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Developments in Practice XXIII: Creating and Evolving a Technology Roadmap

James D. McKeen
Queen's School of Business, Queen's University, jmckeen@business.queensu.ca

Heather A. Smith
Queen's School of Business, Queen's University, hsmith@business.queensu.ca

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James D. McKeen
Heather A. Smith
Queen's University
jmckeen@business.queensu.ca

ABSTRACT

The authors convened a focus group of senior IT managers from a variety of different companies/industries to explore current practice in terms of creating and evolving a technology roadmap. Starting with a definition of a technology roadmap, the paper outlines the benefits attributable to a well-crafted roadmap and presents a 7-step model for its creation. According to the focus group, companies without the guidance of a roadmap run the risk of making sub-optimal decisions – technology choices that make sense today but position the company poorly for the future. The focus group also argued that the exercise of developing a technology roadmap is valuable even if the actual roadmap that is developed is subject to frequent change. This paper represents a summary of the focus group discussion.

Keywords: technology roadmap, technology landscape, technology migration, state-of-the-art technology.

I. INTRODUCTION

There is a line from Alice's Adventures in Wonderland that reads, "If you don't know where you are going, any road will take you there" [Carroll, 1865]. This applies rather well to technology roadmaps. In the past, companies have followed a number of different technology paths that have not always led to the "promised land" despite conscientious effort. There are many reasons for this. First, the target evolves, which means that development of a technology roadmap should be an on-going process; we are forever "traveling" but never "arriving". Second, technology has many different masters. Vendors, trade associations, standard-setting boards, alliance and/or trade partners, business stakeholders, merger/acquisition initiatives, growth, strategic directional change, new technological development, and economic shifts (e.g., price performance, adoption patterns, and obsolescence) all influence where companies need to go with technology. Third, unexpected roadblocks occur (e.g., the company that produces the application platform that supports your business goes bankrupt!). Fourth, even in organizations where technology roadmaps exist, there can be difficulties with adherence to plan. Due to these factors, the creation and management of a technology roadmap represents a significant management challenge.

Why do we need a technology roadmap? IT managers believe that, without the guidance of a roadmap, their companies run the risk of making sub-optimal decisions – technology choices that make sense today but position the company poorly for the future. There is also a strong sense that the exercise of developing a technology roadmap is valuable even if the actual roadmap that is developed is subject to change. Another adage applies – "plans are nothing; planning is

everything" (Anonymous). It is through the articulation of a technology roadmap that you learn what you did well, where you failed, and how to improve the process. Finally, a technology roadmap limits the range of technology options and reduces the decision making effort compared to facing one-off decisions repeatedly over time. Because a roadmap casts technology on a distinct evolutionary trajectory, it allows an organization to simply accept this decision and not revisit it repeatedly. Thus, a technology roadmap reduces the organization's cognitive workload.

To explore how organizations are building and evolving technology roadmaps, we convened a focus group of senior IT managers from a variety of different companies, representing several industries including manufacturing, pharmaceutical, telecommunications, food processing, banking, insurance, media, retail, and government. In preparation for the meeting, focus group members were asked to define what they meant by "technology roadmap", outline the elements of their organization's roadmap, describe the process followed in creating and evolving the roadmap, articulate the benefits that have been realized, and finally, describe how the overall process is governed. The group was sequestered for an entire day, and the discussion was moderated by one of the authors while the other author recorded the dialogue. This paper represents a summary of the focus group discussion. We begin with a general overview of technology roadmaps and present a model to explain various input factors. We then describe each of the components of a technology roadmap and offer advice derived from the shared experiences of the focus group.

II. WHAT IS A TECHNOLOGY ROADMAP?

It is important to develop an understanding of what a technology roadmap actually is. To do so, we can build on the analogy of a travel map. A travel map is a guide that tells you where you are now by positioning you within the greater environs and by highlighting existing options to get you to where you wish to go. In offering directions, it can suggest travel times, routes, and scenic alternatives. Furthermore, the state of the art with respect to travel maps is very advanced, assistance is well-established and highly automated (e.g., MapQuest). A technology roadmap differs. It is difficult to purchase a "map" for the simple reason that organizations all have uniquely different "starting" points, different goals, and therefore different destinations. Travel maps accommodate travel regardless of destination or purpose. Technology roadmaps must also entertain external factors such as industry trends, the competitive landscape, and vendor strategies and offerings. Finally, alternative technology options are not self-evident and must be identified through research and exploration (and sometimes experimentation). Thus each option bears a different cost and time structure. As an analogy, the travel map provides an excellent starting point but, when creating a technology roadmap, more is needed. The first step is to develop a common understanding of what exactly is meant by the term "technology roadmap".

Each member of the focus group used a different definition for their technology roadmaps. Upon analysis, we reached consensus on aspects of the definition. It was clear that the main purpose of a technology roadmap is to establish the technology direction for the organization. It has two objectives. The first is to articulate how technology will support the enterprise's overall vision, strategy, and objectives. This was evident in the definition used at one company:

> *"Our technology roadmap is the collective vision of the opportunities for technology to serve the business".*

The second goal is to "frame and constrain technology solutions to provide coherence and integration among those solutions across the enterprise and to define target architectures to implementers". These dual objectives simply recognize the need for IT to forge a relationship between IT and the business while, at the same time, serving the unique internal needs of IT. After some discussion, the focus group agreed on the following definition:

> "*A technology roadmap is a mechanism for the identification, justification, planned evolution and orchestration of technologies to enhance business performance*."

III. THE BENEFITS OF A TECHNOLOGY ROADMAP

Every organization represented within the focus group had a technology roadmap. That fact, in and of itself, suggests that there are perceived benefits in building and evolving a technology roadmap. These benefits fit into two categories – external and internal – reflecting the dual purpose of the technology roadmap as described previously. External benefits relate to aligning IT with the business and result in IT *effectiveness*. Internal benefits attribute to IT directly and result in IT *efficiency*. Both efficiency and effectiveness ultimately benefit the bottom-line of the organization. The key benefits cited by members of the focus group are:

EXTERNAL BENEFITS (*EFFECTIVENESS*)

- *Achieving business goals* – a technology roadmap compares the business plan with the current technological environment to identify gaps. To the extent that the technology roadmap effectively addresses these gaps, business goals should be supported by technology.
- *Reducing complexity* – the technology environment is highly complex due to the degree of interaction among systems. The adoption of a technology roadmap typically reduces the number and variety of technological choices, thereby simplifying things. Just getting to single versions of applications, for example HR, greatly reduces complexity.
- *Enhancing interoperability* of business functionality across lines of business (LOB) – identifying the technology that supports different LOBs is the first step towards integration. The degree of integration and interoperability is first and foremost a business decision. The technology should be designed to support this vision.
- *Increasing flexibility* – this begs the question of whether differentiation or integration enables flexibility. With respect to technology, the argument is usually won by commonalities.
- *Increasing speed of implementation* – common standards, methodologies, technology platforms relieve the learning burden and thereby increase the time to market with new systems.
- *Preserving investment in new and existing systems* – mapping technologies on an evolutionary trajectory means that IT investments are based on long-term considerations.
- *Responding to market changes* – the focus group did not argue “fast” response to market changes. Instead they argued that having an up-to-date technology roadmap meant IT could respond accurately and appropriately to market changes. Organizations without the benefit of a technology roadmap are forced to build decisions “from the ground up” as opposed to building from an established framework.
- *Focusing investment dollars* – some members felt that having a technology roadmap meant that investments in IT could be much more focused. Furthermore, they felt that fewer dollars, better targeted, produced enhanced results.
- *Responding to new legislation* – compliance with new legislation (e.g., SOX, privacy, environmental programs) is greatly simplified with a rationalized technology roadmap.
- *Reducing difficulties associated with deployment of new technologies* – new technologies necessitate learning and change. Therefore, fewer technologies, common platforms, and similar approaches effectively relieve this burden.

INTERNAL BENEFITS (*EFFICIENCY*)

- *Providing a common design point* for the end-to-end integration of reusable components, applications.
- *Building a consistent and cohesive technology base* – without the proliferation of haphazard technology, it is possible to create a critical mass of skills dedicated to select technologies.
- *Move forward in planned phases* – with technologies mapped onto a life cycle, there is an orderly evolution for each technology which creates synergies.

- *Consolidating global solutions* – for global companies, the local in-country technologies are synched to the global technology roadmap which introduces even greater consistency across business processes, reducing overall IT expenditure.
- *Lowering the cost of development and maintenance* – because technology roadmaps provide an inventory of technology, it is possible to increase the reusability of system components, leverage commodity components available in the marketplace, standardize techniques across multiple applications, and prevent "disintegration" and proliferation of execution, development, and operations architectures.

It is interesting to note that no organization represented within the focus group was able to demonstrate the *financial* impacts attributable to their adoption of a technology roadmap. Perhaps more surprising was the fact that they had not been asked by senior management to produce such a benefit statement. The initial development of a technology roadmap is typically an initiative of the IT department. This would suggest that IT departments understand the benefits of a technology roadmap and appear not to question the value of committing resources to this activity. Perhaps the internal benefits of building a technology roadmap, which are significant judging from the above list, justify the exercise all by themselves. These benefits appear to be more tangible, immediate, and observable than external benefits.

IV. ELEMENTS OF THE TECHNOLOGY ROADMAP

The process of developing a technology roadmap is depicted in Figure 1. It hinges on a gap analysis to assess the extent to which the current state of technology supports the current and forecasted needs of the business. From this are derived the future technology requirements which, coupled with a migration strategy, constitute the core of a technology roadmap. Focus group members identified seven important activities in developing and maintaining a technology roadmap. These are described below and are interspersed with strategies suggested by focus group members based on their experiences. At the outset, it is important to dispel the notion that the development of a technology roadmap is a "once every five years" undertaking. Instead, the group argued that a technology roadmap should constitute "a working instrument to be updated and revised annually". Otherwise it becomes inflexible, perhaps dated, and as a result unresponsive to the business.

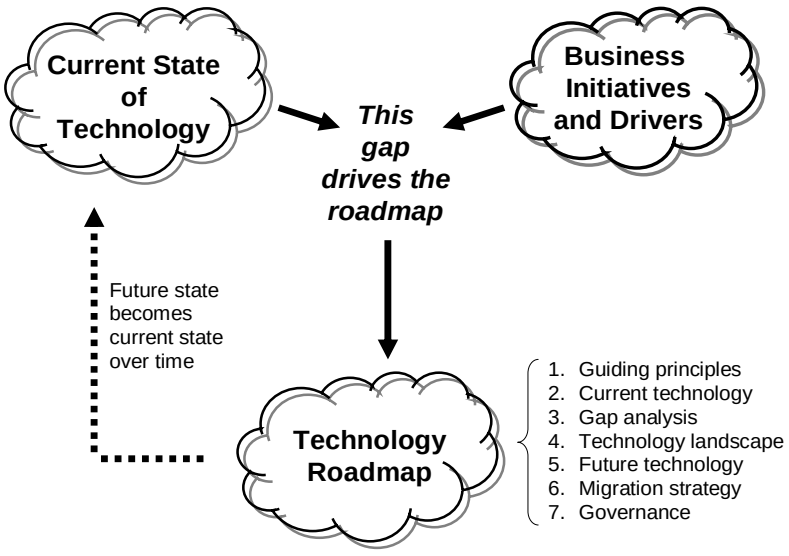

Figure 1. The Process of Developing a Technology Roadmap

1. Guiding Principles. When launching a technology roadmap, it is important to establish a set of principles that will guide its development and enhancement. First and foremost, this is a statement about the role and purpose of technology within the business which should clearly convey aspirations and purpose. It should outline how technology will support the business, stipulating the envisioned role for technology to play. The focus group argued that this should be a statement about the type of technology support to be delivered to the business with a sense of performance. For example, contrast the two following statements: "We will provide technology that is proven, reliable and cost-effective" versus "We will provide leading edge technology".

In addition to establishing the role and purpose for the technology roadmap, it is important to outline its goals. One company established the following goal for their technology roadmap – "to increase the speed of developing, deploying, and productively executing future business models". It then outlined three strategies to accomplish this:

a) decouple the business processes from the underlying IT applications;
b) decouple business applications from the infrastructure; and
c) establish a new collaboration environment that supports the rapid introduction and productive use of the new business processes.

This was an effective means to signal to the organization that they were adopting a Service-Oriented Architecture (SOA). Because SOA was not well understood by the business, the technology roadmap spoke to the desire to:

- Identify components of the business model to be designed as reusable software services.
- Adopt integrated and standardized processes for optimizing cost.
- Accelerate integrated data/information architecture to enable horizontal integration across the enterprise.
- Provide a stable, secure and ubiquitous workspace for employees to be more effective in their roles and efficient in their jobs by delivering information, applications and people to easily collaborate within the context of business processes.

This established the mandate of the technology roadmap, its purpose and goals, using language appropriate for the organizational context.

With the purpose and goals established, members suggested that guiding principles then be articulated to explain other key factors and decisions which would impact technology and, therefore, have a bearing on the technology roadmap. The following statements are examples of key principles used by members of the focus group:

- *Establish investment boundaries* – "we will invest in technology at a rate necessary to sustain our business growth".
- *Outline the role of technology for the organization* – "we will adopt a 'fast follower' strategy, aggressively adopting proven, architecturally-compliant technologies".
- *Outline the role of technology within the industry* – "technology is a core business competency".
- *Reinforce the role of standards* – "all components will adhere to open industry standards".
- *Specify the role of support* – "We will assist employees with technology problems that occur via call centers, desk top support, self help, and/or SLAs."
- *Specify the impact on resident IT skills* – "we will draw technology expertise from our existing large skill base".
- *Outline development preference* – "We will buy first, build second".
- *Establish expectations* – "service levels and availability are outlined for all production systems".

- *Adherence to standards* – "We will be security and privacy compliant."
- *Specify timeframe* – "the 'future' in our technology roadmap has a 3-5 year horizon".

2. Current Technology. This is basically an inventory. It should outline what technologies the organization currently has, including the status of each technology (e.g., standard, non-supported, discontinued). The first task is to develop a classification scheme to assist in managing the inventory. For each type of technology domain (e.g., operating systems; hardware, desktops, servers, and storage; telecommunications and networks; applications; and databases), the focus group recommended that organizations record the following information (at a minimum): business process area, platform, vendor, level of support, dependencies (products, applications), critical versus non-critical, and life cycle.

The next step is to assign a technology custodian/owner so that someone within the firm is responsible for each technology domain. At one company, these individuals are referred to as technology "domain architects". Typical duties of such individuals include acquiring the technology, maintaining the relationship with the vendor, updating and enhancing the technology, facilitating in-house training for those working with the technology, accreditation regarding the technology, recording all applications of the technology, maintaining documentation (e.g., licensing, financing, SLAs, guarantees and warranties), and retiring the technology when appropriate. This can be a major responsibility as some individuals will have more than one domain assigned to them.

One of the key tools in managing the technology inventory is a framework to classify technologies. A number of examples of such frameworks were shared by members of the focus group. We will briefly describe three of these.

- The Application System Asset Management (ASAM) Decision Chart [Mangurian, 1985] assesses the business importance (i.e., the application's overall value to the business), functional support (i.e., how well the system meets the business requirements) and technical support (i.e., the system's efficiency and effectiveness). On an annual basis, all application systems are evaluated against these three criteria leading to one of the following actions: maintain, renovate, replace, augment or eliminate.
- Another focus group member uses a specific 2x2 matrix which evaluates applications on the basis of their criticality to the business (i.e., whether or not they supported business processes deemed critical to the business units) and their strategic importance (i.e., those providing global functions which will not be replaced over the next two years). Placement within this matrix (i.e., maintenance classification) dictates service levels: strategic/critical applications receive "gold" service; critical/non-strategic applications receive "silver" service; strategic/non-critical applications receive "bronze" service; and non-strategic/non-critical applications receive "blue" maintenance.
- The third framework which is referred to as the "WISE" chart [McKeen and Smith, 2003] evaluates technologies on the basis of their strategic value and longevity, yielding four life cycle stages: watch, invest, support and eliminate.

The focus group argued that the specific classification scheme (i.e., framework) mattered less than the fact that a firm has a scheme to manage its technology inventory. The technology inventory provides input to other processes such as risk management, team development, and skills planning.

3. Gap Analysis. With a technology inventory in place, it is possible to perform a gap analysis between the technology that is currently available and that which is required. The first step is to identify the required technology. This ties the technology roadmap directly to the business and is perhaps the most crucial step in developing an effective plan. One focus group member made this point rather emphatically by saying "get this wrong and the roadmap is junk". Focus group members also suggested that simply asking business leaders for their future requirements will not work for a number of reasons. First, business leaders do

not think in terms of requirements; they think in terms of growth, customers, sales, markets, costs, suppliers, and shareholders. It takes a lot of work and skill to translate this view of the business into technology requirements. Second, the roadmap has to be ahead of the business; that is, it must reflect the fact that because business changes faster than technology, a firm must build technology in anticipation of business change and growth. A technology roadmap can not afford to be reactive; it must be proactive regardless of whether your technology vision is "quick second" or "late adopter". Third, business is driven by innovation and differentiation while IT benefits from standards, common features, and universality. This will put IT at odds with the business. According to one focus group member, it boils down to the question, "When is a line of business so different that common systems don't make sense?" What criteria do you apply to test this?

Eliciting business drivers and building a composite picture of the technology required to support the business vision is more of an art than a science. It requires close cooperation between IT and the business. According to the focus group, this cooperation happens at many levels within the organization and should be an ongoing activity. The annual IT planning cycle articulates the applications to be introduced over the next year, but attempting to derive a technology roadmap from this activity is a case of "too little, too late". IT has to be working with the business closely enough to be well ahead of the annual planning cycle. At one focus company, their domain architects are being reoriented to align them more closely with the business units to create a better early warning system for application needs driven by growth and changes to the business model. According to the company representative,

> *"The enterprise has a vision and each line of business has a vision and the job of the domain architects is to put all these visions on the table to expose gaps. To do this, architects need to be 75% business and 25% technology. Today they are the reverse".*

At another company, business analysts work together with enterprise architects to "get a fix on future business directions". While we tend to think of architects and technical experts as playing the key roles, the focus group pointed out that the best vantage point for performing a gap analysis between the existing technology and emerging business drivers is the CIO office, since the CIO sits at the same table as other senior executives to set the strategy for the business. They pointed out that having the CIO at these sessions provides a significant advantage in terms of forecasting the future for technology within the company.

With a "line of sight" to the business strategy coupled with an accurate technology inventory, all the tools to perform a gap analysis are in place. The outcome of the gap analysis is an articulation of the technology required to support the business' vision and strategy. Unfortunately, a technology roadmap cannot be simply created from this analysis because it must also be governed by trends in the external environment.

4. Technology Landscape. The focus group was unanimous in its recommendation that firms must invest in R&D continuously if they are to keep abreast of technology. The size of this investment, however, differs depending on how critical IT is to a firm. The roadmap should articulate how large this investment will be, how it will be enacted, who is responsible, and what guidelines are in place to assist this initiative. Setting these structures in place is the easy part; knowing when enough is enough is more difficult.

In the past, much of a company's technology was dictated by its choice of vendor. In fact, members pointed out that if asked what its technology roadmap was, a firm could simply reply by naming a single vendor. Today's lock-in by vendors is reduced particularly with the widespread adoption of open-standards, interoperability among various platforms, and web services. Interestingly, this has probably resulted in the need for down-stream firms to bear a greater portion of the R&D burden where, in the past, they could leverage the vendor's R&D to a greater extent. Focus group members shared a number of different approaches to R&D, but all shared a common challenge – capital funding.

At some companies, R&D flies "below the radar" as "skunk works". Here the IT department uses its own money that it has squirreled away over time treating R&D similar to a cost of doing business. In others, R&D is financed by a technology investment fund (i.e., a tax to the business levied as a percentage of technology usage). This fund is governed by a committee composed of senior managers who guide the investment in R&D. In another firm, IT maintenance is reduced by 10-15% per year and the dollars are reallocated to strategic IT investments, much of which are funneled to a "technology adoption program" described as a "sandbox where new technologies are tried, improved, tested, scaled, and assessed for business value". These latter approaches are preferable as they don't attempt to hide R&D. In fact, they make R&D transparent to the organization. Business leaders understand the need for re-investment in the physical plant; IT is no different.

5. Future Technology. This should contain a description of the technologies to be adopted in the future. The focus group argued that these future technology roadmaps should not be simple lists. They should also include the *logic* that was used in the decision to follow a certain path. If, for instance, your technology roadmap depicts a preferred vendor strategy, equally, if not more important is the reasoning that was used in selecting this strategy. Making this explicit within the roadmap permits others to challenge the logic without challenging the actual decision. This is essential particularly if you wish to obtain constructive input from business managers when creating your technology roadmap.

As important as the logic behind the roadmap are the assumptions built into the roadmap. IT professionals are frequently guilty of assuming that it is obvious to others why a certain strategy has been adopted. Focus group members suggested that there is value in making all assumptions explicit. As with the need to present the logic of the roadmap, it is also vital to expose all embedded assumptions. These assumptions may reflect trends in the competitive marketplace (e.g., vendor A will continue to dominate with its ERP offerings), the general environment (e.g., open standards adoption will accelerate), specific technologies (e.g., thin client architecture's time has arrived) or general trends (e.g., new development will move towards SOA). This exposure provides the basis for meaningful conversation to help clarify the roadmap's dependence on widely-accepted (but perhaps not articulated) assumptions.

The focus group felt that describing the technology was fairly straightforward; that is, outlining major technology domains such as hardware, software, applications, and networks. The difficulty often was with regard to the granularity of future technology. The question is how do you decide the level of detail in future technology platforms? According to one member of the focus group, "if your roadmap is severely impacted by business change, your roadmap is probably too tactical". The opposite, creating a technology roadmap that is too high level would be equally inadequate. The goal is to find the "sweet spot" between the too extremes – "more art than science" according to one focus group member.

6. Migration Strategy. The technology roadmap should also outline a migration strategy to get a firm from today's technology platforms to tomorrow's. At first glance, the implementation of a technology roadmap appears similar to other major IT initiatives. The focus group, however, was quick to point out the differences. Of these, the primary one is that a technology roadmap is not a self-contained project; it affects *every* project as technologies are embedded within the entire spectrum of applications, many of which cross lines of business, geography, and generations. By positioning each technology domain on a life cycle (e.g., watch, invest, support, eliminate), two dominant migration strategies emerge: "gradual" versus "big bang".

The gradual strategy focuses on the application (i.e., as new applications are implemented or reworked, their technology is updated to fall in line with the new technology directions). The big bang strategy emphasizes the technology (i.e., all instances of a given technology are updated across all applications). The focus group suggested that the choice is not an "either-or" situation nor is it a "technology only" decision. Rather the choice is (or should be) dictated by the business. There are few situations where the "big bang" approach is absolutely

necessary simply because there are always means of staging the conversion over time, applications, business lines, and/or platforms. According to one focus group member, "even large architectural builds/deployments are typically done within a program across several phases". Sometimes, though, the "big bang" is a business necessity due to the need to reap advantages in a reduced timeframe.

A major challenge facing the migration strategy is the need to assign priorities to the various technology components that need to be changed. One organization uses the following criteria to assess the criticality of migration in order to assign order of execution:

- Technology elements that are inflexible
- Elements that do not meet the strategic direction
- Components that are expensive to maintain
- Components that do not meet non-functional requirements (e.g., scalability, extensibility)
- Architectural designs built to reflect obsolete business strategies (e.g., segmentation silos, line of business silos)

Once priorities are assigned, timelines can be established for the migration of various technologies.

Focus group members suggested that a migration strategy should explicitly recognize a number of dominant trends within technology, such as the movement towards service-oriented applications and the deconstruction of applications into layers (e.g., presentation, business process and data). While such trends provide useful high level guidance, they need to be augmented by more tactical guidelines (see Appendix). Of particular interest here is the need for a migration strategy to explicitly plan for the migration of *people* skills in alignment with the future technology demands.

7. Governance. Every organization should have an established process in place to articulate who is responsible for creating the technology roadmap, how and on what basis, and by whom it is updated and enhanced, and finally who approves the technology roadmap. Most of the focus group organizations felt that the technology roadmap was legitimately the responsibility of the enterprise architecture group – the group normally responsible for mapping out the architectural platforms to support the various lines of business. The majority of companies recognized the need for two distinct levels of architecture governance within their organizations:

- **Strategic** – Individuals and groups at this level (typically, senior executives from IT and the business) set the overall architecture direction and strategy and ensure alignment with business objectives. They set standards and approve deviations from these standards. In addition, they monitor the overall attainment of the goals as articulated within the technology roadmap.

- **Tactical** – Members of this tactical group tend to be from the IT ranks including architects, analysts, and managers. They typically work across lines of business as well as within lines of business with responsibility for the execution of the strategy (as opposed to its development). A key role is the provision of architecture consulting services to project teams.

At one company, the key personnel of the tactical group are: domain architects who were appointed with responsibility for broad categories of technology (e.g., server platforms); sub-domain architects had responsibility for technologies within a larger domain (e.g., desktops); and product stewards had responsibility for specific products (e.g., XP). Accountability cascaded down this hierarchy with domain architects responsible for setting strategy, understanding the marketplace and controlling proliferation of technology, and product stewards responsible for new releases and versions of technologies as well as

troubleshooting. At this organization, ultimate accountability rested with the executive architecture review board – a committee comprised of senior business and IT architects – who ratify the technology roadmap and make final decisions regarding proposed deviations to the roadmap. If a need arises for an "off-profile" (that is, "non-compliant") technology, it must be brought before the architecture review board for an "opinion". According to the focus group member, this is a very effective mechanism since "most people don't want their project elevated to the executive architectural review board!"

A major important part of governance is enforcement. The focus group suggested that effective enforcement requires IT to develop a new breed of "corporate" architect who is business-focused and business-centric. According to one member, "tech-centric architects tend to be seen as police officers … there to enforce the law". It is better to have a business-centric architect who can entertain business solutions that violate the preferred technology direction in the light of increased technology risk (that is, the risk of doing it) and business risk (that is, the risk of not doing it) and arrive at a decision that best suits the business. The difference in approach is one of accommodation, as opposed to denial and prevention.

At one company, the IT group did not want to ever have to "tell a business unit that they could not buy a specific package". The trade-off was to let the business specify the application's requirements and to let IT choose the product. Another firm tackled this problem by charging the business for the additional costs of a non-compliant application, such as extra in-house skills, application integration, conversions, and interfacing software. The over-riding goal in all these firms was to achieve optimal decisions for the business, not rigid adherence to a technology roadmap.

A repository can be an aid to tracking decisions, as well as the means of listing assigned responsibilities. At one company, this "architecture library" lists all technology domains (e.g., hardware, applications, etc.) and all products within each domain. Product metadata includes:

- status (i.e., emerging, contained, mainstream, declining, retirement, obsolete),
- proposed replacement product,
- name of product steward, sub-domain architect and architect,
- business impact analysis,
- interdependencies, and
- total cost of ownership.

Knowing that a specific product is "declining", who the product steward is, the name of the replacement product, and the business impact analysis demonstrating exactly where and how this product affects business processes is extremely valuable information to the organization. Such a resource requires a significant amount of work to build but, once built, it greatly reduces the complexity of maintaining and evolving a technology roadmap.

V. FINAL RECOMMENDATIONS

As part of the meeting, focus group members were asked the following question: If you were a "roadmap consultant", what advice would you offer to management?". When these bulleted points were combined and analyzed, the collective wisdom of the focus group reduced to the following four recommendations. Interestingly, this advice would arguably apply to many, if not most, IT initiatives.

a) Be bold and innovative when planning the roadmap

- What you have done should not be the gauge by which you determine what you should do.
- Innovation is key; start with a blank piece of paper.
- Invent your future. Inspire others to help you build it.

b) Align technology with the business

- Determine what role technology will play in satisfying the business vision.
- Focus on using technology to solve business problems and deliver business value.
- Know when it is appropriate to choose bleeding edge technology over being a late adopter/quick second.
- Ensure that the roadmap is flexible, extensible, and attainable to change with the business.
- Ensure that the organizational structure supports the delivery of a technology roadmap.

c) Secure support for the roadmap

- Ensure that the funding model supports a technology roadmap.
- A migration strategy and roadmap requires an executive sponsor, ownership, and accountability. Ensure that strategic decisions are made at the right level.
- Stay the course!

d) Don't forget the people

- Every technology change requires people change.
- Map new technologies to required skill acquisition.
- Take steps to ensure that IT personnel understand the technology roadmap and its logic, ramifications and timeframe.

e) Control, measure and communicate progress

- Measure progress along the way; use leading indicators.
- A successful roadmap must be measurable and updated at appropriate check points.
- Communication of the roadmap is essential to success.
- Establish a governance process to manage technology and vendor choices.

VI. CONCLUSION

The purpose of a technology roadmap is to guide the development of technology in an organization. As pointed out in this paper, however, it serves a much greater purpose for a business. It communicates the role that technology will play in advancing business goals; it outlines the explicit assumptions on which the roadmap is based and describes how these assumptions directly affect the rate and order of attainment of goals; it suggests the impact of future technology on the set of required in-house skills for the IT department; and it provides a vehicle for explaining the logic of technology-related decisions to business managers who otherwise interpret such decisions as overly rigid and non-productive. As such, a technology roadmap should be viewed as an important opportunity for IT to engage the business in meaningful and productive dialog focused on furthering business goals. To limit this activity to simply forecasting technology is to miss a significant opportunity.

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APPENDIX: PRINCIPLES TO GUIDE A MIGRATION STRATEGY

One focus organization adopted the following four key principles to guide their migration strategy:

a) Migrate from product-centric to process-centric applications architecture using a service-based architecture that is grouped into layers such as presentation, business process, and data.

- Maintain a sourcing strategy to develop strategic systems with competitive advantage in-house. Non-strategic systems will be sourced through packages and services as available.
- Maintain a technology skills base for critical technologies.
- Utilize strategic partnerships to bring in leading-edge technology skills to accelerate implementation, while at the same time, transfer knowledge to your staff to permit in-house support and future development.

b) Deploy modular or component based applications to minimize test and utility life cycle costs.
- Adhere to a component based and layered architecture with standardized generic interfaces.
- Ensure conformance of application development initiatives to the logical architecture specifications in order to engineer quality into the applications.
- Build flexibility into the application components by allowing end-users to establish and change business rules.

c) Utilize components based on industry standards as the building blocks of architecture services
- Adhere to (or adopt) industry accepted standards and methodology to promote ease of integration.
- Minimize the complexity of application interfaces by adopting flexible data interface standards (such as XML).
- Adhere to corporate technology and application development standards in order to improve the efficiency, effectiveness, and timeliness of application development initiatives.
- Insulate applications from being affected by changes in other applications through middleware.
- Enterprise application integration (EAI) middleware services will be used to integrate application services across and within business domains.
- Application interfaces will be well defined and documented in a meta-data repository that includes interface methods, purpose and terms of usage.
- EAI services will include both application interface services as well as work flow integration services both within and in the extended enterprise.
- Increase the degree of information and work flow integration across customer and vendor facing processes.

ABOUT THE AUTHORS

James D. McKeen (jmckeen@business.queensu.ca) is a Professor of MIS at the School of Business, Queen's University at Kingston, Canada and is the founding Director of The Monieson Centre which conducts multi-university, collaborative research focused on generating value through knowledge in organizations. Jim received his Ph.D. in Business Administration from the University of Minnesota. He has been working in the field of MIS for many years as a practitioner, researcher, and consultant and is a frequent speaker at business and academic conferences. His research has been widely published in various journals including the *MIS Quarterly*, *Knowledge Management Research and Practice*, the *Journal of Information Technology Management*, the *Communications of the Association of Information Systems*, MIS Quarterly Executive, the *Journal of Systems and Software*, *the International Journal of Management Reviews, Information and Management*, *Communications of the ACM*, *Computers and Education*, *OMEGA*, *Canadian Journal of Administrative Sciences, Journal of MIS*, *KM Review*, *Journal of Information Systems Technology* and *Database*. Jim is a co-author of two books on IT management with Heather Smith – the most recent being *Making IT Happen* (Wiley, 2003). He currently serves on a number of Editorial Boards.

Heather A. Smith (hsmith@business.queensu.ca) has been named North America's most published researcher on IT and knowledge management issues. A Senior Research Associate with Queen's University School of Business, she is the co-author of three books: the award-

winning *Management Challenges in IS: Successful Strategies and Appropriate Action; Making IT Happen: Critical Issues in IT Management;* and *Information Technology and Organizational Transformation: Solving the Management Puzzle.* A former senior IT manager, she is currently co-director of the IT Management Forum and the CIO Brief, which facilitate inter-organizational learning among senior IT executives. She is also a Senior Research Associate with the American Society for Information Management's Advanced Practices Council and a Research Associate with the Lac Carling Congress on E-Government. In addition, she consults, presents, and collaborates with organizations world-wide, including British Petroleum, TD Bank, Canada Post, Ecole des Hautes Etudes Commerciales, the OPP, Boston University, and Farm Credit Canada. Her research is published in a variety of journals and books including *MIT Sloan Management Review, MIS Quarterly Executive, Communications of the Association of Information Systems, Knowledge Management Research and Practice, Journal of Information Systems and Technology, Journal of Information Technology Management, Information and Management, Database, CIO Canada,* and the *CIO Governments Review.*

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