to examine some mature examples. Among transportation agencies, those examples occur generally in Australia, the Netherlands, New Zealand, Great Britain and to some extent in Canada.

Risk management as practiced by these agencies abroad is a flexible, policy-based framework that actively involves senior leadership with the agency's strategic asset management objectives. The Queensland Department of Transport and Main Roads (TMR) explains risk management as an enterprise-wide effort to improve all types of decision making. "Risk management endeavors to achieve an appropriate balance between realizing opportunities while containing losses. When risk management is embedded into management practices, it enables continuous improvement in decision-making and performance and is an essential element of good corporate governance. In managing risks effectively and efficiently, the department will be more likely to achieve its purpose and role." ^(vi)

TMR deploys a comprehensive approach that cascades risk management from the broad strategic level down to the project and operations level. It doesn't use the term "agency risk management" for its highest level but rather uses the term strategic risk management. It defines key strategic risk as:

- ▶ political, economic, social, environmental and technological factors in the external environment;
- ▶ culture, structure, people and system factors in the internal environment.

Its Strategic Risk Management Practice Guide identifies the following agency risks and their consequences.

Future disasters and failures—if TMR is unable to respond quickly and effectively to disasters and failures, damages won't be minimized and its reputation may suffer long-term damage.

Funding pressures—an inability to fund the current and projected transport system needs of Queensland is creating an accumulating risk of major safety, delivery and reputational failures.

Regulatory risk—TMR's regulatory responsibilities represent a major ongoing risk to its ability to ensure that community and government expectations are met.

Workforce challenges—unless TMR can link its capability needs to its future workforce, it will constantly lack key elements of capacity.

Global forces of change—if TMR does not remain alert to long-term forces and trends or is unable to influence how Government and society responds, its future success will be in the hands of others.

Strategic positioning—lack of strategic position with key stakeholders would leave TMR vulnerable in a highly competitive and rapidly changing environment.

Application of IT—if TMR does not take advantage of ongoing fundamental changes in how information is managed and used in society it is unlikely to be able to deliver on its purpose.

Adaptive capability—if TMR is unable to transform itself into a much faster moving and responsive organization it will not be able to deliver on its purpose in a rapidly changing and unpredictable strategic environment.

Whole of government (WoG) and decision making—if TMR is unable to ensure that decision making at all levels is linked to broader government policy and strategy it will fall out step and will become less relevant and effective.

Its strategic risks are formally documented and the ongoing responses to them are reported to the Board of Management and the Audit and Risk Committee. These reports form part of the agency's internal controls and its formal reporting to key external stakeholders such as legislators and the state treasury department.

These agency-wide strategic risks form the highest-level of risks that cut across all functions, and which are broader than the individual program risks over which they span. The TMR stratifies its risk plans and approaches into six distinct but interrelated levels—strategic, portfolio, divisional, program, project and operational. Risks from any of these levels that rise to be potential threats or opportunities for the agency can become agency risks to be managed by the senior leadership.

Across the Pacific from Queensland, the TransLink agency operates multiple transportation modes in the greater Vancouver area of British Columbia. Its 2012 Business Plan reports upon a number of enterprise risks that could prevent it from achieving its major policy objectives for the year. These include possible diesel price increases. Every \$.01 cent increase costs the agency \$400,000. Higher gasoline prices also decrease motorists' fuel usage which decreases its local fuel-tax income. It faces union contract negotiations, increased pressure from local governments for increased financial support of local roads, negotiations with the federal government on some funding sources are unsettled, and a major new toll bridge is not bringing in the expected revenue and threatens its financing plan. Higher rates of absenteeism are driving up overtime costs and complicating bus service schedules. In addition, high attrition rates caused by an aging workforce are increasing recruitment and training costs.

TransLink reports these risks in its Business Plan and then tracks them throughout the year. The reporting of them to its oversight body is a regular occurrence that keeps its leadership apprised of progress toward its strategic objectives.

In Scotland, the Transport Scotland agency documents the agency-wide risks that could impede its Road Asset Management Plan (RAMP.)^(vii) These include:

Imprecise asset deterioration rates—It has insufficient information on asset deterioration rates to support long-term predictions of the needed level of investment. Its mitigation measure will be to identify gaps in its information and to hold workshops with experts to close those gaps.

Insufficient unit cost measures—It has insufficient information on maintenance unit costs and unit rates to support robust financial planning. Its mitigation strategy is to put in place practices to collect accurate unit costs.

Uncertain performance measures—It is difficult to translate strategic aims and objectives into meaningful performance targets and levels of service. The mitigation strategy is to develop a comprehensive performance management framework that links aims and objectives to performance.

Insufficient lifecycle tools—The “whole of life” or lifecycle cost tools are not suitable to support lifecycle planning. The mitigation strategy is to review the current tools and to improve them.

Insufficient scenario planning—The tools for conducting network-level scenarios are not perceived to be robust enough for the needs. The mitigation strategies are to develop a program to put the asset management program planning into a computerized tool.

The Australian state of Victoria's roadway agency is known as VicRoads. It was visited by the US risk-management scan team and the agency emphasized that risk management is a dynamic process that keeps decision makers informed of risks to policy objectives. Risk management is a comprehensive undertaking that flows both from the top down through policy and from the bottom up through identification and response to risks at the front lines. The VicRoads chief executive has the primary responsibility for organizational risk management, along with the Executive Corporate Management Group. All VicRoads executives assume responsibility for effective risk management within their business areas. The director of VicRoads risk management has the responsibility for the development and oversight of corporate risk management policies, processes, systems, coordination and communication. In addition, that position is responsible for the monitoring and reporting of risk status and actions to the executive management. The organization develops a three year risk register and risk management plan. Staff in each business area has training and responsibility for identifying, coordinating and monitoring risk in their units. The agency developed a Corporate Risk Management Assessment Guide that identifies key risk areas and provides for risk severities and corresponding mitigation action. VicRoads officials advised their US counterparts that risk management is a tool that should focus an agency upon how uncertainty could affect its objectives. At the same time, risk analysis should not lead to paralysis. The agency seeks a healthy balance of taking acceptable risk to achieve acceptable returns while avoiding excessive risks.

These examples from Australia, Canada and Scotland illustrate the breadth of practice of risk management, but also the breadth of issues addressed at the agency level. All the issues addressed above could impede the agencies' ability to

achieve their strategic objectives as set for them by their governing bodies. The issues they are tracking illustrate the unique threats they face to achieving their asset management objectives. It is not coincidental that enterprise risk management is used by these agencies as a strategy to achieve their major policy objectives. Rather, risk management begins with policy. Risk management, at all levels, is based upon the entities' unique objectives, whether risk management is applied at the project, program or agency level.

The World Road Association—PIARC says that traditional risks for transportation agencies were infrastructure, personnel and finances.^(viii) Now agency leaders are expected to excel at public policy concerning environmental compliance, energy reduction, climate change, economic development, and social justice. Emerging new forms of social media can bring nearly instantaneous, issue-driven advocacy to bear on these issues when an agency is perceived to have failed to meet its social obligations. This brings a whole new dimension to the risk environment in a modern transportation agency. Threats and opportunities are more diverse, and public agencies are expected to anticipate and respond to them promptly.

PIARC notes that the volatility of modern risks renders obsolete the older, traditional model of risk management that relegated its practice to specialists. A better description of what is needed today could be called dynamic risk management. It reflects the assumption that transportation leaders are expected to be ever-vigilant managers of threats and opportunities across the entire organization. Although PIARC does not use the term, "dynamic enterprise risk management" that term describes the approach it suggests.

A Strategy for Prioritizing Executive Risk Efforts

Well-known management author Robert S. Kaplan conveys a message to senior executives that is similar to PIARC's. In the Harvard Business Review, ^(ix) he writes that executives can delegate the management of some risks to staff, but they cannot effectively delegate strategic risks. He categorizes risks into three areas: preventable risks, such as malfeasance, theft or internal process breakdowns; strategic risks, or those affecting strategic objectives, and; external risks or those not directly in the organization's control. He contends that only the first, preventable risks, can be delegated to a routine staff function. Preventable risks can be addressed through periodic audits, quality-assurance reviews and checklists of compliance. However, he contends that strategic risks do not lend themselves to checklists and formulas but are best dealt with on a case-by-case basis by senior leaders. Often strategic risks create opportunities that leaders may seek to exploit. External risks also fall to the senior leaders to monitor. Even if they can't prevent them, they can track them, explain them and develop contingencies to cope with them. Kaplan's view of agency or strategic risk management, therefore, is that it is a dynamic, core function for leadership and not a compliance task reduced to rote checklists or standardized reviews.

Getting Started with Agency Risk Management

With these examples provided as background, the question now facing U.S. transportation executives may be, how do I begin implementing risk management to my asset management policies?

The protecting and improving of infrastructure assets is a key objective and responsibility for nearly all transportation executives. Even if the conduct of asset management is not a formally expressed strategic objective, in nearly every agency the preservation, maintenance and improvement of infrastructure is viewed as a central, core goal. Therefore, adoption of agency or strategic risk management will have a major focus upon managing physical assets.

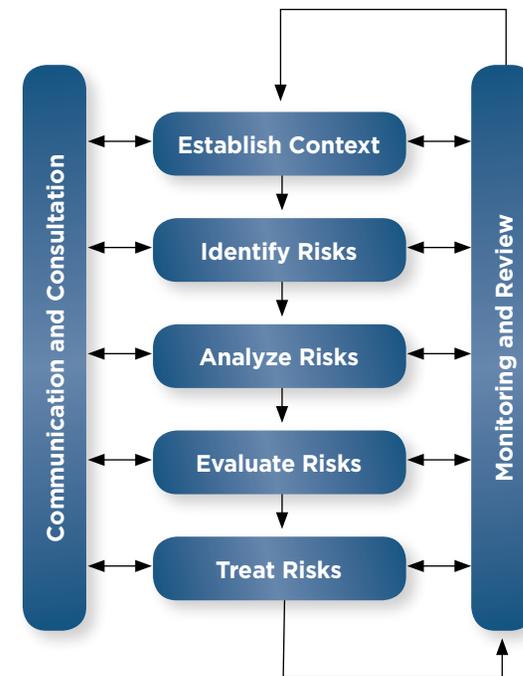


Figure 1. ISO's risk management framework

Although risk management is applied in many countries and across many different industries, its basic structure appears to be very consistent. In fact, variants of Figure 1 from the International Organization for Standardization (ISO) can be found around the world in the risk management policies of many public agencies and in the private-sector guidance of professional trade organizations. Figure 1 illustrates that risk management is a comprehensive framework that includes the steps necessary to inculcate it as an ongoing and formal process. The framework shown in Figure 1 supports the change-management and organizational communication practices needed to ensure that a new major process is adopted by a large, complex organization.

The Institute of Management Accountants (IMA) cites the steps needed to ensure that an organization accepts risk management as seen in Figure 1.^(x) They are slightly modified for this report to relate to asset management. The steps include:

- Establish CEO commitment from the top including a clear tone and messaging that managing risks is critical to managing assets;
- Risk policies and or mission statements are developed and existing agency processes are amended to incorporate a risk-based approach to managing assets;
- Adopt or develop risk language that notes that risks are not just physical threats but also threats to policies, objectives, infrastructure-condition targets and public expectations;
- Staff is encouraged to consider risks as opportunities, and not always threats;
- Create reporting mechanisms to and from business units, executives, and the board or commission for monitoring risks;

- Adopt or develop a risk framework such as Figure 1;
- Establish the agency techniques for identifying risk;
- Establish the tools for assessing risks;
- Incorporate risk into appropriate employees' job descriptions and responsibilities;
- Incorporate risk into the budget function, and;
- Integrate risk identification and assessment into the strategy of the organization.

The above steps provide for the cyclic, ever-improving type of process illustrated in Figure 2. It shows that risk management when comprehensively applied leads to a “learning process” where the results of risk mitigation and opportunity



Figure 2. The cyclical steps of risk management

identification feed back into the strategy-setting process for continuous improvement. Figure 2 also illustrates the dynamic nature of risk management. It continually adjusts as old threats are managed and new ones arise. Figures 1, 2 and the bullets from the IMA illustrate a point repeatedly emphasized in risk management guidance. Risk management is most successful when leaders become active risk managers.

Establishing the Context

Risk management begins with policy. Particularly at the agency or strategic level, the foundation of risk management is not only leadership's embrace of it but also leadership's identification of the key objectives it is to ensure. The setting of context involves asking, "What really matters to us? What policy objectives are strategically critical to us?" "And what could prevent us from achieving them?"

The Institute of Management Accountants (IMA), ISO and the risk management manuals seen in international transportation agencies emphasize that the initial focus of risk management is on clarity of strategies and objectives. From those, the risk management program is built. As the IMA notes, without clear objectives it is more difficult to identify the risks and opportunities surrounding them. In terms of managing risks to assets, the same policy basis applies. The agency articulates its objectives for infrastructure service levels and then identifies risks to them.

This foundation in policy makes risk management similar to asset management. Both can be tied to key policy considerations, such as preserving public value, ensuring sustainable resources for future users, demonstrating transparency, providing accountability and ensuring adequate levels of infrastructure service. As such, risk management becomes an adjunct to asset management as a means to demonstrate

that an agency is striving to achieve the infrastructure policy goals and service targets established by the legislature, governor, Congress or regulatory bodies.

The first step in risk management is to set the agency's context that describes the agency's priorities. This context provides the policy foundation upon which the following risk management activities are built. In setting the context, the agency articulates the key policy objectives that it seeks to achieve. This step not only guides subsequent risk management activities, it also demonstrates to external stakeholders that the agency strategically is approaching its objectives and the risks to them.

Although risk management cascades through all levels of the organization, the identification of the agency's highest-level strategic risks generally falls to the senior leaders. The policies or strategic objectives that the organizations are expected to achieve are often expressed in legislation, executive guidance from the gubernatorial or treasury level, or from the agency's own strategic objectives. As noted on pages 5, 6 and 7, these strategic objectives can vary widely and can change over time. In the Scottish example, some of the risks to be managed were quite specific and addressed the need to improve agency asset management forecasting tools. These reflect a common need for senior leaders to have sound, reliable models with which to conduct scenario planning. Complex organizations—whether in the highway or the financial-investment fields—rely on models and they can be a critical risk factor for successful investment. Over time, as the models mature and become routine, they may no longer rise to the level of a strategic risk. They may become a program or even operational risk addressed by lower levels. However, in the early stages of asset management development, such management systems may be a central threat or opportunity closely monitored by senior leadership.

Noticeable throughout the risk management materials of Australian and New Zealand transportation agencies was a focus upon environmental compliance while managing assets. High political and social expectations that the agencies operate in compliance with environmental goals elevate the leadership's management of environmental risk compliance. Environmental approval is often cited in U.S. risk management activities at the project level. In Australia and New Zealand, the concerns were agency-wide. Reducing the risk that the agency would be cited for violating environmental regulation was a significant focus area for management.

Also, the agencies' growing energy usage and carbon footprints were seen as agency-wide risks. These can spill over into asset management practices in terms of carbon consumption as a consideration in material selection. Environmental compliance also can affect drainage maintenance practices, salt usage, or pavement noise considerations. Such issues generally are addressed at the project, program or operational level but have risen to the agency level when senior leaders are called to task for on-going non-compliance or because of stakeholder concerns.

Preserving public asset value is another area where asset management activities rise to the policy or agency level in the international agencies. In the United States, the Governmental Accounting Standards Board Statement 34 (GASB34) requires public agencies to report on the overall value of their assets and to report any material issues that could affect them. These reports do not generally create substantial public interest.^(xi) However, in England, treasury requirements compel agencies to adopt as a major objective the preservation of the value of agency assets. Similarly, in Australia, statutes require local governments to track their asset values and to prepare long-range plans to ensure that highway assets remain in sound condition. In these instances, the asset management programs become major agency-

wide mechanisms to ensure that the agencies meet these strategic objectives set by their governments. In some cases, the asset management programs are audited and the agencies held accountable to correct deficiencies.

Improving the condition of key asset classes also can rise to an agency risk management focus. In 2003, the Oregon Department of Transportation launched a statewide program to replace 365 bridges that primarily were reinforced concrete deck girder bridges subject to dangerous cracking. The legislature authorized \$1.3 billion for what at that time was one of the largest infrastructure programs in the state's history. The department and its commission managed the program actively and produced monthly reports that tracked not only progress on delivering the bridge projects but also reported on the program's environmental compliance, its recycling of old materials, its job creation and its use of small and disadvantaged businesses. Although bridge replacement projects normally would be considered at the project level of risk management, in this case the severity of the cracking and the large number of structures elevated the issue to an agency risk. Although the Oregon DOT did not describe its efforts in risk management terms, its department-wide focus on delivering the bridge program was representative of an agency risk management approach.

The Missouri Department of Transportation faced a similar enterprise-wide effort with its Safe & Sound Bridge Improvement Program that improved more than 800 bridges in five years. It is on track to replace 554 bridges and to repair the rest. As of Dec. 31, 2011, it had completed 672 bridges through its aggressively managed program.

The Michigan DOT also pursued a strategic effort to address deficient bridges when it realized in the early 2000s that its structural deficiencies were well above national averages. However, after a few years of "worst-first" bridge focus, it

also recognized the long-term risk of allowing good bridges to fall into a state of disrepair. It faced the long-term risk of never adequately improving its entire bridge inventory unless it kept its good bridges in sound condition. As a result, it now pursues a dual approach of focusing upon repair of its structurally deficient bridges but also investing significantly in bridges on the cusp of developing serious structural deficiencies. It has a strategic asset management policy of focusing on bridges in the structural deficiency categories of 5 and 6. It singles out these bridges for repair to return them to a condition of 7 on a 0-9 scale. This strategic policy approach keeps good bridges in acceptable condition and lowers the department's risk of long-term decline in its bridge inventory. Agency executives say they began the strategy as an asset management strategy but recognize it as a risk-based approach intended to prevent the risk of widespread, expensive degradation to their bridge inventory.

Minnesota Department of Transportation (MnDOT) officials take an explicit risk-based approach to asset management and used it to convince their legislature to allow it to better balance long-term investments between bridge and pavement inventories.

The legislature through a statute known as Chapter 152 required the Minnesota DOT to substantially increase its bridge spending following the collapse of the I-35 bridge. MnDOT is required to replace 120 bridges that are either structurally deficient or functionally obsolete. The investment improved bridge conditions but consumed funds that otherwise would have been invested in pavements. In a recent long-term, risk-based forecasting exercise, the staff looked at the department's management system forecasts. The forecasts showed that bridge conditions would remain sound but that rural pavements were at substantial risk of imminent decline. The department staff quantified the risk to pavement conditions and the cost to correct the deficiencies if

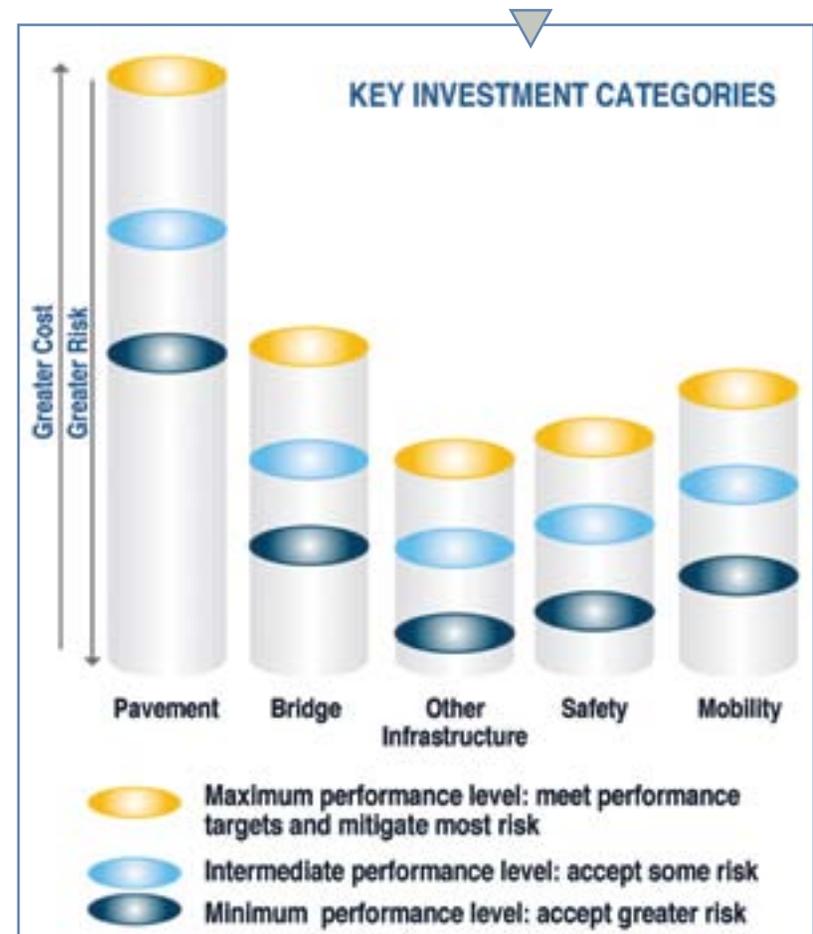


Figure 3. MnDOT used this graphic to illustrate how different funding levels by program increased or decreased risk.

they were allowed to worsen. The staff explicitly articulated the pavement decline as a risk to ride quality, safety and long-term economics. As a result, the legislature allowed the department to shift funds from bridges to pavements and create a more balanced and sustainable investment program.

Figure 3 illustrates that at lower funding levels, shown as the shorter, darker columns, the risks increase that pavements

will deteriorate, not meet condition targets and require more expensive repairs. The higher funding levels, shown in the light blue and yellow columns, decrease the risks to the pavement inventory's condition and long-term repair costs. The arrows indicate that as funding levels rise closer to the yellow, optimum level, risks decline. As funding levels decrease to the black column level, risks increase. The risk-based description allowed the department to illustrate to its Legislature that risks were greater for the pavement program than for the bridge program.

These examples illustrate how risk-based approaches to asset management programs can be tailored to the agency's unique policy needs. Risk management can address either policy outcomes such as environmental compliance or physical condition outcomes such as ensuring that a state corrects growing and threatening pavement deficiencies. Rather than being an arbitrary compliance function, risk management can be especially tailored to support the agency's unique asset policy needs.

Also as part of the context setting, the agency leadership generally articulates its risk management vision and builds the risk management structure. The vision is articulated through the policies that establish the risk management program. The structure involves the assignment of roles and responsibilities. The responsibilities generally are stratified at least at the project, the program and the agency level. Some agencies also manage risk at the operational level, the region level or the portfolio level. Generally, a portfolio would be a collection of related projects. The levels can vary according to agency need, however, most guidance emphasizes that a clearly articulate structure is essential. ISO recommends adoption of a formal Risk Management Framework that is a set of components that provide the founda-

tions and organizational arrangements for a continually improving risk management process. Such frameworks are explicitly documented in several of the largest Australian transportation agencies, as well as in New Zealand ^(xii, xiii) as well as by ISO and the IMA. ^(xiv, xv)

Risk Tolerance or Appetite

A final and important part of the context-setting process is the identification by senior leaders of the agency's "risk appetite" or "risk tolerance." The risk appetite indicates the degree of risk that an agency is willing to accept by issue, policy or even by asset class. For instance, an agency may declare that it will accept very low risks for high-volume, aging, fracture-critical structures. It may declare that they need to be inspected frequently and be instrumented for constant monitoring of stress, strain or subsidence. For other assets, such as low-volume rural pavements, the agency may accept a higher degree of risk. An agency may identify a target of having 90 percent of high-volume pavements meet condition targets. But it also may articulate in the context-setting phase that it wants to accept little risk to the long-term performance of those pavements. Therefore, it insists on sound forecasting and extensive preservation to reduce the risks that those pavements will fail to perform in the future.

Risk appetite also can be qualitative. The English Highways Agency sets a very low risk threshold for risks related to ethics, theft or malfeasance. However, it accepts far-greater risks for innovations such as complex design-build-operate-and finance projects that require more than \$1 billion in long-term investment. Its guidance illustrates how risk appetite can be qualitative and based upon important public sensitivities.

The English Highways Agency Risk Management Policy ^(xvi) says in part,

“The Board welcomes and encourages well-managed risk taking where the potential rewards in terms of improved customer service, savings of time or cost, or improvements in quality make taking the risk worthwhile. No one need fear the consequences for failure if the risks that caused the failure were anticipated, appropriately managed and, where required, escalated to senior management.

The Highways Agency Board has no toleration for risks that threaten:

- Integrity, propriety and regularity in the use and stewardship of public funds and assets, or
- Our ability to demonstrate that safety risks have been reduced as low as reasonably practicable.”

The risk appetite or tolerance also can be dynamic or changing. During spring flooding the risk appetite for having early warning bridge scour systems inoperable may be zero. In the dry months of summer, the tolerance may be higher. The appetite also can change with public expectations or current events. The risk appetite is like risks themselves, it can ebb and flow over time.

The risk appetite becomes a measure against which risks are compared in later steps of the risk-evaluation phase.

Identifying the Risks

Once the framework is in place and the priorities are articulated at the project, program and agency levels, the process of identifying risks to them begins. The guidance from the international risk management scan team and from numerous sources emphasizes that risk identification is best if done inclusively from a broad cross-section of agency participants. Risks that may be obvious to persons at one level of the organization may be unknown to persons from another level. Having a major program’s risks reviewed from all levels of an organization can reduce the possibility of threats and opportunities being missed. The IMA also suggests considering some degree of confidentiality in risk identification. Sometimes, risks are caused by internal operational failures or impediments that staff may be reluctant to publicly identify. ISO’s generic standard says that risks should be identified from all sources, even if the risks are beyond the agency’s control.

The steps used to identify agency risks are not complex. They include brainstorming sessions, Strength Weaknesses Opportunities Threats (SWOT) analyses, questionnaires, workshops and scenario analyses. IMA suggests that facilitated workshops can spur idea generation that will bring forth risks that might otherwise be overlooked. The Queensland Department of Transport and Main Roads Program Risk Management Practice Guide suggests clarifying assumptions of program managers to determine where their assumptions may be based on high-risk or highly variable circumstances.

“Keep it simple” was the advice of the U.S. risk management scan team. They and others emphasize that most risks are known to persons in the agency. They can be documented from past events, from known variables, or from changes in

the agency environment. The agency's internal weaknesses or program conflicts generally are well known, even if they are not formally documented.

Some simple graphical tools can be used to record the risks that are identified. Figure 4 illustrates a graphical mapping of risks to an agency's asset management programs. Risks are categorized as being in one of four categories, financial, strategic, operational, or hazard. The possible events within the inner circle are ones identified as having the highest likelihood and the greatest possible impacts. Examples such as Figure 4 are not based on any software program or particular analysis protocol. Rather, they represent the common, shared opinions of the staff. The expertise of the staff is viewed as the most important element, and the identification of risks is seldom left to outside experts or consultants.

As can be seen in Figure 4 in this theoretical example, the agency leadership has identified the following risks to achieving the agency's asset management strategic objectives.

- ▮ Information systems that do not provide the necessary analysis, insight or reliability;
- ▮ Maintenance failures caused by a lack of timely treatment;
- ▮ Inadequate asset inventories that obscure the size, condition and location of assets;
- ▮ Budget shortfalls that prevent adequate investment;
- ▮ Price increases that erode purchasing power;
- ▮ Rising interest rates that increase the agency's costs to borrow and finance major reconstructions;

- ▮ Changing legislation that may create new mandates that increase costs;
- ▮ Lack of management support, or weak program management;
- ▮ Loss of experienced asset management staff.

An exercise as depicted in Figure 4 allows an agency to communicate both internally and externally that many factors could impede its asset management objectives. This helps to convey to outside stakeholders the complexity facing the agency's asset management programs.



Figure 4.

Not All Risks Are Bad

The evolution of enterprise risk management reflects the realization that organization leaders can't just avoid risks, but must seek to evaluate them for their threats and their opportunities. After the scandals of Enron and WorldCom, U.S. corporate governance laws required chief executive officers and boards of directors to take responsibility for internal risks in their organizations and to anticipate external ones that could affect shareholder value and legal compliance. As one post-scandal industry guidance document said, "The underlying premise of enterprise risk management is that every entity exists to provide value for its stakeholders. All entities face uncertainty, and the challenge for management is to determine how much uncertainty to accept as it strives to grow stakeholder value. Uncertainty presents both risk and opportunity, with the potential to erode or enhance value. Enterprise risk management enables management to effectively deal with uncertainty and associated risk and opportunity,..." ^(xvii)

As Kaplan notes in the Harvard Business Review article cited above, agencies and businesses want to manage risks but they certainly do not want to avoid them all. Only by taking risks can a company launch a new product, enter a new market or form a new partnership. Analogously for transportation agencies, every construction project represents a significant risk. Accidents could occur, contractors could go bankrupt or traffic could be delayed. However, without the risks of projects, agencies could not improve the transportation system. A new management system represents a risk of money, staff time and potential disruption to business processes. Without such risks, however, asset management processes can't be improved. Without trying unproven new pavement treatments or experimenting with new bridge designs, construction innovations would not occur.

Rewards are the fraternal twins of risks.

Each of these risks may also offer opportunity. Improvement in management systems, asset inventories, maintenance treatments, less-than-expected price increases or increasing management support all could cause asset management processes to improve. This duality is what causes risk management to be the supportive complement to other frameworks such as strategic goal setting, asset management or performance management. Once an agency's strategic priorities are clear, the risks to those priorities can be clarified by this step in the risk management process. This step also can identify new opportunities to achieve strategic goals.

Analyze and Evaluate Risks

The next step in managing risks to asset management policies is to analyze and evaluate the risks to them. Some risk management frameworks such as ISO's describe these as two different steps. In that framework, risks are analyzed for the magnitude of their potential impact or opportunity. Then in the evaluation phase, they are evaluated for how they should be treated and how they compare to the risk appetite. The phases are closely connected and in this report will be described here as one process.

Building the Asset Risk Register

As described in report 1 and the literature review, the risk register is an essential tool for managing risks. At its most basic, it is a color-coded table or spreadsheet that lists an organization's risks, ranks them, often color codes them and provides a brief explanation of how they are being treated. They are commonly used around the world to provide executives and staff an at-a-glance summation of the organization's risks and what is being done about them.

Risk Event	Likelihood	Consequence	Rating
Inadequate information systems Risk Mitigation Strategy/Treatment: Invest in updated information systems	0.90	0.70	0.63
Budget Shortfalls Risk Mitigation Strategy/Treatment: Monitor budget, prepare contingency program strategies	0.70	0.80	0.56
Inadequate asset inventories Risk Mitigation Strategy/Treatment: Invest in updated asset inventories	0.70	0.70	0.49
Maintenance failures Risk Mitigation Strategy/Treatment: Increase training, audit maintenance processes	0.70	0.70	0.49
Price increases Risk Mitigation Strategy/Treatment: Monitor bid prices monthly and prepare contingencies	0.30	0.70	0.21
Loss of experienced asset management staff Risk Mitigation Strategy/Treatment: Institute succession planning, training, mentoring	0.30	0.70	0.21
Changing legislation Risk Mitigation Strategy/Treatment: Monitor legislation. Inform legislators of impacts	0.30	0.30	0.09
Economic downturn Risk Mitigation Strategy/Treatment: Monitor economic activity and plan contingencies	0.30	0.30	0.09
Public opinion Risk Mitigation Strategy/Treatment: Sustain robust public information processes	0.30	0.30	0.09
Environmental standards Risk Mitigation Strategy/Treatment: Train staff to comply with standards. Conduct audits.	0.30	0.30	0.09
Lack of management support Risk Mitigation Strategy/Treatment: Train mid-level staff. Ensure compliance with TAM.	0.10	0.70	0.07
Barge strikes to bridges Risk Mitigation Strategy/Treatment: Install navigational warnings.	0.10	0.70	0.07
Excess vehicular loadings Risk Mitigation Strategy/Treatment: Monitor truck weights on vulnerable routes. Urge enforcement.	0.10	0.70	0.07
Rising interest rates Risk Mitigation Strategy/Treatment: Monitor interest rates. Time bond issues accordingly.	0.10	0.30	0.03
Flood Risk Mitigation Strategy/Treatment: Install storm event gauges. Countermeasures at scour-prone structures.	0.10	0.30	0.03
Seismic events Risk Mitigation Strategy/Treatment: Develop contingency planning for detours, emergency repairs.	0.01	0.70	0.01

Figure 5. The risk register shows numeric risk rankings and also is color coded as a heat map.

The 2011 U.S. international risk management scan team members said they did not find many examples of the risk management plans that ISO and others call for. Instead, they found that the risk register was the essential tool that international agencies relied upon.

Figure 5 on the preceding page illustrates the theoretical risk register built from the risks identified in Figure 4. This transportation agency has listed as its highest risks to achieving its asset management strategic objectives as its information systems, maintenance failures caused by a lack of timely treatments, inadequate asset inventories, budget shortfalls, price increases and a variety of other issues.

As seen in the register, the issues are evaluated both for their likelihood and for their consequences. The risk rating is the simple multiplication of likelihood times the consequence. Some agencies illustrate the risk rating with and without risk mitigation strategies illustrated. Figure 6 on page 20 shows the same risk register after mitigation. Figures 5 and 6 are shown separately just for legibility reasons in this report but in most risk registers they are combined.

Table 1. NSW risk rating table

Risk Likelihood	L	Impact	I
Almost certain	0.9	Extreme	0.9
Highly likely	0.7	Very high	0.7
Likely	0.3	Medium	0.3
Unlikely	0.1	Low	0.1
Rare	0.01	Negligible	0.01

Risk management specialists use various tools to help agencies provide nominal rankings to their perceived risks. Some use simple verbal scales such as shown in Table 1 provided by

the New South Wales (Australia) Treasury for use by local governments when evaluating risks in their asset management plans.^(xviii)

In this theoretical example, the agency has identified a major risk as being its information system’s inability to produce credible condition and investment forecasts suitable for making long-term program investment decisions. The agency leaderships knows this is a significant problem and rates its Likelihood as Almost Certain which produces a likelihood of 0.9. The leadership also considers the impact of these information system shortcomings to be Very High to its asset management plans, which produces an impact value of 0.7. The risk rating, shown in Table 2 therefore, is:

Table 2. Risk rating for information systems

L		I	Rating
0.9	X	0.7	.63

All the other risks are likewise rated by their likelihood and their consequence to provide a series of risk ratings that populate the risk register as seen in Figure 5.

Treating the Risks

Once identified, evaluated and ranked, the agency begins to treat the risks. The treatment already is shown in the line below each risk. For inadequate information systems, for instance, the treatment is to invest in updated ones. For budget shortfalls, the treatment is to monitor the budgets and prepare contingencies to programs if budgets need to be reduced. For each risk, a treatment strategy is identified.

Risk treatments fall into four, and sometimes five, categories according to most agency practices. The four universal categories are to treat, tolerate, terminate or transfer. The English Highways Agency and others include “Take advantage of” as the fifth “T” in the risk-response decision tree. The English Highways Agency includes Table 3 in its guidance document.

Table 3. English Highways Agency risk responses

Option	Explanation
Treat	The most commonly used, this means we are going to take action to mitigate the risk.
Tolerate	The second most commonly used, this means the likelihood of the risk materializing is so low or if it does materialize the impact would be so low that we need not worry about the risk. We do, however, monitor the risk to make sure it does not become worse.
Terminate	This does not mean terminate the risk but terminate the activity, and as such is not usually available to us.
Transfer	This is where accountability for managing the activity is transferred to another agent. Again, this usually is not available to us.
Take advantage	To be used in relation to opportunities.

As can be seen in Table 3, the most typical option is to treat the risk. This is because government agencies often lack the ability to terminate or transfer risks. The private sector can cancel a high-risk product line or service but the public

sector usually cannot. A few years ago, many U.S. highway agencies eliminated high-risk underground fuel storage tanks in favor of newer, lower-risk above-ground tanks. In that narrow case, agencies could eliminate a risk of leaking underground tanks. Other examples can include systematic programs to replace culverts of a certain age, or to systematically replace aging sign inventories with signs that use more current reflective materials or to systematically eliminate certain types of bridge elements prone to early failure. Systematic risk-treatment programs are common. However, transportation agencies cannot eliminate other high-risk activities such as conducting highway maintenance activities on high-volume roads, or owning agency bridges, or even owning high-crash locations. Therefore, the treatment of risks tends to be more common than the termination or transfer of it.

Tolerating risks also is commonplace. Agencies know from statistics that run-off-the-road crashes and intersection crashes are among the most common types of crashes. They take steps to treat the risks through improved intersection operations, or the use on two-lane routes of safety edges, rumble strips and highly reflective pavement markings. However, they know they have to tolerate some intersection and run-off-the road risks because they cannot all be eliminated. From an asset management perspective, agencies often lack the resources to exhaust all preservation and preventative maintenance treatments. Therefore, they tolerate the risk of a predictable rate of asset degradation. They may try to slow the rate of asset degradation but it cannot be eliminated and must be tolerated to an extent. Pavement management system forecasts would have less risk if agencies collected 100 percent samples of pavement conditions. However, the cost of collecting data on 100 percent of all lane miles is prohibitive. Therefore, agencies tolerate a degree of risk to the accuracy of their pavement management systems.

The amount of risk an agency is willing to tolerate is set by its risk appetite or risk tolerance established during the context-setting phase. Risk tolerance for public safety generally is low, so that risks of bridge failures are generally not tolerated. Risks to traffic signals generally have low thresholds. However, risks to guardrail condition or pavement smoothness on low-volume routes typically may have much higher tolerance levels, or the agency may have a greater risk appetite for those conditions.

An example of terminating a risk can be the elimination of certain engine-cleaning solvents from maintenance facilities and their replacement with less volatile and less hazardous chemicals that pose lower risk to employees and to groundwater. Or some agencies have terminated the risks caused by guardrail end treatments on high-volume routes by replacing them with crash attenuators. At a more programmatic level, agencies may try to reduce bridge spread footers in areas prone to scour or to reduce manual data collection in lieu of automated collection to terminate the risk of human judgment in data collection. There are examples where agencies can terminate risks but they tend to be less common than treating risks.

Risk transfer is common in construction through the use of performance specifications, bonding and warranties. Through the use of these mechanisms, performance risk of the project is transferred to the contractor to a degree. Design-build projects also can transfer some aspects of risk to the design-build team. The team assumes the professional liability for the design, often assumes the schedule risks and some risks to costs.

In the asset management arena, agencies can transfer data-collection risks by contracting for data collection. This puts upon the outside contractor the risk of cost, scope and schedule for collecting data as well as the physical risks for

collecting data under traffic. In a paper produced for the FHWA Office of Asset Management in 2011 “Key Performance Indicators in Public-Private Partnerships” it was reported Australian and British public-private partnership (PPP) projects transferred large amounts of asset management risks to the companies who were awarded the design-build-operate-and maintain projects.^(xix) In those contracts, the private contractor was responsible for developing robust asset management processes that guaranteed that when the project was turned back over to the government in 30 years that its assets would be in sound condition. Those systems required the contractors to develop accurate asset inventories, frequent condition inspections, robust maintenance regimes and periodic asset renewals to ensure that in 30 years the assets would be in sound condition.

The transfer of asset management risk in the U.S. still is relatively rare but is seen in some of the privatized maintenance contracts that are slowly expanding in use. Generally, however, transportation agencies own the risks to asset management inventories, data systems, decision making and investment levels. Therefore, the asset management process can be a high-risk activity for agencies.

Taking advantage of risks in the asset management arena is less common but is possible. An example could be adoption of a new technique for data collection, such as relying on rolling wheel deflectometer for assessing pavement structure, or using ground penetrating radar to assess bridge decks. These technologies have inherent risks because they are relatively new and lack the decades of testing and refinement that may be common in other data-collection processes. These techniques can create contract risks because there may not be many bidders to provide the services, or the agency may have few back-up options if the processes work poorly. However, the acceptance of such risks are what lead over time to the development of new processes and tech-

nologies. Taking advantage of the opportunities inherent within some risks is routinely considered within a risk management framework.

Identifying the Risk Treatments

In a formal risk management process, the risk management staff or consultants are likely to lead the senior leadership through an extensive series of issues and have the leadership examine each strategic asset management risk for its threats, opportunities or treatment strategy. The New South Wales RTA guideline for using its project risk register^(xx) walks the user through 58 standard issues that should be considered when evaluating project risks. This list of the types of risks that have been identified before serves as a prompt to ensure that the risk managers have considered a full range of threats and opportunities surrounding project risk and consider the appropriate treatment. Such prompt lists for strategic risks are much less common because of the still-evolving nature of strategic or agency risk management in transportation agencies. However, the role of the agency’s risk management staff is to compile such lists that are pertinent to the agency and to use them in exercises with the senior staff as they develop their risk register for the agency’s strategic risks to its asset management processes or to the assets themselves.

For the risks identified in Figures 4 and 5, such an exercise for the issue of the “inadequate information systems” risk could include the staff leading the team through an exercise to consider:

- ▮ Are the risks to the information systems caused by the age or outdated nature of the systems?
- ▮ Is the system recent but failing to operate because of design or operational problems?

- ▮ Is the system adequate but hampered by incomplete or inaccurate data?
- ▮ Is the system adequate but users are not heeding its outputs or scenarios?

Such a prompt list stimulates an exercise in which the leadership examines the strategic issue from all of its perspectives and decides which of the five 'Ts' to apply to the risk. In this case the agency leadership concludes that it can treat the risk and will do so by replacing the system.

For the next risk, budget shortfalls, the agency leadership concludes that it cannot influence the amount of revenue that it receives and must rely on the strategy of monitoring its income and preparing contingency allocations if budget shortfalls arise. The agency only has the ability to tolerate the budget shortfall risk and cannot terminate it. Contingency planning is its only risk-response option.

The third risk, inadequate asset inventories, is viewed in this analysis as a treatable risk. The agency will upgrade its asset inventories to more fully support its asset management policy objectives.

These steps taken by the strategic leadership leads to another calculation showing the risks after they have been treated, as seen in Figure 6. It illustrates that a budget shortfall remains as a high, untreatable risk that must be monitored, tolerated and reacted to with contingencies and budget reductions if it occurs. However, with treatment, the risks to inadequate information systems, inadequate asset inventories and maintenance failures have had their likelihood reduced. They still remain high risks but are no longer critical. Other issues, such as price increases and loss of experienced asset management staff are viewed as less controllable, and again remain to be treated to the extent possible and to be monitored.

Risk Event	Likelihood	Consequence	Rating
Budget Shortfalls Risk Mitigation Strategy/Treatment: Monitor budget, prepare contingency program strategies	0.70	0.80	0.56
Inadequate information systems Risk Mitigation Strategy/Treatment: Invest in updated information systems	0.30	0.70	0.21
Inadequate asset inventories Risk Mitigation Strategy/Treatment: Invest in updated asset inventories	0.30	0.70	0.21
Maintenance failures Risk Mitigation Strategy/Treatment: Increase training, audit maintenance processes	0.30	0.70	0.21
Price increases Risk Mitigation Strategy/Treatment: Monitor bid prices monthly and prepare contingencies	0.30	0.70	0.21
Loss of experienced asset management staff Risk Mitigation Strategy/Treatment: Institute succession planning, training, mentoring	0.30	0.70	0.21
Changing legislation Risk Mitigation Strategy/Treatment: Monitor legislation. Inform legislators of impacts	0.30	0.30	0.09
Economic downturn Risk Mitigation Strategy/Treatment: Monitor economic activity and plan contingencies	0.30	0.30	0.09
Public opinion Risk Mitigation Strategy/Treatment: Sustain robust public information processes	0.30	0.30	0.09
Environmental standards Risk Mitigation Strategy/Treatment: Train staff to comply with standards. Conduct audits.	0.30	0.30	0.09
Lack of management support Risk Mitigation Strategy/Treatment: Train mid-level staff. Ensure compliance with TAM.	0.10	0.70	0.07
Barge strikes to bridges Risk Mitigation Strategy/Treatment: Install navigational warnings.	0.10	0.70	0.07
Excess vehicular loadings Risk Mitigation Strategy/Treatment: Monitor truck weights on vulnerable routes. Urge enforcement.	0.10	0.70	0.07
Rising interest rates Risk Mitigation Strategy/Treatment: Monitor interest rates. Time bond issues accordingly.	0.10	0.30	0.03
Flood Risk Mitigation Strategy/Treatment: Install storm event gauges. Countermeasures at scour-prone structures.	0.10	0.30	0.03
Seismic events Risk Mitigation Strategy/Treatment: Develop contingency planning for detours, emergency repairs.	0.01	0.70	0.01

Figure 6. The risk register shows numeric risk rankings and also is color coded as a heat map.

This simplified analysis illustrates the close alignment of risk management with strategic planning or performance management. Even without a risk management framework, the agency may have identified these issues from the risk register as strategic priorities. The risk management framework walks the agency leadership through a formal process that allows it to evaluate and prioritize the risks and to place them in a nominal ranking. The ranking may be based upon the agency's perceived risk and not upon more quantifiable risk but nonetheless it leads to a formal articulation of the strategic risks, the ranking of those risks and the treatment it identifies. As such, the risk register serves to reinforce the strategic planning process by clearly identifying the issues upon which the agency must concentrate in order to achieve its strategic asset management objectives.

Communicating, Monitoring Strategic Risks

Figure 1 from the ISO guidelines also includes the elements of Communication and Consultation and Monitoring and Review of risks. It depicts them as dynamic ongoing processes. Much of the literature relating to management of strategic risk emphasizes that it is a continuous, dynamic process owned by the organization's senior leadership. Because senior leadership is expected to promptly address strategic risks, risk management allows for the prompt reassessment of risks, the addition of new risks and the diminishing of old ones as circumstances change. In the risk register above, if a new environmental standard arises that could affect asset costs, the senior leadership could quickly reassess the risk, elevate it in the risk register, communicate that risk to internal and external stakeholders and continue to mitigate and monitor the risk. For instance, if the storm

run-off regulations change in a state and require the agency to significantly change its maintenance or drainage-design standards this could change the issue's ranking in the risk register. Such regulatory changes create risks of cost, regulatory non-compliance, loss of reputation and delay in projects that must be redesigned to accommodate new runoff requirements. Such an issue can be quickly added to the register if it becomes a high strategic priority for the agency. Another policy risk could be a legal decision or policy decision to quickly address sidewalk ramps to accommodate the Americans with Disabilities Act (ADA). Such a change could be very costly and could directly affect capital program amounts. Failing to address the issue exposes the agency to reputational, regulatory and even legal risks.

These examples illustrate the policy basis of strategic risk management. As Kaplan noted the rapidly changing nature of some risks and the need for artful responses to them, mitigates against the use of standardized checklists to monitor strategic risks to assets. The monitoring of these risks requires constant assessment of the external environment and prompt response to it by the agency leadership. Risk management serves as a means for the agency to formally identify such risks, place them in a hierarchy of similar risks and articulate the agency's response to them. This ranking also serves the function of communicating to the public, legislators and other stakeholders why the agency needs to make tradeoffs in one area to pay for other priorities. To need to invest in new storm-water control structures or sidewalk ramps requires the reduction in other capital spending, and perhaps an increased risk to other classes of assets.

Conclusion

A simple acid test for whether or not agency risk management is succeeding is to ask these questions. They have been modified to address a transportation agency's physical assets:^(xxi)

- ▶ What are the top 10 risks to our asset management objectives?
- ▶ Do we have a concise report that shows our risk exposures and trends?
- ▶ Are we in compliance with internal asset management policies and external laws and regulations?
- ▶ Were the majority of our asset management failures anticipated in our risk reports?
- ▶ Are we managing assets on a risk basis?

ENDNOTES

- ⁱ Lam, James, Enterprise Risk Management” John Wiley and Sons, Hoboken, N.J. 2003, p.4
- ⁱⁱ Trieschmann
- ⁱⁱⁱ Lam, p.48
- ^{iv} Brady, Diane, General Electric the Immelt Way, Business Week, Sept. 11, 2006, accessed at http://www.businessweek.com/magazine/content/06_37/b4000060.htm Feb. 23, 2012.
- ^v ISO and old management book
- ^{vi} Queensland Department of Transport and Main Roads Risk Management Organisational Policy 2011 p.6
- ^{vii} Transport Scotland Road Asset Management Plan, 2007-2009 accessed at <http://www.transportscotland.gov.uk/strategy-and-research/publications-and-consultations/j9061-16.htm> on Feb. 23, 2012
- ^{viii} PIARC
- ^{ix} Kaplan, Robert S. and Anette Mikes, “Managing Risks: A New Framework, Harvard Business Review, June 2012, p.48
- ^x Add ISO reference
- ^{xi} Get reference from ASI report
- ^{xii} Get Australian frameworks
- ^{xiii} Get New Zealand frameworks
- ^{xiv} ISO
- ^{xv} IMA
- ^{xvi} Highways Agency Risk Management Policy & Guidance, 2001 p.5
- ^{xvii} Maki
- ^{xviii} New South Wales Treasury Total Asset Management Manual, Appendix E, Calculating Risk Factors, 2001
- ^{xix} Get the KPI citation
- ^{xx} Guideline Using the Risk Register, NSWRTA, Nov. 2009, pp 8-14
- ^{xxi} Lam 44

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