# Some organizational issues of technology roadmapping experienced in Hungary

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## Abstract

*Technology roadmapping (TRM) is a technique for exploring the evolution of markets, products, technologies, and their linkages. During our Hungarian TRM-applications we found important a clear business need; senior level ownership; effective communication; information and knowledge sharing; spending considerable time at the beginning; preferring less frequent but longer workshops than more frequent shorter ones; involving all related functions, active participation of senior managers; having a TRM-champion inside the company; a case-study-based training to teach TRM; and calling TRM a different name at the beginning.*

## Keywords

*technology roadmapping · technology management · technology strategy · business strategy*

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## 1 Introduction

Technology roadmapping (TRM) is a relatively new and powerful technique enabling the evolution of markets, products and technologies to be explored, together with the linkages between the various perspectives. A technology roadmap is a multi-level chart with time axis showing market, product, technological and other types of information and their linkages. The purpose of a company level technology roadmapping is to make sure the necessary technological capabilities will be in the right place at the right time to achieve the organization's objectives [2,3,8]. There are industrial level roadmaps as well, but in this paper we focus on the company level application of roadmapping. During our Hungarian TRM-applications we experienced the importance of nine strategic and organizational issues, some of them are known from the literature, some of them are not covered by the literature before.

## 2 The essence of technology roadmapping

TRM had its roots in the US automotive industry, but in its present form it was applied first by Motorola and Corning in the late 1970s and the early 1980s [8]. The Motorola model [9] became the foundation upon TRM evolved in the US. After publishing the Motorola article several European firms (e.g. BP and Philips) adopted the method, and the European Industrial Research Management Association in 1997 documented an eight-step TRM process based on the experiences of 25 companies [8]. TRM became a popular topic in management literature in the 2000s, the method is still evolving, and has to be further researched and developed.

The roadmap focuses our attention by stating the most vital technology areas, supporting the critical few product attributes that are most important to target markets. Technology roadmapping helps achieve the following key objectives [1]:

– Linking strategy to product plans to technology plans.

– Enabling corporate-level technology plans.

– Focus on longer-term planning.

– Improving communication and ownership of plans.

– Focus planning on the highest-priority topics.

It is important to examine our knowledge gaps during the TRM process [5,6]. The list of our knowledge gaps forms the basis of further information gathering, processing and evaluating activities for reducing uncertainty.

There are several different types of technology roadmaps (see e.g. [5,6]). The characteristic structure of the most frequently used type is shown on Fig. 1. The layers can contain bar charts of projects, different kinds of diagrams, matrixes with data etc. Uncertain events, decisions to be made, conditional activities etc, can be roadmapped as well, not only certain ones. (See some actual roadmap examples at `http://strategis.ic.gc.ca/ epic/internet/intrm-crt.nsf/en/home`.)

The list below shows a frequently used structure of TRM [1]:

Market section

– competitive assessment
– market segmentation and trends

Product section

– product drivers
– experience curve price forecast
– product roadmap
– product evolution plan

Technology Section

– technology roadmap (product/manufacturing)
– forward costing

Summary / Action Plan

– strategic summary
– risk roadmap

There are different structures as well, e.g. in the T-Plan methodology [5] product drivers are examined in the market section, not the product section like above. But the essence is similar in every type of TRM.

There are six typical purposes of applying TRM [6], see below.

1 Product-technology planning: The roadmap is used to develop an integrated product-technology plan that meets the requirements of both the market and business, with the product feature and technology choices prioritized on the basis of customer needs.

2 Strategic appraisal: The aim is to identify, structure, assess and share knowledge about strategic issues, leading to agreement on appropriate actions.

3 Business reconfiguration: The TRM template is used to explore the implications of a strategic vision, to assess the current position, and to explore the paths that bridge the gap between the company's current strategic position and future vision.

4 Process development: Roadmapping is used to explore the flow of knowledge between commercial and technological functions, to improve and develop business processes.

5 Research network development: The aim is to capture, structure and share knowledge from both the commercial and technological perspectives, and to identify future application requirements and opportunities, together with current research and network priorities.

6 Sector foresight: The template is used to capture, structure and share knowledge about industry and market trends and drivers, which are used to define performance measures and targets for the system. Future technology evolution is explored, and R&D challenges are identified.

TRM always has to be customized for the particular application regarding context, architecture and time [6], see below.

Context

– ownership of the business problem
– scope (the domain of interest)
– focus (the need to roadmap)
– aims (hopes to achieve with roadmapping)
– resources needed
– participants (multi-functional team is required)
– information sources

Architecture

– timeframe (horizon and milestones)
– layers and sub-layers

Process

– macro-process (overall TRM process plan)
– micro-processes (agendas of the workshops)

**3 Lessons learned from our TRM practice**

We have consulted three TRM customization and application projects between 2006 and 2009. In two cases we consulted a market leader Hungarian subsidiary of a large foreign service company, and in one case our client was a fully employee-owned Hungarian manufacturing company. We observed more or less the same important organizational issues as we found in the literature before, and some other key factors which were not covered previously in the literature. We want to reinforce the importance of those issues which were already covered in the literature and turned out to be important in our practice as well, and to add some new considerations to them. And we also want to discuss our own findings not covered in the literature before.

3.1 Clear business need

It has to be clear for every participant why roadmapping is needed, what are the tangible benefits of it [6]. We also found this issue very important in our practice. It is not very easy to make the real nature, role and importance of TRM in strategic
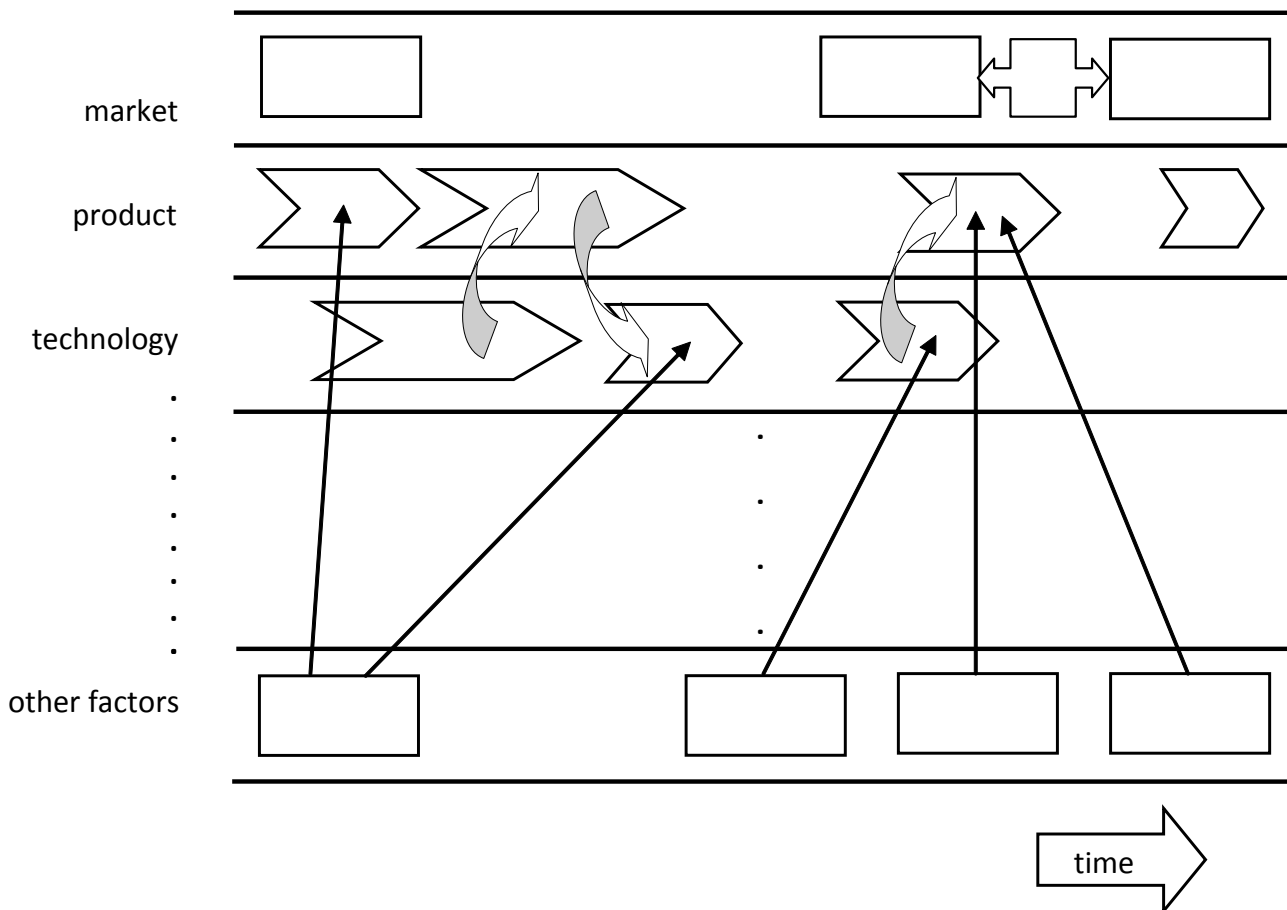
**Fig. 1.** Structure of the most frequently used type of Technology Roadmap

planning clear for the top management at the very beginning. Everybody should understand that TRM is the new method of the complex business and technology strategic planning in the firm, not an independent activity from strategic planning. We experienced this false approach when some members of the top management did not understand the real nature of TRM and its role in strategic planning.

One of our client firms continued the old way of strategic planning by business units and functions separately, without integrating their planning efforts, just wanting to integrate the separately prepared plans afterwards, while in the same time a partly different team was working on roadmapping as an absolutely separate activity. It might have been reasonable to run the old and new process of strategic planning in parallel for safety's sake, but it definitely was not reasonable to run them so that key persons were not able to participate in both processes. In such a way it was a waste of time. For example: once we met a TRM team member in the corridor when we were going to the board-room for the next TRM session. She told us that she was not able to take part in the session because she had to work on the technology strategy plan of the company and she was pressed of time. In other words: she could not participate in technology strategy planning because she was busy with working on technology strategy planning. It seemed that she did not feel the absurdity of the situation. But we did not blame her: it was

her bosses' fault not to understand what is TRM about and not to run the old and new process really parallel but degrading the pilot project for the sake of the old way.

### 3.2 Commitment and ownership from senior management

Strong commitment and ownership from senior management is vitally important for a successful and sustainable roadmapping initiative [6]. We also found it substantially important. TRM requires joint planning efforts of the company's different divisions and functions. Only a top level executive with the necessary authority covering all the organizational units to be involved can make all the participants taking part in TRM, nobody else. It is almost impossible to involve the necessary participants by somebody on a lower level of the organization.

Just 'supporting' TRM from senior level is not enough because in this case only a small group of enthusiastic people tries to produce a roadmap somewhere in the organization. They can not involve the necessary participants, do not have enough time, resources, information etc, and they are not authorized to make decisions. The top management has to initiate the introduction of TRM – or not introducing it. Without top-level ownership any TRM effort is only a waste of time, it can not produce serious results. It can be only a TRM-training, practicing the method, nothing more.

At one of our client companies the ownership of TRM was

on a lower level than it should have been. The higher level managers just 'supported' the TRM project without fully understanding its real nature, potential key role and significance in the strategic planning process of the company. They regarded it as an exclusively technological planning tool without any close connection with other functions of the company and without any considerable strategic significance. (Their ignorance was partly due to the name of the method – we will come back to that later, in section 3.9). The owner of the TRM project was a technological executive without the authority to tell members of non-technological functions to participate. Experts from other functions were asked only informally to take part in the TRM sessions. They came only if they had enough time and if the technologists were able to invite them convincingly and attractively. Because of that the team composition always changed from session to session and we always had to explain to the newcomers what TRM is, what are we doing, etc. to put them in the picture. It was a waste of time, lasting sometimes even more than half an hour, while the regular participants were bored. We provided written handouts about everything but it was always uncertain who would come next (if anybody comes) from the non-technological functions, whom to send the materials to. Even if they received the handouts they almost never read them before the meetings because it was not their duty but only an informal request of the technologists and they considered their participation as a favour. (See another problem caused by the lack of authority to tell non-technological people to take part in the TRM sessions in section 3.6).

At another client company of us the situation was just the opposite. The owner of the TRM project was the CEO himself. He had read one of our publications about TRM and fully understood its nature, role and significance. After reading our paper he asked us to consult his company and gave the TRM pilot project top priority. Every function was told to participate by the CEO and all of their managers took part in the project as one of their duties not as an informal favour. The composition of the TRM team was almost always the same, everybody read the handouts for every session, so there was no need to waste time with repeating the same explanations again and again. It was clear to everybody what we were doing and why it was important for the company. Even the CEO was present on each and every TRM meeting all over the project.

### 3.3 Communication (information flow, knowledge sharing)

Information and knowledge sharing and common discussion between experts and divisions belong to the essence of TRM [4, 6, 7]. We also found the same: a roadmap can be an effective tool for promoting communication between enterprise divisions if only the participants of the roadmapping process are ready to share their knowledge and information with other divisions.

At one of our client companies we experienced a startling degree of secret mongering when we wanted to discuss the new product concepts of a division in order to make it possible to plan the necessary technology developments for those products. The divisions of that firm have not got technology development departments of their own, the company has a centralized technology development department serving all their different product divisions. We wanted to integrate the product and technology development plans in the technology roadmap, so we went to that department to discuss their plans. They had got several new product concepts based on both primary and secondary marketing information about consumer needs. They always wrote down their new product documents in a shorter, sketchy form and in a longer, detailed version. They wanted to show us only the short sketches. We asked for the detailed ones as well but they refused to show us them in spite of the fact that we signed the secrecy agreement with the company as a part of our consultancy contract. When we saw it was hopeless to get the longer versions we asked for sending them to the central technology development department at least, but they refused even that request. It turned out that they never shared the longer versions with any other divisions or with the central technology development department even though they worked on the same project. They worked as an isolated island within the organization, not sharing their ideas and information with other divisions and central departments. After our consultancy that secret mongering division was closed down during the reorganization of the company, and now another division is responsible for their profile.

Successful application of TRM is impossible if the participant divisions or functions do not want to inform each other. If the roadmap is full of important knowledge and information gaps then the benefits of using it afterwards are very limited – if it has any benefit at all. This issue is connected to the top level ownership: only a top level executive with the necessary authority can open the communication channels between the participating units if they do not want to do it themselves.

### 3.4 Time requirement

TRM requires a lot of time and work at the beginning. Once the roadmap is ready then the continuous usage and updating require much less time. This continuous updating of the roadmap is nothing else than the continuous strategic planning process itself using the roadmap, so TRM does not need any extra time and effort any more. Top managers have to understand that during the pilot roadmapping project it is inevitably necessary to free the participants from a part of their regular work because they need considerable time and energy to produce the very first roadmap from scratch. But this initial time and effort investment is highly rewarding.

We always explain our clients the necessity of the initial considerable time investment and the minimal time consumption afterwards. In spite of that the participants at one of our client companies very rarely (if ever) did the tasks we asked them to do between our sessions. Those tasks – we called them 'homeworks' – needed their expertise alone, they did not need our assistance at all: gathering data, making calculations in their own

field etc., without using any TRM specific tool. But they simply did not want to invest the necessary initial effort and time. The coordinator of the TRM project on the client organization's side told us at the end of the project that they simply did not believe us that they had to invest such a huge effort and time at the beginning and hoped that we, the consultants would do the bulk of the job. But we could not because we are not competent in their business, we are competent only in TRM. This kind of consultancy is a typical process consulting, not expert consulting. Using an analogy from chemistry: our role is the catalyst, not the reagent. Because of the weakness of their own efforts we almost always had to do the entirely business-related 'homeworks' during our sessions which was a waste of our consultant time. Our role in these cases was to make them work, nothing more. They could have done the same job without us absolutely perfectly.

At another client company the participants understood the complementary nature of their and our role in the TRM project and always invested the necessary effort to do their 'homework'. Every time we arrived to the next meeting we found a set of photocopies prepared on table with the information we asked them to gather and process. (Or we received electronic documents from them well before the session it was needed for.) We were always able to start our sessions with the TRM specific analysis using their data without wasting time.

### 3.5 Timetable

Less frequently held but longer workshops are more advantageous than more frequently run shorter ones. One or two day long undisturbed workshops could be very useful. Short, e.g. two hours long meetings often have to be finished just when the team gets warmed up to work really effectively and efficiently. One hour can be enough for a TRM expert to consult separately with one or very few professionals, collecting information and expert opinion. The statement above regards to the cross functional team workshops.

We could not manage to organize the ideal one or two day long workshops at any of our client firms. At a manufacturing firm each workshop lasted 3 hours. But during the workshops the team composition was always the same, all participants were present from the beginning right until the end of the workshops. They always read the written materials we sent them before the sessions and were prepared for the workshops. These sessions were characterized by intensive team work, the participants from different functions were active actors whenever it was needed during the whole workshop. So the short duration of the workshop sessions did not cause any serious problem.

At another company the duration of the sessions was similar but they did not work very well. Although we made preparatory work before each workshop, sent all the necessary written materials, it seemed that the participants did not read them in most cases – as we mentioned in section 3.2. They misunderstood their role in the workshop: they thought that we, the consultants would do the bulk of the job, as we discussed in section 3.4. We always had to spend a lot of time with presenting the content of the written materials which they had not read. These presentations took cca. half an hour at the beginning of the sessions instead of working on the tasks which were defined and explained in the written materials. The remaining two and half hours in most cases were not enough for completing the tasks perfectly. It always takes time for a team to 'warm up' and reach peak activity. When the task and the tools are new for them – like in these cases – the 'warm up' needs even more time. Very often we had to finish the workshop before completing the task, when the team was on the right track and was progressing effectively. We will come back to the required minimum duration of the TRM sessions at the end of this section.

In the same TRM project it was quite usual that some participants arrived very late or left much earlier the workshops. We always had to stop when somebody arrived late and had to explain him or her what we were working on. Earlier leaving also caused serious problems – for instance, when we had a very important workshop dealing with two issues, and both of them were planned to be discussed in half of the time duration of the session. When we finished the first topic and wanted to follow with the other one the specialist of the second topic told us that he has to leave the workshop in five minutes. This happened right in that moment when his role became vital. There was nobody else left in the room from the same function, so the workshop got stuck suddenly and we had to continue the work with other subjects to discuss. The two topics could have been discussed in the opposite order, but the specialist of the second issue did not tell us his time limitation at the beginning of the session. Maybe he even did not want to because he was from the same secret mongering division mentioned in section 3.3.

During another TRM project we were able to run 4 hours long workshops in some cases. We did not send written materials to the participants before but gave cca. half hour long presentations about the tasks and the tools instead at the beginning of the sessions. The remaining 3 and a half hour was enough to complete the task in every case. It is important to note that all the participants were always present at the workshops all along. Our experience confirms that 4 hours recommended by Phaal et. al. [5] is a usable duration for a TRM session if everybody participates actively form the beginning until the end.

### 3.6 Participants
*Horizontally:* as TRM typically requires multifunctional input [6], the right people from all the important functions should be involved and above this, their participation in TRM should be considered as their necessary task. Divisions from all important professional fields (marketing, technology and product development and so on) have to take part in the workshops. The technology roadmap contains much more and more diverse information if the participants come from different divisions and functions and the composition of the team does not change.

Let us see our negative example in section 3.2 again, where a technological department initiated the TRM project and the project owner had not got the authority to tell marketing people to participate. In this case the final map contained one-sidedly much more and more accurate technology related and lesser market related information and we had more knowledge gaps to fill afterwards in the market dimension. A positive example is another client company of us when the CEO was the TRM project owner and told every function to participate. In that case there was no problem with gathering ideas and information from all the relevant aspects.

*Vertically:* as TRM is a strategic management tool, senior executives must be involved personally into the workshops by all means. Solely they know certain strategic priorities and information, and without their knowledge and guidance the participants can sometimes only make guesses when they should make decisions during the TRM process.

This is what happened at one of our TRM projects when we were often lacking the personal participation of executives on our workshops. When they took part in the sessions it was always very useful – but very rare unfortunately. In another TRM project consulted by us the CEO and the top managers were present in every workshop and they always told the necessary information, priorities, and guidance for the participants when it was needed. Strong commitment and ownership from senior management (see above) is of crucial importance but not enough in itself. Senior managers have to participate personally in the TRM workshops – at least when the topic of the session is closely related to their field of expertise and responsibility.

### 3.7 External consultant and internal champion

Beside the ownership from senior management, an internal champion is also needed for a successful application of TRM [6]. We can state some important observations concerning the role of this champion. The internal champion should be trained to TRM, and be able not only to manage the process but also to facilitate the workshops. In the beginning an external consultant who is familiar with the method can be a useful facilitator, but for a routine application a trained champion has a crucial role. He or she has to be trained and then should apply the method on his or her own. Naturally, external consultation may be necessary from time to time, but it is not the same as a process managed and facilitated by external consultants.

The champion should come from the organization, because the same person should be an expert of the special field at the organization and of TRM as well. Accordingly he or she can successfully select the domain of interest and to define the units of the analysis, realistically assess the project's time and resource requirements, and with an approximate accuracy can plan the mapping process. We experienced that if we have one expert of the field and another one of the TRM method, there is no one who can realistically assess the work to be done concerning the

factors listed above.

During our consultancy work we experienced different attitudes from the people who were meant to be the champions of the projects. At a large service firm there were actually 2 people who were handling the TRM project, a senior manager and his subordinate. The senior manager was committed to the TRM work and had significant preliminary knowledge about the method, but he was too busy to participate in every workshop. He could become a great champion in the future because he is an expert of his field and also gathered substantial knowledge and experience about the application of TRM. Unfortunately he could not motivate others to do active work throughout the whole project. His subordinate was responsible for the project and he was the one to organize each workshop. He could not have become the champion because he was not motivated at all for the success of the TRM project, it was only an extra task for him what his boss gave him, nothing else.

At another client company the CEO clearly named at the beginning who is in charge with acquiring the TRM method and should be able to apply it in the future. That person was a manager in one of the engineering-related functions of the firm. She was attending every workshop and also took part in the preparatory work of the workshops. We had continuous interaction with her. We assume she has the skills to become a champion in the future but she also has to be motivated much more.

We may conclude that the requirements of the successful champion are the followings: should come from the organization, should be motivated and be able to motivate the others, be present at the introductory workshops and play active role in the whole TRM pilot project in general.

### 3.8 Introducing the method

It is advisable to start with a training. Future participants can learn and exercise the method through case studies. In this way we do not have to deal with the technical basics of TRM during the real application process. Many tools which are used in TRM are already known techniques. In the homeland of TRM, the USA, these methods have been routinely used in business life for a long time, so it is relatively easy to integrate them into the methodological framework of TRM. In Hungary these techniques are still far from being applied routinely, so first they have to be learned and practiced before starting to apply them as the building blocks of TRM. Initial training is particularly important if we want to apply the method at domestic firms in Hungary.

For the rapid introduction of TRM, a method called T-Plan Fast Start Process [5] is widely used in the international practice and it was also suitable for the projects we had. This method is limited only to the most important analysis, and it does not need accurate, detailed data, only estimates, 'quick and dirty'. The goal of the T-Plan application is to introduce TRM as a whole and its major tools relatively quickly and easily for the participants.

Neither client company of us wanted to spend time for case

**Tab. 1.** The essence of our findings about some organizational issues of TRM

| Issue | Bad practice | Good practice |
|---|---|---|
| Clear business need | Considering TRM an independent activity from strategic planning. | Considering TRM the new method of the complex business and technology strategic planning. |
| Commitment and ownership from senior management | – Just 'supporting' TRM from senior level.<br>– TRM project owner without the authority to involve the necessary participants. | – The top management has to initiate the introduction of TRM.<br>– TRM project owner with the competence to involve the necessary participants. |
| Communication (information flow, knowledge sharing) | The participants do not want to inform each other (secret mongering). | The participants are ready to share their knowledge and information with others. |
| Time requirement | Expecting the participants to work on the pilot TRM project in addition to their regular work. | To free the participants from a part of their regular work during the pilot TRM project. |
| Timetable | – Maximum two hours long team meetings.<br>– Arriving late or leaving earlier. | – Minimum three hours long team meetings, and one or two day long undisturbed workshops.<br>– Being present all along. |
| Participants | Horizontally:<br>– missing divisions or functions<br>– ever changing participants<br><br>Vertically: senior managers do not participate personally in the workshops | Horizontally:<br>– all divisions or functions represented<br>– unchanging participants<br><br>Vertically: senior managers participate personally in the workshops |
| External consultant and internal champion | Expecting an external consultant's assistance through all ages. | Asking the external consultant to train an internal TRM champion. |
| Introducing the method | To begin learning TRM immediately with a real application. | TRM case study training before beginning the real application. |
| The name of the method | To label the method as technology roadmapping from the very beginning, without any explanation. | To label the method as technology-product, product, business or strategic roadmapping at the beginning. |

study sessions to learn quickly and easily how to roadmap. They thought it would have been a waste of time, they wanted to start immediately with the real application. They wanted to learn how to create roadmaps and to deal with their real-life problems at the same time. We found their approach rather difficult and time-consuming. The TRM method is too complex for a novice company to apply successfully for its real problems for the very first time because they had to focus to two absolutely different things: on the one hand to the brand new concept, techniques and tools of TRM and on the other hand to their strategic plans. An initial case study based training would have been worth the time investment and the whole project would have been less time consuming and would have produced more useful results in the long run. We have no idea at the moment how to convince our clients that an initial case study training is not a waste of time but on the contrary: a very profitable time and effort investment.

## 3.9 The name of the method

"The expression *technology management* may discourage involvement of commercial functions in the firm. Expressions such as *technology-product, product, business or strategic roadmapping* may be more appropriate; these reflect the potential of the method for integrating and synchronizing plans across technology, product and marketing perspectives in the firm." [4] We experienced the same initial aversion to TRM when we tried to involve non-technological (e.g. marketing) people into the cross-functional teamwork. We explained to them that behind the technological name there is a multidisciplinary tool which needs their participation as well.

But we experienced a more serious problem caused by the name of the method which we have not found mentioned in the literature. If the members of the client company do not know TRM yet they do not think it needs top level ownership and delegate it to one of the technology managers. But they can not

make all the participants taking part in TRM simply because they are not the bosses of them.

We experienced this problem in our consultancy practice when one of the technological strategic executive became the owner of TRM and it was very difficult to involve e.g. marketing people into the cross-functional teamwork. Their participation was always just a favor for their technological colleagues when they have some free time and felt like coming to the workshops. It was not their task because nobody ordered them to take part in the project. The heads of the other departments are not the subordinates of the TRM process owner so those experts were asked to participate only informally. Sometimes it worked, sometimes not. It turned out e.g. when we interviewed a marketing executive that he did not know about the TRM project at all before our interview. He even did not know that we were external consultants, he thought we were employees of the company before we gave him our business cards. We had to spend almost half an our with explaining what TRM is, what we were doing in that project etc., while he had altogether only one hour for the whole interview with us. It is not surprising that his subordinates were missing from most of the workshops.

We have never tried the alternative names suggested by Phaal et. al [4] and it was very difficult to correct the consequences of the wrong place of ownership afterwards. Based on our experience we suggest using a different name when introducing TRM. The CEO of one of our client companies also suggested us the same when we evaluated the finished TRM project.

### 4 Summary

We summarized the key points of our findings In Table 1. These short notes in the table contain only the most important things very briefly and cannot substitute our detailed discussions above.

It is very important to note that technology roadmapping cannot be used really effectively if these organizational issues are not taken into consideration. The tools and techniques of the TRM method are not enough for the successful application – we found that the appropriate organizational conditions discussed above are vitally important in the same way.

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