Ordino Inc.

An Overview of Technology Management

Services provided by Ordino Inc. to address management concerns and to resolve technology problems

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Ordino's business

Ordino provides services in the field of technology management. This is a very broad undertaking. The following material describes exactly what these services are and why they are needed.

Ordino offers two advantages to companies using its services: the first is a wide range of experience which can help to suggest different alternatives, and overlooked considerations. The second is objectivity: most people involved in technology development are extremely strong advocates of what they have produced. They have to be, since without that degree of commitment the work would never get done. However, whilst being sympathetic to the claims of the individual, technology management has to make a decision on what is best for the specific organization. This is where the objectivity comes in.

On some occasions the objectivity is applied at a higher level in the organization, where the technology manager is a lone voice supporting a claim for consideration in the sharing of resources. The expectation is that the advocate will be able to put everything into layman's terms and hence guide the highest level decision. This may be characterized as the objectivity of ignorance. Frequently the layman's terms are confusing and lose the essence of what is being done or what is being proposed. To produce estimates of benefits, timescales, costs, etc., some specific considerations have to be made and these will not be apparent to other managers and will not necessarily be objective.

The better process is to provide informed objectivity where the right questions are asked of those who are doing the technology management task, not to hinder the process, but to strengthen it. Then a plan may be carried forward with the knowledge that it has been vetted by some third party who does not have the commitment of advocacy, but does have the understanding of technology.

This document describes what Ordino does, the studies it undertakes and the services it provides.

What Ordino does

1. Technology management overview

1a. What is it?

Technology management is required in all phases of the technology development and deployment cycle. As with any activity a management process tries to ensure effective and efficient undertakings, but with technology management there is the added requirement that to some degree new techniques, fitted to the particular characteristics of the technology, will be required. Thus we cannot depend on past experience to the same degree that we can with other fields, but need instead to evolve management processes specifically fitted to the particular technology.

There are, of course, some principles which help in this evolutionary process, and in many cases the degree of change required may be slight. To be most effective however, there is a need to look at the issues critically to ensure that the best management process is being used.

Because there is innovation involved, there is always a higher degree of risk than there is with routine management activities. Risk is accordingly treated with special care in technology management, and risk mitigation is one of the most important considerations.

In summary, technology management is management especially adapted to meet the particular needs of technology creation and use.

1b. The scope of technology management – the technology cycle

The technology cycle starts with an identification of a need or of an opportunity. It continues through the development of a plan to address the need or opportunity, and the subsequent development of a new technology. The next stage requires the application of the new technology to create a new product, or process, which can then be brought into use, or into the market.

In most instances the technology cycle continues with the education of the user community and the development of the support and installation services required to make the use of the new technology effective. There may also be the requirement to continue to refine the new technology and to create additional applications so that a greater economic benefit may be obtained. In some instances there may be standards that need to be set, associated with the use of the new technology, and testing defined to ensure that those standards are met.

At the end of the cycle there are special requirements to identify a technology which has reached the end of its useful life and which is in need of being replaced. It is through the analysis of the costs associated with the technology in all phases of its lifecycle that the requirements for the replacement technology can be most specifically identified. Once this is done, the cycle starts again.

It should be noted that the next cycle is not a replay of its predecessor. It typically involves a change in costs to emphasize capital requirements, for example, and a wider range of applications, which together create larger economies of scale. It may shift the user education requirements to either a higher or a lower skill level. The same mixture of technology management components will be present, but there will be differences which need to be accurately gauged.

1c. How is it done? Tools, skills, outcomes

Technology management starts with a situation assessment. The scope of this assessment will depend on what is known and at what part of the technology cycle the requirement exists. The tools used will be drawn from the following set. Some of these tools are specific to a particular phase in the cycle: others apply more widely.

1. Risk
   As noted above, a key activity is identifying the potential risks which exist and how they may best be mitigated, or avoided. Risk is addressed systematically by observing the possible points of failure and estimating the probabilities of the different possible outcomes.

2. Skills assessment
   Skills assessment takes the form of a technology competence evaluation, which can be performed at both the individual and the organization unit levels. This identifies gaps which need to be addressed either through training, or through the acquisition of specific skills.

3. Planning
   This includes technology scanning to determine what exists elsewhere, either with a view to acquiring it, or to avoid existing intellectual property, or to avoid known dead-ends. Plans are constructed with proven frameworks to ensure that all aspects of the plan requirements are covered and that consistent methods are applied throughout

4. Project management
   This entails both the development and resourcing of a detailed plan, which may be executed inside or external to an organization. The monitoring of the execution of that plan including appropriate review points is the heart of project management. A crucial part of this process is the modification of the plan to accommodate problems that arise or to take advantage of serendipitous outcomes.

5. Intellectual property protection
   A wide range of options exist for this: trade secret, copyright, registered design and patent all have their appropriate roles. Issues such as licensing and asset valuation may need to be addressed.

6. Technology transfer
   This is a requirement whether technology is developed within the organization or obtained from outside. The technology needs to be recontextualized from the perceptions and understandings of the researchers who developed it to those of the developers who will create the application of the technology in a new product or service. Without the proper preparation and dialogue this can be an inefficient process which may result in much of the technology being redeveloped.

7. Technology support
   This entails issues associated with the installation of technology in the field, customization, diagnostics, monitoring, repair processes, provision of ancillary services such as calibration and the provision of consumables that the technology may call for.

8. Infrastructure
   No technology exists by itself in isolation: it may exist in a field which requires standards, the development of test equipment to ensure that standards are met, testing to ensure that standards are adequate and the collection of ongoing data. This is commonly an area where individual businesses and governments, or government authorized regulatory authorities come into collision, whether it is in getting a new drug to the market quickly or in the allocation of wireless spectrum to ensure that the needs of all potential users are equitably balanced.

1d. Where is it used?

Technology management is used wherever a recognizable part of the technology cycle exists. Just because an organization does not develop its own technology does not relieve it from the need to manage technology. The acquisition and adoption of technology into an organization raises many of the same issues as those that exist for technology developers.

There are few organizations which are not touched by one technology or another and hence the needs for this form of management are widespread. If a formal technology group, such as an R&D Department exists, then that will be the obvious focal point for technology management activities, but equally the requirement may exist within a marketing group whose product and service range includes technology based products and services, or in manufacturing groups whose responsibility is in the area of production of technology-based products, or in the area of using technology for production processes.

1e. What benefits does it offer?

Technology management confers the benefits of management in the specific domain it is used in. Its effectiveness is measured by such factors as reduced costs, increased revenues, reduced time to market, market share and market leadership. Which of these benefits is most applicable in any specific case will be identified as part of the planning process.

1f. Can it really be done?

There is a view, often put forward, that technology introduces so many changes and so rapidly that it is impractical to formally manage it: the only realistic stance is to provide a responsive management approach which can react to any particular outcome. This is the firefighter approach. In practice this approach can be adopted to some degree, but it will not provide optimum results and, in particular, it will not take full advantage of the upside of technology.

The essence of the management process is to have a realistic plan which lays out a plausible path from start to finish. It clearly identifies the critical points which will establish at an early stage the likely success or failure of the plan. It will provide a firm basis for introducing modifications to the management process which will coherently enhance the prospects of success.

There are always external, uncontrollable factors which will cause a plan to fail, no matter how well it is thought out. A new breakthrough may come from some third party which renders a plan obsolete. But a good technology management approach allows such external information to assessed systematically and the appropriate management decision to be made.

The higher the level of management the broader the view required and the clear identification of the key aspects of the process, outcomes and risks, is essential.

2. Technology planning

This section provides more detail on the role of technology planning in overall technology management. It examines the role of planning for different levels of organization and the separate facets of technology planning that may be adopted. By setting the right kind of plans in place, the rest of technology management has a greater likelihood of falling into place.

2a. Government/institutional strategy

The benefits of technology development to economic development have been widely recognized: however, it is not always true that investments in technology always provide benefits at the national economy level. How to make the correct choice of technologies and programs to pursue is a critical matter in setting government level policy.

Institutions have to face similar considerations: whether they are supported by governments, by industries or by a combination of both, they have to provide something that could not be provided by industry for itself directly. They are in effect middlemen in the technology business and they have to justify the price they charge for their product. Institutions may be research establishments or universities: each have potential benefits to offer, but they need to understand where they can contribute and where they cannot exploit their particular capabilities.

It is also important at this level to understand that technology is a worldwide opportunity and presents worldwide competition. It has been demonstrated that in economic terms import substitution does not lead to rapid economic development: the better model is to find those technologies which add substantial value to the commodities produced within the economy in question. This is the necessary world focus.

To understand this view there is a need to understand what industries exist within an economy: this is not a trivial question. An industry is more than a simple capability of producing a single product or family of products. It is a complex interlaced structure which draws together raw materials, investments, market access and knowledge creation along with production capabilities. The structure is not static since many industries may share technologies and as new technologies emerge there is the potential for overlap with, and dependence on, other industries.

Technology sectors offer a complementary dynamic view: as the scope of a technology extends so its rage of application extends and so new layers may be built upon it. This offers a two fold growth, vertical and horizontal. In order to reap the full benefits of technology investment, the industrial elements that can take advantage of both types of growth must be in place.

The significance of an industry to an economy is an important factor to establish. This may be easily accomplished in financial terms i.e. the ratio of imports and exports associated with the industry. This however ignores internal consumption, and the availability of non-dollar inputs e.g. a skilled workforce.

An early process in establishing a government level strategy is to obtain an understanding of the System of Innovation. This may be a National System of Innovation (NSI), but it may be a regional system within a country, or it may transcend national boundaries. In more and more cases the System of Innovation concept makes more sense at either the local level or the international level.

2b. Corporate technology strategy

Corporations engage in research and in the application of technology because it offers them a financial benefit, either in the short term or the long term. Research organization often have as much focus on training as they do on result production, and they frequently serve as sources of information. This leads to differences: commercial research tends to focus on need, whilst institutional and academic research focuses more on opportunity. Whilst an exclusive focus on the short-term would not be beneficial to the overall health of a business, neither can the company afford to put all its investments in technology into the long term future. To meet both requirements simultaneously the corporation will adopt a balanced strategy which allocates appropriate parts of its technology investment to short, medium and long term goals.

In addition the corporation will have to decide how risk averse it is and how it can adequately manage the risk of technology development and technology application. This offers another segmentation of the technology investment program in this case balanced across low, medium and high risk undertakings. It is, of course, understood that the return on these three categories is directly proportional to the risk: thus low risk offers low returns, and high risk, high returns. If this is not true then the strategy must accommodate a different kind of return structure.

Return is always hard to assess, since it may be achieved through a variety of different channels. It may arise from cost reduction, from increased revenues from existing or extended products, from benefits arising from improved service levels, from new revenues from new products, or from market dominance and leadership. The mixture of direct and indirect benefits needs to be accurately assessed.

There is a close link to the market position that a company wishes to establish. The possible technology stances e.g. early adopter, low-cost follower, etc., have considerable influence over the technology strategy. The stance is a marketing-led decision, and not something which can be determined by technologists.

2c. Technology creation strategy

Technology creation strategy is a subset of the overall technology strategy. Once the overall strategic goals have been established the possibility of meeting these through technology creation is considered. The alternative of technology acquisition should always be considered in this context.

The key issues are what are the key technology areas for the corporation i.e. where has technology leadership been established, or where might it be established? This combines with the understanding obtained from the higher level strategy and addresses factors such as what are the exact requirements for competitive advantage, what are existing cost structures and where might technology offer a benefit, and what is the position of the external competition.

The identification of technology sources is also important. These may be other corporations, research institutions or universities. In cases where fundamental or basic technology is under consideration collaborative partnerships, which may even include competitors is possible, both to reduce costs and to extend the number of alternatives addressed.

The way in which technology is acquired is also important, whether it is as technology itself, or whether it is a technology embodied in a product or subassembly.

Across all these consideration are two paramount factors, namely timeliness and risk reduction. An acquired technology will probably reduce the time to reach deployment and should reduce risk, since it is already demonstrable.

2d. Technology foresight

Technologies change in two ways: first by incremental improvements and then by breakthroughs. After a breakthrough there is a period of successive incremental changes which after a period start to show a plateauing effect, so that each successive improvement offers a diminishing benefit.

Technology foresight addresses this problem by trying to anticipate when a technology will enter its sunset state and no further incremental improvements will offer a significant return, and will endeavour to bring about the conditions under which a replacement technology will emerge. It may be found that a product depends on a series of technologies rather than a single technology. Replacement of a key technology may well have a ripple effect which entails change or replacement of subsidiary technologies.

It is observed that in some cases the new technology will address a broader field than its predecessor: this allows for the convergence situation to occur: in other cases the new technology will not address the same breadth of applications and then specialization follows.

The nurturing process entails the development of technology and the development of applications of that technology in close conjunction: it offers a public role in the development of the technology infrastructure required to support the new technology.

2e. Technology forecasting

Where is the technology in its lifecycle, what are the changes occurring to it, and what are the potential successors? The key information to be determined is changes in performance, reliability and cost. When this is known product development can proceed more confidently on the assumption that certain inputs will be available at a given price at a planned future time.

Some technologies are termed “enabling”. They facilitate the development of other technologies. A series of levels can be defined:-

- base level e.g. computer hardware
- applied levels – first level functional software e.g. database systems, software development tools
- second level e.g. primary application level
- third level – value added application and data.
- etc.

The base level offers the greatest scope for economic return but the higher applied levels offer niche dominance opportunities. A company developing a higher level technology needs to be aware of what may change at the lower levels which will affect their work.

2f. Technology acquisition strategy

Successful technology acquisition requires as much if not more planning than technology creation: this is because effectively timescales get compressed but still the same number of considerations have to be applied.

The first stage is to understand and identify exactly what the target technology is. It must be understood what level the technology is at: is it a base technology or an applied technology. Acquiring a base technology may mean entering into an extended relationship with the technology supplier and the implications of this need to be considered. Acquiring an application may mean that the recipient will not have the depth to move the technology further, or be able to address issues that arise with the technology in use.

The technology acquisition must offer a benefit in terms of timeliness or of risk reduction. If these are not adequate then there is no point in pursuing the acquisition strategy.

Once the acquisition route has been identified as beneficial and viable, then the potential sources of the technology need to be identified.

2g. Start-up company planning

Many start-ups evolve from a technology base: the issues that need to be addressed are whether this offers enough to make a viable company, or whether the technology should be sold to an existing player in the market.

The first assessment is whether the technology has enough impact either on the market, whether this is through cost reduction or performance enhancement, or on the internal cost structures of the company. The higher the degree of novelty the harder this is to assess.

If the technology offers enough benefit and the market is plausible then the company as a technology developer and technology applier has to be evaluated. The most common problem is that the founder of the company may have great technology skills but is not actually capable of managing a company. Depending on the individual entrepreneur this problem may arise earlier or later, but the issue of bringing in the right skills to the company to manage it and to continue its technology development eventually always has to be addressed.

3. Technology creation

Technology creation is R&D. The complete creation cycle, from start of investigation to completed product is lengthy: it varies in different disciplines but typically 5 or 6 years should be considered from basic research to product or service creation. If the cycle starts at the applied research or experimental product development level then it will be significantly shorter, subject to any learning cycles.

3a. What skills are needed, both R&D and management

To execute a project successfully there must be technical skills and management capability which can address the specific needs of R&D. Part of the project planning process is the assessment of technology competence of the group proposing to undertake the project. Gaps will be identified if they exist. If the group has substantial prior experience in the same field then the risk of the project is substantially diminished and the probability of project estimates being accurate is substantially enhanced.

3b. How beneficial to the corporate plan?

R&D only creates value for a business if it addresses the problems that the business has and is closely linked to the company's overall strategy. At the operational level it is the linkage of R&D to marketing and production that needs to be examined to see that the right technology is being created and that it is reaching the place where it is needed.

Other issues that determine the net corporate benefit are the scale of the technologies produced i.e. is the program addressing at least a proportion of short term projects to provide immediate benefit? And how productive is the process i.e. how many technologies does it create?

3c. Partnering opportunities

Partnering varies from joining a consortium to jointly fund long term fundamental research to partnerships with one other company which may be a supplier, a competitor, or a customer. In any case the questions address whether the extra resources or the sharing of scarce resources make sense, and whether non-exclusivity is a risk that can reasonably be borne.

The other implications of partnering fall into the technology acquisition area i.e. the need for technology transfer and possible adaptation.

3d. Managing R&D

Managing R&D is a multilevel topic. At the highest level there are issues about managerial process and reporting. What are the reasonable ways of demonstrating the progress of R&D and the expected outcomes? The requirements vary from the assessment of actual benefits realized, to recognition of intermediate outputs that can act as surrogates for the long term, ultimate outputs of R&D programs and projects.

The manager who looks after R&D resources will be interested in R&D efficiency i.e. are those resources being as productive as they might be? Ordino has produced a refined way of measuring efficiency in R&D departments.

Project management is the most fundamental level of R&D management, and one which is crucial: the task is often assigned to technical resources who do not necessarily have the complete set of skills needed.

3e. Mentoring

Ordino will assist R&D managers at any level by providing a mentoring function. This may vary from periodic discussions of issues that arise, to looking over the shoulder and taking the larger view. At project reviews a second opinion can be provided either as part of a review meeting or from a review of papers so that privacy can be maintained.

4. Technology use

4a. Introduction of technology

The introduction of a new technology to an organization requires a careful plan to make sure that anticipated benefits are obtained. The match of capabilities of the new technology to the expectations of the organization is the first stage in this, the installation of the technology follows, and the process completes with the elimination of the old way of performing the upgraded task.

The monitoring of the new technology to ensure that performance goals are being met is a key part of the undertaking and assessments of issues that arise which may point to some unanticipated effects. The monitoring puts in place a system which will continue with the technology for as long as it used.

4b. Technology training requirements

This requirement is often associated with the introduction of the new technology and is also an important part of technology transfer. The training requirements can usually be determined easily, but there is also a need to capture the experience of those trained so that repositories of frequently asked questions and similar mechanisms can be used to support the new trainees as they perform their tasks.

4c. Technology assessment

This is usually a precursor of technology acquisition and requires an assessment of all aspects of the technology including performance, support requirements, extensibility and adaptability, and total cost of installation and operation. This provides the objective information which can then be used to determine whether an acquisition is economically justified.

4d. Technology acquisition

The technology acquisition process starts with the assessment described above and then proceeds to develop the infrastructure which will be required to support it. This includes training support, maintenance requirements and changes that may flow from the new technology.

4e. Technology communication and marketing

This is a broadly based activity which may focus on ways of presenting the work of an R&D group to a wider public so as to gain support for it, or to prepare materials that can be used in the marketing of a technology based product, or of the technology itself.

5. R&D evaluation

5a. Evaluation of plans

The planning process for R&D occurs at two levels, the program and the project. The program plans define the high level and the criteria for the projects and the mix of projects that will be undertaken.

Project plans will define milestones and review processes as well as the anticipated way in which the goal of the project will be achieved.

The assessments that need to be undertaken are whether the program plans accurately meet the goals of the organization and define the project selection process in sufficient detail, and whether project plans provide realistic detail and estimation of timescales and resources needed to complete them.

5b. Evaluation of performance and usability of technology: benefit assessment

When a project has completed by meeting its goals the question is whether it provides a good enough margin over what it is intended to replace, the incumbent technology, and whether it can practically be put into use. R&D passes through a series of prototype stages which move from demonstration of principle with the laboratory prototype, to demonstrable use in the commercial prototype, to demonstrable production capability with the production prototype. The determination that one of these levels has been met usually requires an assessment by an independent body to ensure objectivity.

Before a commitment to commercialization and product or service launch is made the case for the user of the technology needs to be established. This is partly an economic case but may also require assessment of non-financial benefits.

5c. Project review

R&D projects are harder to evaluate than other development projects. This is because of the fundamental uncertainties being addressed regarding whether something can be done at all, or what is the best way of doing it. Milestones can be set but it is hard to ensure whether they have been fully met or not. A milestone implies a black or white decision, but in practice there is a greyness associated with the choice.

Objective evaluation of the milestones of a project or of its completion help in assessing what has tangibly been achieved, what has been learned and what might have a general applicability in other situations.

5d. Diagnostic: what happened in this project?

Projects sometimes hit barriers and progress towards a milestone is no longer apparent. At this point the R&D Manager has a hard decision: is the project dead, or does it need refocusing? An external assessment takes some of the difficult human dynamics away from such a decision, particularly if the refocusing solution requires taking the project to a new group of researchers.

In addition there is a learning which needs to be obtained: could the outcome have been predicted earlier? What were the warning signs which might apply in another case. This

knowledge is important to the R&D Manager so that improvement of project management processes can occur.

5e. Technology financial valuation

When a technology has been developed there are occasions when it is important to assess its value, either because it is being sold, or because it is being used in a start-up company and represents a part of the assets of that business. Valuation is not a simple economic process: some consideration has to be given to alternatives technologies. It frequently occurs that whilst a technology is being developed to achieve a specific goal, an alternative way of doing the same thing will also emerge from an unrelated source.

This presents the dilemma of whether the new alternative would be a better way of achieving the target, and if so how much would it cost to do that, versus the present availability of the developed solution.

6. Use of information

Information is an important by-product of technologies, particularly those which we call ‘smart” technologies. The successful and beneficial use of information is therefore an important adjunct of the management of technology.

6a. How information is applied in decision making

Information as a strategic resource makes it a central organizing principle of an organization. Information, as commonly used, covers three separate concepts, data, information and knowledge. In operational terms, data is measured and recorded: knowledge is gained by interpretation of data and information is created by the use of knowledge to extrapolate from data what potential outcomes may be.

The ability to compete, and to continue to compete, is what characterizes the high performance organization. In any selected strategy, which may combine elements of cost leadership, differentiation, or focus, it is the evolution of an information culture within the organization that is critical. Information can be used to address many competitive factors. Which of these is most critical to an organization will depend on its exact strategy.

The high performing organization focuses on decision making. It makes the right decisions at the right levels at the right times. To make the right decisions it uses the right knowledge about how to make the decision and the right information. Hence high performance depends on knowledge and information.

Decisions may be structured or unstructured. In general, unstructured decisions have to be undertaken at higher levels in the organization: hence to empower the organization it is helpful to try and structure more decisions.

Activities in decision making include:-

1. intelligence i.e. problem finding, which includes comparisons of plans with actuals, exception reporting

2. design, which is the development of alternatives

3. choice, which is the selection between alternatives.

The reduction of the level in the organization at which intelligence gathering and design development occurs is the key: this means that data and knowledge requirements of the decision have been clearly established. The role of management can then be seen as coaching the employees to develop an acceptable decision protocol, which once established, can be successfully delegated to them for repeated use.

The goal of the organization is to improve its performance and it does this by measuring monitoring the processes which are critical to performance. One kind of data which helps the decision making improvement is the retention of decision details as a history which can be accessed and analyzed for improvement opportunities.

Benefits of information use arise through waste reduction, including the inappropriate use of resources, through the creation of new opportunities and through asset appreciation.

6b. Quality of information assessment

When information is being used it needs to be of high enough quality for the purpose. Indefinite refinement of information does not provide a pay-off for the high costs involved. The assessment of whether something is good enough entails an understanding of the decision process and the potential compensatory mechanisms which can be invoked to provide corrections as predicted events actually unfold.

6c. Quality of information use

This is an assessment of the decision making processes within an organization and how well, it at all, they use the information that is available.

7. R&D

7a. Special projects

Ordino is undertaking some specific projects in areas such as content management and automatic analysis of documentation, broadband content, and in the area of computer security.

b. Third party projects

Ordino has undertaken direct management of specific projects for clients.

Ordino's experience

Ordino Inc. was founded in 1993 to specialize in information technology, technology management and strategic planning. The projects undertaken include:-

- Developed an assessment of technology transfer opportunities from an Canadian national information technology research institute to Alberta's information technology industry.
- Developed an assessment of economic impact of research institutes in Alberta, and a plan for how these institutes might enhance their value to the technology community in the province.
- Prepared initial technology evaluations, assistance in obtaining investment funding and ongoing monitoring of start up IT companies, including independent evaluations for companies wishing to list on Stock Exchanges.
- Designed, developed and edited a monograph on research activities at one of Canada's Defence R&D organizations.
- Developed case studies of technology transfer from NRC research institutes to private enterprises.
- Identified R&D partnership opportunities between a government laboratory and the private sector.
- Planned, briefed all participants and managed a meeting to help research organizations pool interests through a common problem identification approach.
- Participated in a Western Canada study of technology clusters and their relation to economic drivers. The work was done under the leadership of KPMG for the Western provincial governments, Western Diversification, Industry Canada and the NRC.
- Assessed the value of the NRC Canada IRAP program to one of the sponsoring organizations.
- Developed a methodology and tools to assess the maturity of organizations in their use of information technology. Data was collected from a number of clients for inclusion in a comparative database.
- Identified the extent and the business value of the information technology infrastructure of a research organization, and established the potential value of information to them.
- Reviewed the opportunities that technology offers to a utility company and provided tools to assess the technology strategy impact on the business, using both quantitative assessment and scenario analysis.
- Identified the potential partners in Alberta for a joint Canada-Israel partnership program, and brought them to a meeting in Edmonton to explore specific opportunities. For those organizations unable to attend the meeting identified actual requirements for potential partnerships with economic merit.
- Developed an Information Strategy for a major research organization, facilitating its focus on information collection, exploitation and decision making.

- Identified the potential role choices for a public research body, ensuring that there was no overlap with other similar bodies, that there was a demand for the capabilities of the organization and that there was no competition with the private sector.

- Evaluated technology proposals on behalf of the Canadian Space Agency determining the fit of the technologies proposed to the agency and also the viability of commercial exploitation.

- Developed a methodology for measuring the efficiency of research performance and used this as the basis of a comparative benchmark and study of a government research laboratory.

- Assessed the impact of the Worldwide Web on the Canadian software industry and identified the twelve key trends that affect the industry.

- Provided an assessment of the potential structure and impact of the interactive multimedia industry, the potential markets for this industry and the work required to accelerate the formation of the industry.

- Provided the framework for an assessment of the performance of Herzberg Institute for Astrophysics, for the National Research Council, Canada.

- Provided strategic direction and ongoing planning support to a nutraceutical start-up company.

- Invited Lecturer at the APEC R&D Management meeting, Seoul, Korea, June 1998.

- Experience in the area of assessing Canada Customs and Revenue Agency claims in the fields of information technology and communications for SR&ED tax credit.

- Developed a business plan for a startup software company and assisted in obtaining seed capital.

- Developed a business plan, valuation and Offering Memorandum for a novel display and advertising technology start-up company.

* Started an ebusiness company addressing the needs of the tourism industry and the promotion of adventure vacations. This also entailed the development of a prototype prediction tool for anticipating the needs of website visitors.

- Developed a business model for a community based technology start-up incubator. (Partly funded by the NRC IRAP program)

- Technology advisor to a start-up company planning to provide broadband wireless services. Work included setting strategy and meeting with various suppliers to assess their products and the potential role they could play in rolling out the network.

- Assessed the quality of research in scientific reports and established a methodology for determining the reliability of such work.