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Michael G. Klasen

Abstract

The desire for innovative competitiveness is nearly universal. Unfortunately, no well-accepted procedure to manage and continuously improve innovative processes exists. This paper introduces the concept of structured Innovation Management as an effective, efficient, and easy-to-use methodology that facilitates continuous improvement of innovative processes. The conclusion is that successful Innovation Management requires process specialization for project and proposal management, as well as a dedicated project team to consistently, and accountably, manage the innovative potential of uncertain new ideas.

Defining Innovation Management

The search for a practical and generally applicable Innovation Management (IM) methodology has continued unsuccessfully for more than 40 years (Souder, 1978). Decades of research and trial application of potential solutions show that purely financial (Boer, 2002), strategic (Roussel et al., 1991), project management (Cooper, 2001) or quantitative (Heidenberger et al, 1999) approaches provide only partial solutions. Unlike other management functions, IM practitioners have limited theoretical support and virtually no standardized procedures to direct their efforts towards Continuous Process Improvement (CPI).

A key issue is the creation of an IM definition that meaningfully separates IM from the many uncertain and complex management challenges faced by organizations. A common dictionary definition of innovation is "the (useful) introduction of new things, ideas, or ways of doing something." It follows that IM is the process of achieving the goals of innovation. This definition answers the question "what is IM," but does not resolve the decades old question of how organizations should optimally manage and support innovative processes.

Attempts to partition the IM problem into application segments, such as early-stage New Product Development (NPD), have not resulted in the creation of an optimal process for either early-stage NPD or IM in general (Koen et al., 2001). Elaborate NPD procedures that separate innovative activities into management "stages" and decision "gates" provide a useful structure to

manage evolving projects (Cooper, 2001), but do not address the pervasive uncertainty of the processes that create new projects (Koen et al.).

Numerous analytical and process solutions that focus on partial IM solutions such as project selection (Meade, Presley, 2002) or idea creation (Leonard, Straus, 1977) have failed to resolve IM problems in a generally applicable manner. This is because limited solutions typically overlook critical organizational behavior issues that can dramatically inhibit innovative capacity in real world environments. Example issues include bargaining, selective participation, and personally biased decision-making (Galbraith, 1973). Clear indications of partial or insufficient IM solutions are: (1) no documented procedure for new idea promotion due to lack of management capacity and resistance to broadening the franchise for idea creation, and (2) non-existent IM performance tracking to facilitate continuous improvement of innovation practices.

A recent IM modeling trend defines the innovation challenge not as the need for a formula or optimal set of evaluation variables, but as an organizationally holistic (Khurana, Rosenthal, 1998) structure that takes advantage of decision-process (Schmidt, Freeman, 1992) and systems theory (Senge, 1990). Defining IM as a process that organizations build over time parallels efforts to define innovation as a knowledge management (Nonaka, 1991) challenge that requires cyclic processes to acquire and manage new information (Parikh, 2001). While decision-process, systems, and knowledge management theories provide useful insights into the complexity of IM, all three bodies of theory have failed to create a generally applicable and easy-to-use IM solution.

Strategic management theory is interrelated with IM to the extent that the issues approached by both can be synonymous. If IM is the management of creating value from new ideas, then it follows that IM theory would influence all levels (corporate, business, functional) of strategic management theory (Adler et al, 1992). At the same time, the literature repeatedly emphasizes all IM decisions should take into account strategic considerations facilitated by senior managers who participate in IM processes (Drucker, 1985). The implied overlap between IM and strategic management objectives seems to broaden the range of IM challenges and therefore does little to facilitate the creation of an optimally simple and well-defined IM procedure.

Table 1 provides a summary of known and unknown factors about IM. Emphasis on the strategic, knowledge, or financial management considerations of IM does little to facilitate creation of a simple and effective IM solution. The idea that IM is important, hard work, and must be all-inclusive seems to conflict with the observation that IM represents only a minor share of organizational investment in new product development. This last observation implies that many organizations believe IM does not require significant investment, or that no recognized investment channel to credibly improve IM performance exists.

The fact that analytical solutions have failed to resolve IM issues for a vast majority of organizations usefully directs attention towards process solutions as a more promising IM

Table 1: Innovation Management (IM) Know and Unknown Summary

What is Known about Innovation Management (IM)	Unresolved Questions
IM decisions must be strategic (Adler et al, 1992)	How to use ?
IM requires knowledge management (Nonaka, 1991)	How to use ?
IM must be financially justifiable (Boer, 2002)	How to use ?
IM must include everyone and all ideas (Drucker, 1985)	Too general to be useful
IM is important for technology managers (Scott, 2001)	Too general to be useful
IM requires hard work and commitment (Cooper, 2001)	How much of both ?
IM is <5% of typical NPD budget (Roussel, et al, 1991)	Natural or unnatural limit ?
IM requires trial and error (Cole, 2002)	How to do efficiently ?
Analytical solutions have issues (Jones, Stevens, 1999)	How to resolve ?
IM must be holistic (Khurana, Rosenthal, 1998)	How holistic (inclusive) ?

methodology. Also useful are the observations that any IM solution must be holistic, address organizational behavior issues, and incorporate relevant knowledge-management theory. The IM related literature implies that the best theoretical tools to address IM issues are a combination of decision-process theory and organizational behavior theory. These theoretical tools must address the resource and uncertainty issues that create environments where many organizations conclude IM is strategically important, but unworthy of investment.

A working definition of IM requires careful consideration of how organizations presently manage innovation. To fail to consider current operations invites repetition of decades of theoretical model development that has failed to create a broadly applicable IM solution. Any practical IM procedure must help organizations to smoothly improve IM processes without the requirement for an unjustifiable level of effort. The implementation and use of an IM process must also address real-world issues such as the prioritized need to manage ongoing business operations or to financially justify all IM investment.

Unstructured Innovation Management

Figure 1 shows a model of an unstructured IM process tacitly used by many organizations. This figure only refers to the management of uncertain ideas and not well-defined or repetitive activities such as existing production, incremental product development, customer service, logistic management, etc. The input to the model is idea creation, which is the genesis of uncertainty because all unevaluated new ideas are by definition uncertain. Idea creation includes the introduction of all uncertain information ranging from on-going operations to opportunities that have no relationship with an organization's current activities.

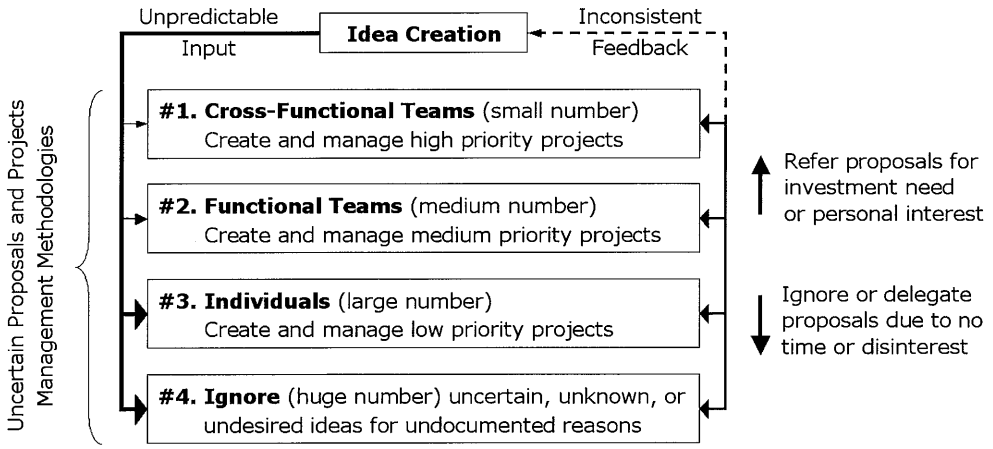

Figure 1: Unstructured IM Model

Figure 1 shows four primary methods that organizations use to investigate new ideas and to manage uncertain projects. First is the cross-functional team that includes senior management representation as well as the best-qualified subject area experts within an organization. The literature has many references to the IM necessity for the decision-making authority and effectiveness of cross-functional teams (Cooper, 2001). While cross-functional teams are an effective organizational management structure for IM (Galbraith, 1973), the influence of cross-functional team resource limits on IM performance and structure remains under-reported in the literature.

The cause of cross-functional team resource limitations is the small number of best-qualified people that exist within organizations and the limited time those people can dedicate to IM activities. Diverting talented people from high strategic priority assignments to conduct uncertain IM tasks will only happen when IM tasks have sufficient priority to compete for cross-functional team resources. No organization can justify using cross-functional team resources to process the broad range of uncertain ideas that potentially fall in the category of IM.

The unstructured IM solution to the unavailability of cross-functional teams is an ad hoc substitution of functional teams or individuals to perform cross-functional team duties. An example of a functional team and the type of uncertain project that it is well qualified to manage is a group of production engineers who consider technology alternatives to resolve a manufacturing process problem. Functional teams have the advantage of superior numbers, a similar perspective of proposal feasibility that facilitates efficient (but not necessarily effective) decision-making, and relatively easy access to functional management compared to cross-functional team access to general management.

When the perceived importance of an uncertain idea is not worth the attention of a functional

team, the next choice is to assign an individual to perform IM tasks. In the example above, an individual could investigate new equipment purchase terms from multiple vendors and report the results to a functional team. While the number of functional teams is larger than cross-functional teams, the number of individuals who manage uncertain activities is typically much larger than the number of functional or cross-functional teams.

The last unstructured IM methodology is to ignore uncertain ideas entirely due to a lack of time, a lack of personal interest, or the existence of overpowering uncertainty or undesirability. The number of uncertain or undesirable ideas an organization could potentially process is huge because all activities an organization does not engage in fall within this category. Ignoring ideas that obviously have no strategic value is an inevitable and desirable IM task, but delegating the choice of which ideas to ignore and which to pursue to under-qualified teams or individuals is a fundamental problem of unstructured IM processes.

Creating a well-qualified cross-functional team to manage obviously good ideas or projects is a relatively simple task compared to achieving the same level of strategic decision competence for all uncertain ideas. The reason is the limitation of cross-functional team resources and the associated need to delegate strategic decisions to less qualified decision-makers who lack the authority or knowledge to make the best possible strategic investment decisions. Prioritizing what projects or proposals receive which management resources is inevitable and explains why many potentially innovative ideas do not receive sufficient attention to realize their full potential.

Functional teams and individuals also delegate or refer decisions to their superiors on an as needed basis. It is problematic when significant uncertainty or resource limitations make the decision to ignore IM systematically preferable to redirecting IM resources from certain activities. Asymmetric incentives that favor the pursuit of measurable project results over uncertain proposal investigation create a structural bias against innovative processes such as idea creation or feasibility evaluation. The influence of a structural bias against innovation also exists in decisions that individuals and functional teams make regarding which proposals to refer to upper management or to ignore.

In extreme cases, the combination of uncertainty, insufficient knowledge, and lack of oversight results in the potential loss of valuable ideas because of seemingly trivial or personal reasons. For example, a manufacturing manager may resist considering a subordinate's proposal for sales reorganization because of a personal dislike of the vice president of sales. Such functional or individual decision bias inhibits effective idea creation and evaluation. This is the reason why cross-functional with senior management participation are the undisputed best methodology for IM. To summarize, the main problems of unstructured IM are:

1. No documentation of new ideas or consistent feedback for idea creators
2. Undocumented strategic justification and potential bias for delegated decisions

3 . Structural bias in favor of project certainty over innovative proposal uncertainty
4 . Limited ability to facilitate Continuous Process Improvement (CPI)
5 . Overall wasted innovative potential from all of the above

The unstructured IM model shown in Figure 1 can seem entirely rational and even optimal to people who work hard on certain projects and prioritize uncertain activities according to the directives of their managers. The unstructured IM problem does not concern the quality of IM participants as much as the structural inability of an organization to optimally manage the combination of certain projects and uncertain proposals. The structured IM solution to this problem requires separation of uncertain and certain IM challenges and the application of optimal organizational structures.

Structured Innovation Management

By definition, the management of functionally certain projects is beyond the scope of IM because such projects do not involve significant levels of uncertainty or newness. An example of a functionally certain project is the promotion of a well-defined upgrade for an existing product. If the financial benefit, procedure, and strategic desire to proceed with such a project are certain, then the project does not represent an IM challenge. In contrast, a potentially unpopular and unprofitable lower cost idea for new product may represent an IM challenge if the creator of such an idea receives no strategically justified feedback as to why his or her idea is undesirable.

Figure 2 shows a structured IM process designed to resolve the unstructured IM issues. The structured IM process provides a single input for new ideas compared to the uncontrolled entry of ideas into an unstructured IM process. This assures consistent treatment of new ideas and assures an organization does not inadvertently ignore valuable ideas or unjustifiably accelerate consideration of undesirable ideas. For example, a manufacturing idea may receive serious attention if created by a member of an important manufacturing department team, while a sales department manager may discard the same idea as being "none of his business."

The Innovation Uncertainty Management (IUM) Model is the proposed IM decision process that captures, screens, archives, monitors, and evaluates uncertain ideas. The IUM Model also facilitates the creation and selection of an appropriate management methodology for new projects. The horizontal line shown in the middle of Figure 2 signifies the separation between the strategically uncertain ideas managed by the IUM Model and the strategically certain (and potentially functionally uncertain) projects managed by traditional project management methodologies.

The distinction between strategically certain projects and strategically uncertain proposals

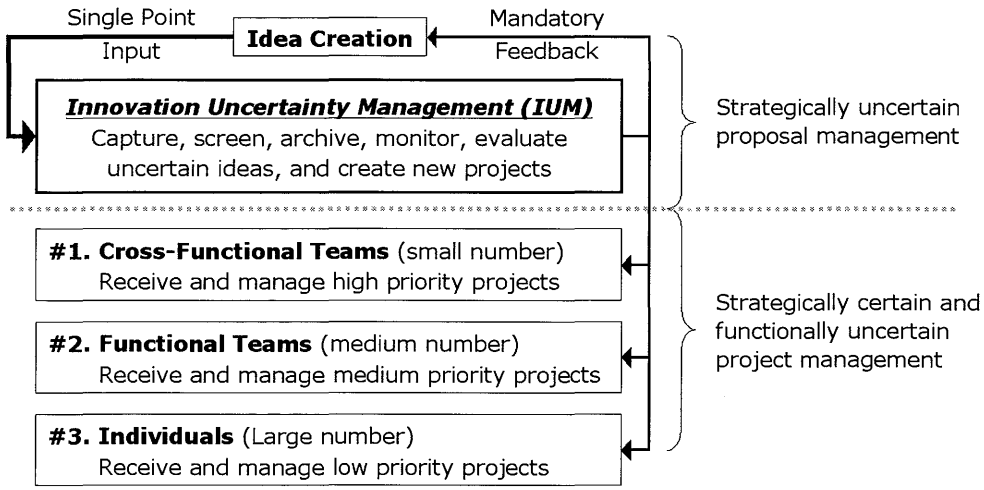

Figure 2 : Structured IM Model

separates the overall IM challenge into two manageable parts. When a project investment decision is appropriately justified, the job of the IUM Model is complete and uncertain project management takes over responsibility for managing the organization's investment. Strategic certainty signifies an organization's desire to invest in a project, regardless of the level of residual functional uncertainty the project may exhibit.

An example of the strategically certain and functionally uncertain project would be an organization's urgent development program to counter the successful product introduction of a competitor. In such a case, an organization may need to make a strategic project investment decision regardless of the technical, manufacturing, financial, or other uncertainties associated with the proposed development program. The urgency and operational uncertainty of such a strategically certain project typically results in the senior management assignment of a suitably qualified cross-functional team, functional team, or individual to the required task.

In all cases, the methodology an organization uses must be flexible enough to adjust to the dynamic financial, resource, and knowledge challenges of uncertain project management. In contrast, the evaluation of strategically uncertain proposals requires structured and repeatable processes for idea capture, evaluation, and project creation. The separation of IUM from project management enables the use of innovation performance metrics that facilitate continuous improvement of new idea evaluation and investment decision processes. The comparatively narrow focus of IUM on early stage IM enables improved process and structural specialization for both project creation and project management activities.

New project creation and project management are fundamentally different activities. Project management must contend with investment budgets that can range in size by many orders of

magnitude and that may have rapidly changing participation requirements. A typical example of such a project is a new product development activity that progresses from an R&D prototype to full production and possibly into the formation of an independent business unit. Organizations typically address such broadly varying challenges with project management teams that evolve over time to match the unique requirements of individual projects.

In comparison, an organization's single IUM team only conducts pre-project investigation and new project creation activities. Because of this narrow focus, participation in IUM activities should remain as consistent as possible to build expertise in the key IUM functions of new idea creation support, feasibility evaluation, and investment management. The need for consistency and the lack of demand to adjust to dramatically different levels of investment support the conclusion that IUM and project management are unique activities that require specialized, and in many cases, incompatible organizational structures.

To be effective a structured IM process requires investment decision effectiveness that approximates the capability of a well-qualified cross-functional team. The functionality of structured IM therefore depends entirely upon the ability of the IUM function to achieve its stated objectives. The next section will examine the internal structure of IUM that enables effective, efficient, and consistent idea evaluation and project creation.

Innovation Uncertainty Management Model

Figure 3 shows the internal structure and operational flow of the IUM Model. Proposals enter the Process Control function from any entity capable of creating useful ideas. The IUM Model does not address the cognitive processes of idea creation, but it does assure that all submitted ideas receive consistent treatment and that all idea creators receive prompt feedback about the investigation status and strategic value of their proposals. The scope of acceptable proposals is purposefully broad to promote all categories of potential innovation.

The Investment Management function controls project formulation at the output of the model. Investment Management determines the extent that strategic, portfolio, and resource-allocation considerations enter into initial project formulation decisions. At a minimum, all proposals considered by the IUM Model receive Strategic Fit feasibility scores and documented justification for whatever investment (or non-investment) decision Investment Management makes. Process Control uses investment justification records to create an evolving proposal screening standard and to encourage submission of potentially useful proposals.

Process Control makes the proposal screening decisions that determine the initial route of proposals through the model. Proposals perceived as strategically certain or time-critical proceed directly to Investment Management for consideration during a periodic Investment

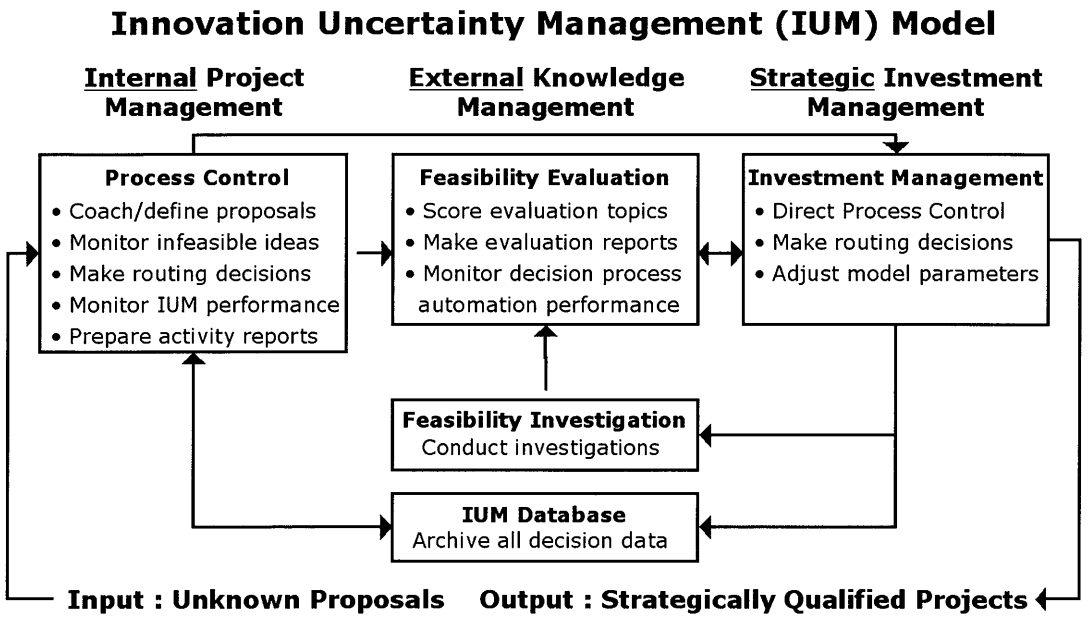

Figure 3 : IUM Model Structure

Management Meeting. Strategically uncertain proposals automatically receive Feasibility Evaluation attention, while justifiably infeasible proposals go to the IUM Database for archiving and monitoring for feasibility changes. The first agenda item of the Investment Management Meeting is the authorization of all Process Control screening actions to assure these decisions are strategically valid.

Process Control, functioning as the project manager of the IUM Model, collects personal, functional, and financial performance metric data for Investment Management and validates that IUM Model process adjustments support continuous performance improvement. Process Control participants do not make project formation or feasibility evaluation decisions to avoid the potential for decision bias due to conflicting objectives, and to assure that subject area experts make those decisions. An example of a conflicting objective is the use of inconsistent or undocumented evaluation procedures to justify investment in a personally desirable proposal.

Feasibility Evaluation consists of five independent evaluation teams that score proposal desirability and uncertainty from the perspective of the five evaluation topics shown in Figure 4. Financial Value and Competitiveness Impact selectively support final project creation decisions, while Technology Control, Commercial Delivery, and Manufacturing Creation (with optional detail) describe proposal feasibility from independent perspectives.

Each Feasibility Evaluation team scores proposal feasibility using the 0 to 5 scoring scale shown in Figure 4, and justifies the score qualitatively. The objective of Feasibility Evaluation

is to provide Investment Management with a summary of feasibility status of each proposal from independent perspectives, and to provide advice for how best to address proposal uncertainty and undesirability for each evaluation topic. Investment Management reviews Feasibility Evaluation score and justification records before creating a Strategic Fit score that corresponds directly to a final investment decision for each proposal under consideration.

During the periodic Investment Management Meeting, strategically authorized managers make one of the following project creation decisions: (1) terminate investment in infeasible proposals, (2) return proposals to Feasibility Evaluation for additional evaluation, (3) initiate Feasibility Investigation projects to create new knowledge, or (4) turn proposals into strategically justified projects. The last agenda item of the Investment Management Meeting is authorization of any IUM operational changes that Process Control will implement.

Feasibility Investigation is an ad hoc project team that creates new knowledge to determine the feasibility of proposals when existing Feasibility Evaluation knowledge is insufficient. Feasibility Investigation represents the third stage of knowledge management imbedded within the IUM Model. The first stage is Process Control use of historical data from the IUM Database to screen new proposals. The second stage is the collection of currently available knowledge by Feasibility Evaluation. Feasibility Investigation activities consist of limited term projects, such as market research or prototype creation, that aim at determining the strategic value of a proposal.

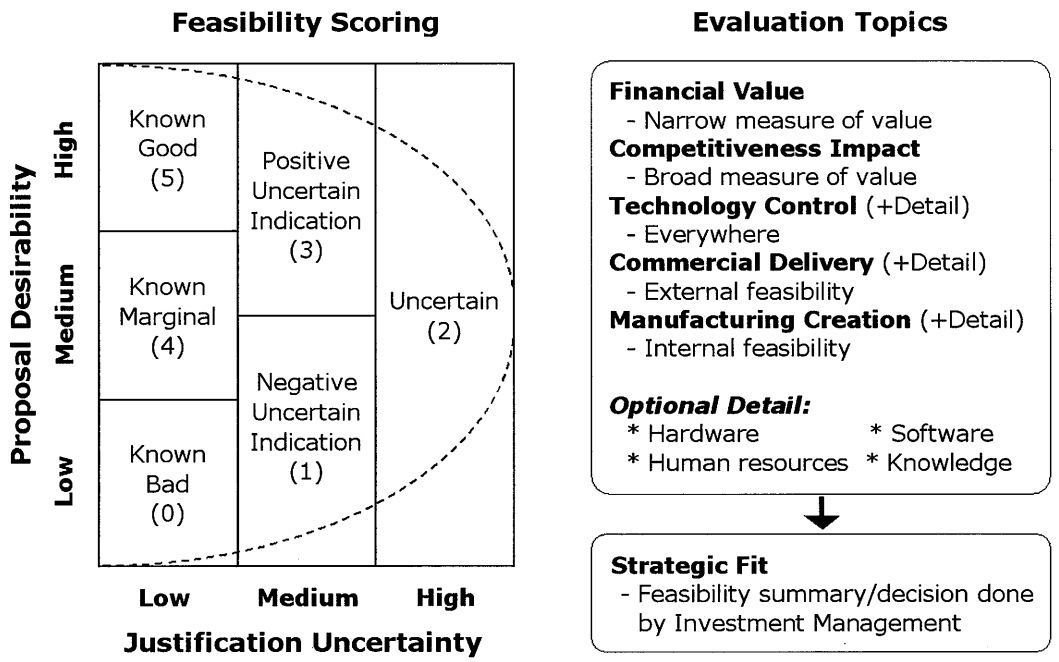

Figure 4 : IUM Model Feasibility Evaluation

Feasibility Investigation contrasts with project management activities that try to achieve the objectives of a defined project.

IUM Model effectiveness originates from the specialization achievable by the three primary functions. Process Control is the efficiency-seeking project manager for IUM that gains expertise with experience in managing internally oriented tasks. Feasibility Evaluation team members are subject area experts know where knowledge is located and how to extract and report it, but they do not need to know the details of IUM processes or how to make strategic decisions that influence the entire organization. Investment Management is the strategic investment gatekeeper that assures the effectiveness of all IUM operational and project creation decisions.

The capability of Process Control, Feasibility Evaluation, and Investment Management to continuously improve their respective IUM performance independent of each other's assigned tasks is critical for continuous process improvement assurance of an acceptable model return-on-investment. Separation of duties also reduces the likelihood of undesirable organizational behavior issues, such as personal decision bias or non-optimal office politics, by limiting the decision-making powers of each model participant to the activities that they are best qualified to conduct and by tracking decision accountability accordingly.

Conclusion

Table 2 summarizes the benefits of structured IM compared to unstructured IM. The IUM Model plays an important role in the elimination of unstructured IM issues by assuring consistent proposal treatment and feedback to idea creators through single point facilitation of both activities. Concentration of new project creation decisions at the output stage of the IUM Model also assures that no idea becomes a project without sufficient justification, that that such justification is then fed back into the process to promote continuous improvement.

The delegation of cross-functional decisions to less qualified functional teams or individuals is the primary cause of unstructured IM decision bias and ineffectiveness. Even the best people within an organization can only make decisions according to the knowledge they have access to and the directives provided by their immediate managers. Organizations will continue to experience non-optimal IM as long as the only method to process new ideas is by filtering them through established organizational structures designed for on-going project management instead of proposal processing.

Resource limitations that prevent isolated performance tracking of IUM functions are the primary reason why many organizations cannot continuously improve IM performance. The need to conduct IM activities that fall outside an individual's area of expertise (knowledge resource) or availability (time resource) is common in an unstructured IM environment. In

Table 2 : Unstructured and Structured IM Comparison

Unstructured IM Problem	Structured IM Solution
No consistent documentation of ideas or feedback to idea creators	Documentation of all ideas and feedback mandatory
No consistent justification for delegated investigation or project creation decisions	Documented justification for investigation and project creation
Uncontrolled injection of personal or functional decision bias	Eliminates bias by removing delegation of investigation or project creation decisions
Resource limitations inhibit innovation continuous process improvement (CPI)	IUM Model functional specialization enables performance tracking for CPI
Tacit knowledge	Explicit knowledge

addition to a lack of management resources, unstructured IM environments lack the documentation and processing expertise infrastructure to efficiently determine the uniqueness and potential desirability of a wide range of new ideas. The unstructured IM process fundamentally lacks the efficiency and effectiveness capacity of a structured IM process because of accountability, repeatability, and resources limitation problems.

In an unstructured IM process, innovation expertise is tacit, with some people or departments performing better than others for no documented reason. The only plausible reaction to such a situation is to promote or listen to people who achieve good results over those who do not. In a structured IM environment, tacit knowledge becomes explicit in the form of individual performance records and verifiable efforts by each function to improve IM return-on-investment. Making tacit knowledge explicit improves overall innovation performance instead of perpetuating an unstructured process where only top performers have the franchise to innovate.

Structured IM does not answer the questions of what strategic investment decisions an organization should make or how best to manage uncertain project complexity. Structured IM does help organizations create an innovation-friendly environment free from impossible resource competition, managerial neglect, and decision bias. Organizations that use structured IM turn the uncontrolled project creation process into a well defined and continuously improving procedure that everyone within an organization can productively support.

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