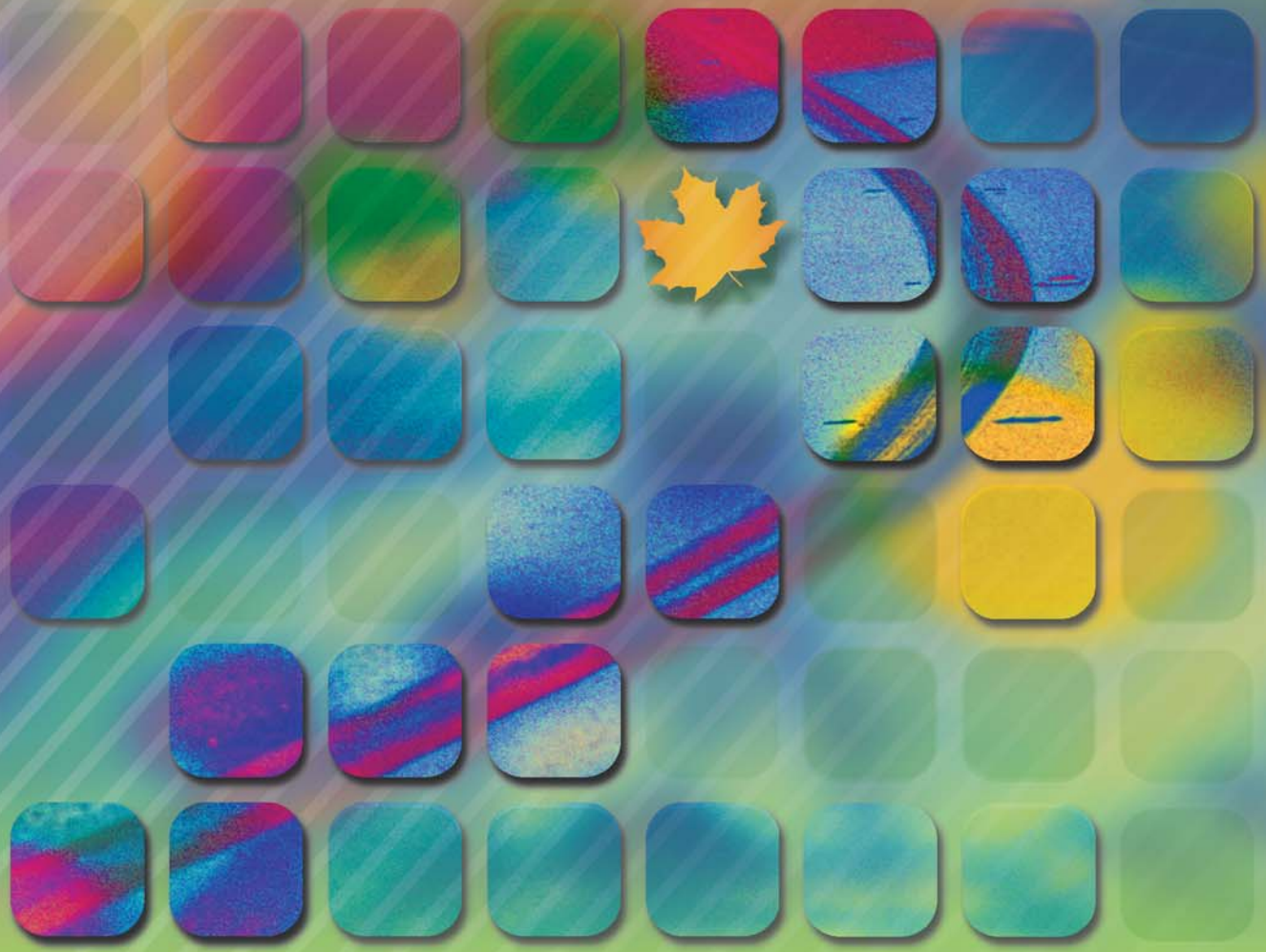
Industry Canada Industrie Canada

Evaluating Technology Roadmaps

A Framework for Monitoring and Measuring Results



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Evaluating Technology Roadmaps

A Framework for Monitoring and Measuring Results

This document sets out a framework to assist with the monitoring and measuring of results achieved through Industry Canada's Technology Roadmaps initiative. While the document references Industry Canada (IC), the substantive content of the various sections would be of use to any federal or provincial government department or agency, or any industry, company or sector that understands technology Roadmapping in the same manner as Industry Canada.

We at Industry Canada believe strongly that Technology Roadmaps (TRMs) are valuable tools for both government and industry. They provide a proven mechanism for Canadian companies to make accurate predictions of future market demands and determine the innovative processes and products required to satisfy them.

To achieve success in today's global economies, companies must be able to produce the right product at the appropriate time. TRMs are exceptional analytical and marketing tools with the capacity to chart future market directions, forecast technological developments, and help determine the strategic choices that companies need to make. Through this process, TRMs provide the impetus for research and development, technological innovation and technology transfer.

The formation of dynamic partnerships between public and private sector organizations is another critical element for success in the evolving marketplace. By stimulating dialogue and collecting valuable information, TRMs encourage such partnerships and can help establish policies and set planning priorities for both industries and government.

The TRM initiative is an important component of how Industry Canada interacts with industry, academic institutions, research organizations, and other governments. It is critical therefore, to develop and implement a mechanism to monitor how well the initiative is achieving its intended results.

To ensure that effective evaluations were undertaken, an independent consulting company was hired to develop a framework to assist with the monitoring and measuring of results achieved through the Roadmapping exercise. While recognizing that there are differences between Roadmaps, this framework provides a series of common "yardsticks" by which the performance of TRMs can be determined.

Industry Canada has completed evaluations on each of six Technology Roadmaps followed by a horizontal evaluation conducted across the same six TRMS to identify common elements. Evaluations were also conducted on four TRMs that had been specifically developed in response to funding from the Climate Change Action Fund.

Evaluating Technology Roadmaps is an essential tool for Canadian industry to better gauge how they can technologically prepare themselves to compete in a global and innovative marketplace.

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Overview of Technology Roadmaps

The Technology Roadmap (TRM) concept is a consultative process that is designed to help industry, its supply chain, academic and research groups, and governments come together to jointly identify and prioritize the technologies needed to support strategic R&D, marketing and investment decisions. These technologies are those which will be of critical importance to an industry in the next five to ten years.

In the development of a TRM, companies within a sector, and sometimes beyond that sector, come together in a joint commitment to identify critical technologies. The TRM document formally codifies the collective decision on which technologies are important and will be addressed by many companies. As a result, the TRM is a means to achieve a joint decision on future research and development, and to establish a commitment to work together in addressing the related technological challenges. This approach is significantly different from the more traditional way of addressing technology development in Canada.

Each Technology Roadmap is based on industry-specific information and, in today's highly competitive environment in which "domestic" markets have been replaced by "global" ones, this information changes continuously. Accordingly, the Technology Roadmap concept is an iterative process, one in which information must be continuously updated, and criteria for decisions scrutinized and revisited.

Evaluating TRMs

This document sets out an approach and proposed tools for determining the results being achieved through TRMs. While the intended results of the initiative are largely similar for each Roadmap project regardless of the industry – that is, to address critical technologies using a collective approach – it can be expected that each industry may follow a somewhat different process and set of activities for achieving those results. It can be anticipated then that the evaluation of results from any one TRM may also differ from others.

The approach for evaluating TRMs set out in this document is presented as a guideline, and not a prescriptive recipe. This approach does however provide a series of common "yardsticks" by which the performance of TRMs can be determined.

The framework in this report includes key elements for examining the success of individual Roadmaps, as well as information that can contribute to determining the success of the overall TRM initiative from a departmental perspective.

Structure of this Document

This document sets out:

1. an explanation of the three phases and the steps in developing a TRM (pages 6-15);
2. a discussion of the intended results throughout the TRM process (pages 17-23); and,
3. an approach and pro forma research tools to guide the evaluation process of individual TRMs, as well as the TRM initiative as a whole (pages 25-35).

Evaluating Technology Roadmaps

A Framework for Monitoring and Measuring Results

The Three Phases of a TRM Initiative

As discussed earlier, a TRM involves an approach that is intended to change the way in which Canadian companies address technology challenges. The process that leads to the development of a TRM involves a series of phases that eventually lead to a change in industry's behaviour. Each of the three TRM phases, described below, includes several steps.

The first phase of a TRM – which leads to the development of a Roadmap document – includes five steps. The first three steps involve Industry Canada's preliminary, then detailed analysis of the potential for a TRM for a specific industry or sector. The fourth and fifth steps include increasing industry members' involvement and commitment to the TRM concept and the development of a formal TRM document. It is expected that this first phase would be carried out over a period of six to 18 months, depending on the characteristics of the industry.

The second phase of a TRM – which leads to industry's first iteration of their TRM – includes three steps. The first involves conducting a planning and definition stage for specific projects under a TRM; the second involves undertaking the projects and monitoring their progress; and the third involves planning for the second iteration of the TRM.

The third phase of a TRM – where industry adopts Roadmaps as standard practice – includes two inter-related steps. In the first step, TRM practices become more defined and established within an industry; while the second step involves monitoring and measuring the results from TRM activities on an ongoing basis.

These three phases end with discrete achievements which are set out below:

- Phase 1 ends with the development of a formal Technology Roadmap – a document that reflects the commitment decisions and direction of the concerned industry.

- Phase 2 ends when the industry participants have completed the first iteration of the TRM. It is expected that once industry members have begun to work with a TRM, participants will undertake subsequent iterations as they learn more and as solutions to identified critical technologies are developed and implemented.

- Phase 3 ends with the industry adopting TRMs as the standard approach to conducting research and development, and as a result, the TRM process becomes self-sustaining within an industry.

A detailed explanation of the phases and steps of a TRM, as well as the relationships between *Inputs*, *Activities*, *Outputs* and *Intended Results* from each step are set out in the tables presented on the following pages.

1.1

Developing a Technology Roadmap
Phase 1 - Industry Embraces the TRM Concept and Develops its Roadmap

	Inputs	Activities	Ouputs	Intended Results
Feasibility Analysis	• Some initial sense by industry/ government that TRMs would apply to and be feasible for a particular industry • Preliminary criteria to determine whether a TRM is feasible for an industry	• IC: Learn the TRM concept and its application to a particular industry • IC: Develop a preliminary plan of what the TRM process may be for the specific industry (e.g., segmented, serial, parallel, other)	• Concept of what a TRM might look like for a particular industry • Possible industry knowledge of TRM • Communication strategy on the part of IC	• IC has developed an interest in pursuing a TRM for a specific industry, and has developed an initial approach for contacting and involving industry
Commitment of Resources	• IC: Branch management commitment of resources, a defined budget for a specific industry TRM initiative	• IC: Engage Branch human resources and funds to: - foster and build industry awareness and understanding of TRM - foster and build industry's trust in TRM process • IC: Set out communications strategy	• Information, communications strategies • Industry's knowledge and understanding of TRM	• Industry has developed an awareness, understanding and positive attitude toward TRM concept
Initial Analysis of Industry	• Background information on key industry elements, for ex., - industry supply chain - key industry stakeholders - national associations - market drivers and their interrelationships - other government initiatives/ programs which may contribute to or support this initiative - other similar initiatives (int'l) • Time and funding by IC and industry members	• IC: Involve industry in the initiative • IC: Develop communications tools • IC analysis may include: - research and present alternative scenarios of industry's market - explore existing industry contacts - analysis/evaluation of what technology development initiatives currently exist - analysis/evaluation of current literature and other sources of information of TRM initiatives to identify possible approaches that could be used for the industry	• Components of the TRM analysis are being developed, including: - components of the supply chain - market outlook scenarios • Increasing participation by industry • Communications strategies refined to reflect analyses	• A commitment has been made by the industry to proceed with development of a TRM document

Developing a Technology Roadmap
Phase 1 - Industry Embraces the TRM Concept and Develops its Roadmap

1.1

	Inputs	Activities	Ouputs	Intended Results
Industry's Role Is Increasing	• Additional time and effort by IC and industry members	• IC: Encourage momentum of initiative • IC: Provide forum for key stake-holders to meet and discuss the TRM • IC: Help to identify TRM roles for industry members • IC: Information and communications tools are refined and promulgated	• Elements of TRM document are beginning to be developed and refined • Formal and informal industry networks • Refined information and communications tools for that industry's needs	• Industry involvement/leadership has increased • An industry champion/leader may have been identified • Industry stakeholders are more accepting of the benefits of working with each other
Industry Codifies TRM	• Additional time and effort by IC and industry members	• IC: Provides assistance/guidance for developing criteria for critical technologies • Industry: Develop criteria to identify what constitutes a critical technology (e.g., risk, cost, key for future competitiveness) • Industry: Develop priorized list of the technologies that are critical to their industry	• Criteria for technologies that reflect, to the extent practicable, the priorities, policies, strategies and directions of IC (e.g., environmental sustainability) • A consensus on Roadmap document for the industry • TRM document that identifies opportunities, critical technologies	• Core group of key stakeholders committed to the TRM initiative and their role in the TRM process is increasing (and may evolve) • Industry is well positioned to proceed with the first iteration of its TRM

1.2

Developing a Technology Roadmap
Phase 2 – Industry's Implementation of the First TRM

	Inputs	Activities	Ouputs	Intended Results
Projects Are Defined and Initiated	• TRM document • Industry commitment • Resources • New formal/informal networks	• IC: Providing guidance and information • Industry: - developing criteria for prioritizing list of critical technologies - refining the list to a short list of technologies to be developed - identifying projects to address the selected technologies - time, resources, responsibilities - identifying and contact additional stakeholder groups required to implement the defined projects - involving additional members of the industry, where required	• Selection criteria for priority critical technologies • Projects and action plans for each technology • Additional stakeholders involved in the TRM, for example: - universities, research institutes - sources of funding - other sectors (where industry technologies may complement)	• Culture of partnering has become more acceptable to industry members • Industry has committed to action related to the TRM • Other stakeholders have become involved/committed – directly/ indirectly, formally/informally • Priorities for projects reflect IC's policies, priorities, and directions
Projects Are Monitored and Managed	• Action plans • Resources	• Industry: Taking actions set out in plans, and monitoring and managing progress • IC: - assisting with coordination - assisting with developing the processes, practices to monitor/measure results and other achievements - assisting with monitoring - facilitating the projects - analyzing the potential for broadening the TRM across the sector	• Knowledge about the industry's TRM, selected priorities • Outputs and results from individual projects: - solutions (e.g., technologies identified as critical have been developed, and are in place and in use) - strategic alliances – formal or informal: new R&D partnerships; new supply partnerships; new production partnerships - identified barriers to implementation of key technologies	• Industry is deriving benefits from projects/initiatives and learning more about the TRM and its potential • Basic TRM Initiative management systems have been developed and implemented • The TRM process was well received by industry • The following results may occur, but are not necessarily expected from the first iteration: - new technological solutions - reconsideration, redirection of R&D funds

continued *continued* *continued*

Developing a Technology Roadmap
Phase 2 – Industry's Implementation of the First TRM

Projects Are Monitored and Managed

Inputs	Activities	Ouputs	Intended Results
	- exchanging information with other areas in IC for use by other industries	• Other linkages, including inter-sector • Processes and practices for monitoring and measuring results	- new products - new exports, new export markets - new jobs - barriers to development and transfer of critical technologies are better understood and overcome - improved understanding and use of the flows of information related to technology development and inter-firm projects - improved competitiveness - new financing sources - formal projects and/or less formal spin-off projects are undertaken - some industry-wide - some between fewer companies - some may be on an individual basis - new, additional related Roadmaps were initiated/created - other industries have become interested - industry has become fully committed to the TRM - government has been responsive to results of TRM process - new/revised policy - new/revised regulations - TRM has become an integral part of policy and other government initiatives

1.2

Developing a Technology Roadmap
Phase 2 – Industry's Implementation of the First TRM

Planning for Subsequent Iterations of the TRM

Inputs	Activities	Ouputs	Intended Results
• Results from first projects, plans	• IC, Industry and other stakeholders: - develop strategy for ensuring the self-sustainability of the TRM for the industry - apply lessons learned from the first iteration and from other industries' TRMs • IC: - market and communicate to those already involved in the TRM process, other components of the sector and to others - develop information and communication tools - identify target organizations - encourage actions required for subsequent iterations		• Branch has reduced its overall level of participation and/or has reconsidered its role/function

Developing a Technology Roadmap
Phase 3 – Generating Knowledge-Based, Self-Sustaining Future Iterations

TRMs Evolve and Become Self-Sustaining

Inputs

- Knowledge, information, lessons learned, and results from actions from first iteration – formal or informal, with or without the involvement of IC-Branch
- Knowledge/understanding of TRM process and dynamic
- Relationships already developed

Activities

- IC/Industry:
  - establish process/discipline to re-examine at defined milestone the criteria for technology and project selection
  - define steady-state roles and responsibilities
  - establish process that will reconsider directions and projects at defined milestones
  - monitor implementation
  - monitor environment for new information
- IC:
  - continue to promote TRM initiative and broaden involvement across the industry
  - continue to facilitate and coordinate efforts of industry and to promote IC's policies, priorities and directions

Ouputs

- New/additional TRMs or subsequent iterations of existing TRMs
- Processes and disciplines to encourage future iterations
- Additional strategies, projects, plans for future iterations
- Adjustments to process for developing a TRM
- Improving information flow between industry and government funded R&D

Intended Results

- Industry has continued to refine the TRM based on results and other information from the first iteration of projects and plans
- The TRM document has been updated to remain relevant, or increase relevance
- New directions, projects, stake-holders have been added to the TRM initiative
- The TRM process has evolved to ensure self-sustainment
- Industry champions/custodians of the TRM have been firmly established
- New/additional benefits are derived from projects/initiatives — same as from Phase 2 plus the following:
  - new technological solutions
  - reconsideration, redirection of R&D funds
  - new products
  - new exports, new export markets
  - new jobs
  - barriers to development and transfer of critical technologies are better understood and overcome
  - improved understanding and use of the flows of information related to technology development and inter-firm projects
  - improved competitiveness

continued

1.3

Developing a Technology Roadmap
Phase 3 – Generating Knowledge-Based, Self-Sustaining Future Iterations

	Inputs	Activities	Ouputs	Intended Results
TRMs Evolve and Become Self-Sustaining				- new financing sources - formal projects and/or less formal spin-off projects are undertaken - some industry-wide - some between fewer companies - some may be on an individual basis - new, additional related Roadmaps were initiated/created - other industries have become interested - industry has become fully committed to the TRM - governments have become more responsive to the needs of the TRM initiative - new/revised policies - new/revised regulations - TRM has become an integral part of policy development and other government initiatives

Developing a Technology Roadmap
Phase 3 – Generating Knowledge-Based, Self-Sustaining Future Iterations

Results Are Systematically Monitored and Measured

Inputs	Activities	Ouputs	Intended Results
• Data, information related to TRM projects, relationships, related activities - quantifiable, measurable data/information collected systematically over time - qualitative data/information	• IC/Industry: - establish processes and practices to collect data and information on a systematic basis - analyze data: results achieved, successful practices, what worked well and what did not - a set of acitivities which occur throughout the TRM process which are highlighted in this phase: - disseminate information about results, lessons, processes - encourage utilization of results and other information to improve TRM directions/projects and/or develop subsequent iterations of TRMs strategies and actions	• Information, case studies • Communication tools, approaches	• Results from TRMs are being measured and the information is being used by Industry in the development of subsequent Roadmap/projects/plans

Evaluating Technology Roadmaps

A Framework for Monitoring and Measuring Results

Monitoring and measuring the results achieved through TRMs will ensure that effective evaluations are undertaken. This is important for two reasons: it enables Industry Canada to determine the types and extent of incremental benefits that can be associated with the initiative; and, it enables Industry Canada to determine whether the TRM process can be improved to generate even greater results.

The tables on the following pages set out the *Intended Results* from each step in the TRM process as well as the possible *Measures* for determining the achievement of those results.

2.1

Measuring Results
Phase 1 – Industry Embraces the TRM Concept and Develops its Roadmap

	Intended Results	Measures of those Results
Feasibility Analysis	• Government/industry has developed an interest in pursuing a TRM for a specific industry, and has developed an initial approach for contacting and involving industry	• Number of Roadmap Initiatives considered (based on a formal analysis) or initiated [sectors]
Commitment of Resources	• Industry has developed an awareness, understanding and positive attitude towards TRM concept	• Views of industry members, overall positive reception of TRM concepts [individual companies' views] • Number of TRM information presentations [sectors] - number of industry stakeholders in attendance at those presentations [sectors]
Initial Analysis of Industry	• A commitment has been made by the industry to proceed with development of a TRM document	• Amount and level of resources and time committed by Industry members and associations, at this early stage [individual companies – stating their anticipated level of commitment, i.e., number of person days] • Number and relative "importance" of industry members involved at this stage [sectors]
Industry's Role Is Increasing	• Industry involvement/leadership has increased • An industry champion/leader may have been identified • Industry stakeholders are more accepting of the benefits of working with one another	• Number of actions, communications, interventions initiated by industry, with government still facilitating [individual companies] • Evidence that industry is becoming more involved/committed [individual companies] - for example, level of senior technology managers' time involved with TRM development • Level of involvement of key industry members, level of involvement of their senior management team [individual companies, sectors]

Measuring Results
Phase 1 – Industry Embraces the TRM Concept and Develops its Roadmap

Industry Codifies TRM Document

Intended Results

- Core group of key stakeholders are committed to the TRM initiative and their role in the TRM process is increasing (and may evolve)
- Industry is well positioned to proceed with the first iteration of its TRM

Measures of those Results

- Number of TRMs formally produced [individual companies]
- Evidence of interest/momentum of industry [individual companies]
  - level of senior technology managers' time involved with TRM development [individual companies]
  - extent of promulgation of TRM document within the industry [sector groups, companies and industry associations]
  - number of requested materials and presentations
  - level of industry participation at presentations
  - volume/number of discussions with industry (e.g., at industry association meetings)
  - use of the TRM materials and documents by industry

2.2

Measuring Results
Phase 2 – Industry's Implementation of the First TRM

	Intended Results	Measures of those Results
Projects Are Defined and Initiated	• Culture of partnering has become more acceptable to industry members • Industry has committed to action related to the TRM • Other stakeholders have become involved/committed – directly/indirectly, formally/informally • Priorities for projects reflect government policies, priorities, and directions	• Evidence that industry members are establishing or pursuing strategic alliances: discussions between companies [individual companies and associations] • Number of formal or informal strategic alliances established [individual companies and associations] • Number of projects and action plans established [individual companies and associations] • Number/level of industry resources allocated to TRM projects, actions [individual companies] • Number of new industry participants or others in the projects, plans [individual companies] • Evidence of linkage between project selection criteria and IC policies and priorities: key themes, linkages to indicators [sectors]
Projects Are Monitored and Managed	• Industry is deriving benefits from projects/initiatives and learning more about the TRM and its potential • Basic TRM Initiative management systems have been developed and implemented • The TRM process was well received by industry • The following results may occur, but are not necessarily expected from the first iteration: - new enabling technological solutions - reconsideration, redirection of R&D funds - new products or utilization of new products - new exports, new export markets of the enabling technology - barriers to development and transfer of critical technologies are better understood and overcome - improved understanding and use of the flows of information related to technology development and inter-firm projects - formal projects and/or less formal spin-off projects are undertaken - some industry-wide - some between fewer companies - some may be on an individual basis	• Evidence of changing behaviour of industry members: number and types of strategic alliances, number of new strategic alliances under consideration, importance of technologies that are being developed [sectors and individual companies] • Extent of reported management practices in place: planning and discussion for agendas, minutes, reporting [sectors and individual companies] - methods, practices for transferring information between companies • Increased commitment of resources to TRM Initiative on the part of government [sectors] • Increased commitment of funding to TRM projects and plans by industry [individual companies] • Changes in R&D directions and R&D policies: new technologies, new approaches to R&D by industry and federal performers [federal R&D performers and individual companies] • Number of references to TRMs in industry and government communications [sectors and individual companies] • Number and type of technological solutions developed, implemented [individual companies] • Number of potential marketing opportunities created/provided by TRM for

continued

continued

Measuring Results
Phase 2 – Industry's Implementation of the First TRM

	Intended Results	Measures of those Results
Projects Are Monitored and Managed	- new, additional related Roadmaps were initiated/created - other industries have become interested - industry has become fully committed to the TRM - government has become more responsive to the needs of the TRM initiative - new/revised policy - new/revised regulations - TRM has become an integral part of policy and other government initiatives	technology suppliers [individual companies] • Number of barriers to development, replication, commercialization are overcome [individual companies] • Influence on other industries: influenced the development of a TRM in another industry, initiated a TRM in a related industry [sectors] • Possibly (attributable to some extent to the TRM projects/plans): [upstream and downstream companies] - number and types of new products or uses of products – enabling technologies - new products exported – enabling technologies and/or a product Roadmap - number of new markets - number and characteristics of spin-off projects
Planning for Subsequent Iterations of the TRM	• Branch has reduced its overall level of participation and/or has reconsidered its role/function	

2.3

Measuring Results
Phase 3 – Generating Knowledge-Based, Self-Sustaining Future Iterations

TRMs Evolve and Become Self-Sustaining

Intended Results

- Industry has continued to refine the TRM based on results and other information from the first iteration of projects and plans
- The TRM document has been updated to remain relevant, or increase relevance
- New directions, projects, stakeholders have been added to the TRM initiative
- The TRM process has evolved to ensure self-sustainment
- Industry champions/custodians of the TRM have been firmly established
- New/additional benefits are derived from projects/initiatives — same as from Phase 2 plus the following:
  - new enabling technological solutions
  - reconsideration, redirection of R&D funds
  - new products or utilization of new products
  - new exports, new export markets of the enabling technology
  - barriers to development and transfer of critical technologies are better understood and overcome
  - improved understanding and use of the flows of information related to technology development and inter-firm projects
  - formal projects and/or less formal spin-off projects are undertaken
  - some industry-wide
  - some between fewer companies
  - some may be on an individual basis
  - new, additional related Roadmaps were initiated/created
  - other industries have become interested
  - industry has become fully committed to the TRM
  - government has become more responsive to the needs of the TRM initiative
  - new/revised policies
  - new/revised regulations
  - TRM has become an integral part of policy and other government initiatives

Measures of those Results

- Number and scope of subsequent TRM iterations, TRM projects and plans [individual companies and any strategic alliance]
- Number of segments of an industry affected by TRM projects [industry associations and any strategic alliance]
- Changes/improvements to project selection criteria [individual companies and any strategic alliance]
- Evidence of accomplishments from previous iterations - may be just anecdotes [industry associations and any strategic alliance]
- Increased commitment of funding to TRM projects and plans by industry members [industry associations and individual companies]
- Changes in R&D directions and R&D policy: new technologies, new approaches to R&D by industry and federal performers [individual companies and sectors]
- Number and types of new R&D partners [industry associations]
- Number of references to TRMs in industry and government communications [sectors, individual companies and industry associations]
- Number and type of technological solutions developed, implemented [individual companies]
- Number of barriers to development, replication, commercialization are overcome [individual companies]
- Influence on other industries: influenced the development of a TRM in another industry, initiated a TRM in a related industry [sectors]
- Number and types of new products and new uses of products that can be attributed to a TRM initiative [individual companies, upstream and downstream]
- Volume of increased exports, that can be attributed to a TRM initiative [individual companies, upstream and downstream]
- Number of new markets that can be attributed to a TRM initiative [individual companies, upstream and downstream]
- Number and characteristics of spin-off projects [individual companies, upstream and downstream]

Measuring Results
Phase 3 – Generating Knowledge-Based, Self-Sustaining Future Iterations

Results Are Systematically Monitored and Measured

Intended Results	Measures of those Results
• Results from TRMs are being measured and the information is being used by Industry in the development of subsequent Roadmap/projects/plans	• Evidence of use of TRM results are used: information is communicated between companies, increased references to TRM project results, recognition that results are from a TRM initiative, linkages between TRM projects [individual companies]

Evaluating Technology Roadmaps

A Framework for Monitoring and Measuring Results

A systematic analysis of the results from TRMs enables Industry Canada to determine the performance of the initiative at specific junctures and enable a more formalized examination of the benefits of the TRM initiative. The former tends to focus primarily on the activities, outputs and reach as well as the direct and/or immediate impacts of the TRM initiative; whereas the latter examines these along with the longer-term impacts of the initiative.

The evaluation is based on three key issues:

1. Industry participation in the TRM process;
2. Government participation in the TRM process; and
3. How TRM projects are monitored and managed.

Analysis of the first issue provides information on industry's role in the TRM: the level of buy-in, industry's perception of the success of the TRM, as well as what worked and what did not work for a specific industry. The second issue analyses government participation in the TRM process: the sector officer as facilitator, the rationale for Industry Canada to continue TRMs, and the linkage to Industry Canada's policies. The final issue provides information on the actual results being achieved through TRMs, such as what development projects are underway and which are being monitored.

3.1

Conducting Systematic Evaluation Research
1 – Industry Participation in the TRM Process

Industry Participation in the TRM Process	Internal Questions	Questions for Industry
A. Level of Industry Buy-In Achieved		
• What evidence do you have that demonstrates industry buy-in? • What evidence do you have that demonstrates the level and breadth of industry buy-in?	• To what extent are key industry stakeholders involved in the initiative? - number of members of industry supply chain involved - number of members of other sectors where technologies overlap - number of sources of funding? - number of universities and research organizations - other • To what extent are the senior technology managers of the key industry stakeholders involved?	• Number of members of industry supply chain involved • Number of members of other sectors where technologies overlap • Number of sources of funding • Number of universities and research organizations • Other • To what extent are the senior technology managers of the key industry stakeholders involved?
• How was this level of buy-in achieved?	• How was this level of buy-in achieved? - has an industry champion been identified? - if yes, who is the champion? - an industry association - an individual industry member - other - how was this facilitated? - if no, why not? Any barriers? - how high would you characterize the level of industry's commitment to the TRM? • Please rate the degree to which you believe government marketing and communications activities played an integral, supportive role in assisting you to promote this initiative	• How was this level of buy-in achieved? - has an industry champion been identified? - if yes, who is the champion? - an industry association - an individual industry member - other - how was this facilitated? - if no, why not? Any barriers? • How high would you characterize the level of your organization's and/or industry's commitment to the TRM?
• Please comment on the likelihood of this industry being able to achieve this level of buy-in without the help of government	• Please comment on the likelihood of this industry being able to achieve this level of buy-in without government intervention	• Please comment on the likelihood of this industry being able to achieve this level of buy-in without government intervention

Industry Participation in the TRM Process	Internal Questions	Questions for Industry
B. Method of Achievement		
• How did you get to this step?	• What facilitated the accomplishments to date? What "building blocks" were available/suitable? • Did you have any barriers to overcome? - if so, what were they? - for example, internal/organizational barriers such as resources or external barriers such as structure/nature of the industry - how significant are these barriers? - how did you overcome them? - are there any barriers that were not overcome? If so, what were they and why were they not overcome?	
• How did you go about selecting this sector as a good candidate for a TRM?	• What type and extent of analysis did you conduct? • Please indicate the breadth and volume of consultations with government and industry stakeholders which took place • What amount of resources was used to accomplish this task? • Rate the degree to which you believe this level of effort was sufficient • What key factors suggested to you that a TRM would be particularly feasible or not feasible for your industry?	
• What evidence do you have, at this point, to show that the TRM initiative was a successful undertaking for your industry?	• Does industry have an overall positive perception of TRM concepts? • Number of Roadmap Initiatives considered or initiated • Please indicate the amount and level of resources/time committed by industry members and associations (or anticipated level)	

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Industry Participation in the TRM Process	Internal Questions	Questions for Industry
	• Please indicate the number and relative importance of industry members involved at this point • Amount of senior technology manager' and/or senior management team members' time committed	
• What are your expectations (near-term and longer-term) of benefits to TRM participants – including government?	• What are your expectations (near-term and longer-term) of benefits for TRM participants – including IC? - near-term, longer-term • Have these expectations changed from those you set in the feasibility analysis step of this phase? If so, to what extent and why?	• What are your expectations (near-term and longer-term) of benefits? Have your expectations changed since the beginning of your involvement in the TRM initiative? If so, to what extent, in what ways, and why?
C. What Worked (and What Did Not) • What is different about your industry? What distinguishes your sector from the other sectors that are involved in TRMs?	• What is different about your industry? What distinguishes your sector from the other sectors that are involved in TRMs? - culture - competitiveness - size - structure - historical relationship between IC and industry	

Conducting Systematic Evaluation Research
1 – Industry Participation in the TRM Process

Industry Participation in the TRM Process	Internal Questions	Questions for Industry
• In regards to your role, what worked and what did not work for your industry? For example: - what approach/methods did you use to introduce industry to the TRM initiative? In your opinion, which ones were most successful and why? - what element(s) of the TRM initiative was most appealing to industry? Why? - what element(s) of your role in the initiative was most appealing to industry? Why?	• In regards to your role, what worked and what did not work for your industry? For example: - what approach/methods did you use to introduce industry to the TRM initiative? In your opinion, which ones were most/least successful and why? - what element(s) of the TRM initiative have been most appealing to industry? Why? - what element(s) of your role in the initiative have been most/least appealing to industry? Why?	• In regards to IC's role in the TRM Initiative, what worked and what did not work for your industry? - what elements of IC's role were most/least appealing and why? - what elements of the TRM initiative itself were most/least appealing and why?
• What, if anything, would you do differently to improve the successful promotion of the TRMs for your sector? For example: - how to raise industry's awareness and understanding of TRMs - how to raise the awareness and understanding of TRMs by other sector stakeholders - how to generate commitment to TRMs from industry and other stakeholders - how to get industry to lead the initiative	• What, if anything, would you do differently to improve the successful promotion of the TRMs for your sector? For example: - how to raise industry's awareness and understanding of TRMs - how to raise the awareness and understanding of TRMs by other sector stakeholders - how to generate commitment to TRMs from industry and other stakeholders - how to get industry to begin to lead the initiative	• Do you have any recommendations to IC regarding its role in this phase of the initiative, the next phase? • How high would you rate IC's success in leading industry to this initiative and through to this step in an efficient and effective manner? • Please rate the degree to which you believe the TRM developed will be a relevant tool for industry • Have any unintended negative impacts resulted from your involvement in this initiative? If yes, what are they? Please rate their significance as a deciding factor in your future participation (or level of participation) in such initiatives
	• Please rate the degree to which you believe you have been successful in leading industry to this step in a timely/efficient/effective manner • Please indicate the amount of time, approximately, that has passed since you embarked on the first step of the initiative to the present • Please comment on the degree to which you believe this amount of time was appropriate or suitable • Are there any unexpected negative impacts of the TRM initiative (including IC's role) at this time? What are they and to what do you attribute them?	

3.2

Conducting Systematic Evaluation Research
2 – Government Participation in the TRM Process

Government Participation in the TRM Process	Internal Questions	Questions for Industry
A. The TRM Process and Industry Canada's Role		
• Please comment on the degree to which you believe your role as facilitator was aligned with the needs and expectations of your sector	• Please comment on the degree to which you believe your role as facilitator was aligned with the needs and expectations of your sector	• Please rate the degree to which you believe the TRM developed to be a relevant tool for industry
• What have you learned about the TRM process which may be of benefit for future iterations of the TRM?	• What have you learned about the TRM process which may be of benefit for future iterations of the TRM?	• What have you learned about the TRM process which may be of benefit for future iterations of the TRM?
• What, if anything, would you do differently to improve the successful implementation of this industry-led initiative?	• What, if anything, would you do differently to improve the successful implementation of this industry-led initiative?	
• Do you expect that your current role as a facilitator will change or evolve for the next iteration(s) of the TRM? If yes, why and in what ways do you anticipate the role to change?	• Do you expect that your current role as a facilitator will change or evolve for the next iteration(s) of the TRM? If yes, why and in what ways do you anticipate the role to change?	
• What elements of your role do you believe were most successful and/or most helpful to industry stakeholders with respect to the implementation phase of the TRM initiative? Why?	• What elements of your role do you believe were most successful and/or most helpful to industry stakeholders with respect to the implementation phase of the TRM initiative? Why?	• What elements of IC's facilitation role do you believe were most successful/unsuccessful for industry stakeholders with respect to the implementation phase?
• What are your overall impressions of the TRM concept? Its viability for your sector and/or for others	• What are your overall impressions (on the viability) of the TRM concept? Its viability for your sector and/or for others	• What are your overall impressions of the TRM concept? Is it viable for your industry and/or for others?
• What is the rationale for IC to continue (and potentially increase) funding the TRM Initiative?	• What is the rationale for IC to continue (and potentially to increase) funding the TRM Initiative?	• For what reasons which you continue to participate in the TRM initiative and would your organization/industry increase the commitment of resources?

Conducting Systematic Evaluation Research
2 – Government Participation in the TRM Process

Government Participation in the TRM Process	Internal Questions	Questions for Industry
B. Link to Industry Canada's Policies • To what extent is there a link between TRM project selection criteria and Industry Canada's policies and priorities? If there are links: - how clear are they, what are they? - how can you tell there are links? - how were these links developed and maintained? - if there are few or no links to IC polices and priorities, why is this the case?	• To what extent is there a relationship or link between TRM project selection criteria and Industry Canada's policies and priorities? - what is the relationship or linkage? - how clear and deliberate are they? - how were they developed and maintained? - if there are few or no relationships or linkages to IC polices and priorities, why is this the case? Is the existing level of alignment appropriate? Why or why not?	

How TRM Projects Are Monitored and Managed	Internal Questions	Questions for Industry
A. Level of TRM Related Activity • Has a TRM document been developed? - if not, why? What has been developed to date? - if yes, to what extent have action plans been developed to implement the TRM document?	• Has a TRM document been developed? - to what extent have action plans been developed to implement the TRM document? - please comment on the process used to define projects: - how were criteria developed? - who was involved? - when were the criteria formally established? - how long did the process take? - were there many changes to the criteria along the process? - were there many barriers and/or facilitators to the process?	
• As evidence of the level of TRM related activity anticipated by this phase, please comment on the following factors: - number and level of industry resources allocated to TRM projects/plans - increased commitment of funding to TRM projects and plan by industry - number of projects and/or action plans established [To be measured 1 year after completion of TRM document] - level of senior technology manager(s) time in TRM development - extent of promulgation of TRM document within the industry - number of requested materials and presentations - level of industry participation at presentations - volume/number of discussions with industry (e.g., at association meetings)	• As evidence of the level of TRM related activity anticipated by this phase, please comment on the following factors: - number and level of industry resources allocated to TRM projects/plans - increased commitment of funding to TRM projects and plan by industry - number of projects and/or action plans established [To be measured 1 year after completion of TRM document] - how many projects have been selected for imple mentation - how long did it take to make this selection? - level of senior technology manager(s) time in TRM development - extent of promulgation of TRM document within the industry - number of requested materials and presentations	• As evidence of the level of TRM-related activity anticipated by this phase, please comment on the following factors: - number and level of industry resources allocated to TRM projects/plans - increased commitment of funding to TRM projects and plan by industry - number of projects and/or action plans established [To be measured 1 year after completion of TRM document] - how many projects have been selected for implementation? - how long did it take to make a selection? - level of senior technology manager(s) time in TRM development - extent of promulgation of TRM document within the industry - number of requested materials and presentations

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How TRM Projects Are Monitored and Managed	Internal Questions	Questions for Industry
- use of TRM materials and documents by industry	- level of industry participation at presentations - volume/number of discussions with industry (e.g., at association meetings) - use of TRM materials and documents by industry	- level of industry participation at presentations - volume/number of discussions with industry (e.g., at association meetings) - use of TRM materials and documents by industry
• To what extent are other stakeholders becoming involved in the TRM initiative for the industry? - how is this being facilitated (who)? In what ways? - if other stakeholders are not becoming involved, why is this the case and what do you expect the impacts will be? - to what extent is the breadth of stakeholder involvement increasing? How was this achieved? - other evidence of changing behaviour of industry members	• To what extent are other stakeholders becoming involved in the TRM initiative for the industry? - how many and what type of new participants since the development of the TRM? How is this being facilitated (who)? In what ways? - if other stakeholders are not becoming involved, why is this the case and what do you expect the impacts will be? - to what extent is the breadth of stakeholder involvement increasing? How was this achieved?	• To what extent are other stakeholders becoming involved in the TRM initiative for the industry? - how many and what type of new participants since the development of the TRM? - how is this being facilitated (who)? In what ways? - to what extent is the breadth of stakeholder involvement increasing? How was this achieved? - if other stakeholders are not becoming involved, why is this the case and what do you expect the impacts will be? How would you propose to address this problem?
• Overall, does your sector's TRM reflect all the fundamental characteristics one could expect in a TRM?	• Other evidence of changing behavior of industry members: - number and types of new strategic alliances initiated/established - across directly/indirectly-related industries - across one industry - across supply chain - among a few companies - change in attitude about importance of technologies that are being developed as a result of TRM initiative. In what ways is this evident? - change in attitude about importance of TRM initiative. In what ways is this evident? • Please rate the degree to which you believe your sector's TRM reflects all the fundamental characteristics one could expect in a TRM. Please comment on this rating	• Other evidence of changing behaviour of industry members: - number and types of new strategic alliances initiated/established - change in attitude about importance of technologies that are being developed as a result of TRM initiative - change in attitude about importance of TRM initiative

How TRM Projects Are Monitored and Managed	Internal Questions	Questions for Industry
B. Results Achieved		
• What basic TRM Initiative management systems have been developed and implemented to enable projects to be monitored and managed? What level of resources was necessary to accomplish this task?	• What basic TRM Initiative management systems have been developed and implemented to enable projects to be monitored and managed? - what level of resources was necessary to accomplish this task? - is this system conducive to the measurement of project progress? Why or why not?	
• Is industry deriving any benefits that are, to some extent, attributable to the TRM initiative? - if yes, what evidence do you have to demonstrate this?	• Is industry deriving any benefits that are, to some extent, attributable to the TRM initiative? - if yes, what are they? - please rate their significance to industry - please discuss any factors, industry-specific or otherwise, which may have facilitated these results - if no, why not? Are there barriers to implementation that need to be addressed? - to what extent have your expectation of benefits for TRM participants been realized? What evidence do you have to demonstrate this? - please comment on the likelihood that these results would have been realized in the absence of the TRM Initiative, and/or in the absence of IC's intervention	• Is industry deriving any benefits that are, to some extent, attributable to the TRM initiative? - what are they? How high would you rate the significance/importance of each of these results? - number, type, and importance/significance of technological solutions developed/implemented - please comment on the nature of these solutions – their importance and significance to your industry, to your organization. Were they marginal/incremental or were they "breakthrough" solutions? - number, and importance/significance of potential marketing opportunities created/provided by TRM for technology suppliers - number of barriers to development, replication, and commercialization overcome. Were these barriers significant? - number, types, and importance/significance of new products or uses of products - number/volume, and importance/significance of new products exported. How high would you rate the importance/significance of new products exported? - number and importance/significance of new markets exported to

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How TRM Projects Are Monitored and Managed	Internal Questions	Questions for Industry
• If no, why not? Are there barriers to implementation that need to be addressed? • Please comment on the likelihood that these results would have been realized in the absence of the TRM Initiative, and/or in the absence of IC's help		- number and characteristics of spin-off projects. For example, are they within a single organization or a product of several organizations coming together? • If results are evident, please discuss any factors that may have facilitated these results • If no, why not? Are there barriers to implementation that need to be addressed? How significant are these barriers? • Please comment on the likelihood that these results would have been realized in the absence of the TRM Initiative, and/or in the absence of IC's intervention
• Is the Canadian government becoming more responsive to the needs of the TRM initiative? For example: - new/revised policy - new/revised regulations - TRM has become an integral part of policy and other government initiatives - changes in R&D directions and R&D policies - increased commitment of resources/funding to TRM initiative	• Is the Canadian government becoming more responsive to the needs of the TRM initiative? For example: - new/revised policy. Marginal/incremental or radical change - new/revised regulations. Marginal/incremental or radical change - TRM has become an integral part of policy and other government initiatives - changes in R&D directions and R&D policies. Marginal/incremental or radical change - please rate the significance of these changes for industry - increased commitment of resources/funding to TRM initiative. Marginal/incremental or radical change • Have any unintended negative impacts resulted from this TRM initiative? - how high would you rate the significance of these impacts with regard to the viability of this initiative? Please comment	• Have any unintended negative impacts resulted from your involvement in this initiative? If yes, what are they? For example, conflicts over IP issues or confidential information - is there anything that could have been done to avoid these? Please discuss

Evaluating Technology Roadmaps

A Framework for Monitoring and Measuring Results

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