Technology Roadmapping: integrating technology resources into business decision making. Pirelli Tyre Case Study

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The purpose of this paper is to provide a concrete case study of how to use the Technology Roadmapping to support the decision makers about products and technologies in a manufacturing technology based firm. The process and the tool Pirelli introduced to pursue this scope is a TRM process integrated with the Projects Portfolio Management, providing a map about where R&D organisation is moving and which direction it wants to follow. the fundamental idea is to create a big comprehensive picture of the Pirelli research, innovation and development system articulating in detail all the relevant variables in an integrated system into a relational database system. Activities, ideas and their impacts on products and markets are the components of a system made by entities and relations among them. The resulting map is then full of details and intended to cope with the complexity of the job to be done without reducing or simplifying it. The approach is bottom-up and is able to determine a technology and product strategy that could be then defined as 'emerging' one, built on the precise mapping of individual customer needs and evolution of technologies in different fields.

1. Introduction: Technology Roadmapping (TRM)

A roadmap is a strategic plan describing steps and organisation needs to be taken into account for achieving defined outcomes and goals. It clearly outlines links among tasks and priorities for action in the near, medium and long term. An effective roadmap also includes metrics and milestones to allow regular tracking of progress towards the roadmap's ultimate goals.

Technology Roadmaps (TRM) were originally developed by MOTOROLA in the'70s in order to align the evolution of their products and their supporting technologies. The Technology Roadmaps are part of a methodology that guarantees the coordination of investments in technology and the development of new capabilities, so that the decision makers can make capital out of future market needs. TRM is a tool that brings important support to innovation managers, letting them define in advance the firm's technological evolution. The tool manages the relationship between technologies, products, services target markets. As a result, the firm's technological status can be changed, improved or, at least, maintain

According to Phaal et al. (2001), Technology Roadmaps can have different applications. This paper shows how Pirelli Tyre has developed one of those applications into something useful to support its own of Innovation approach.

2. Pirelli Tyre: Company profile and innovation

The automotive industry is exposed to several external factors, such as macroeconomic trends, regulatory obligations and evolving consumer and lifestyle habits. This leads to an ever changing external scenario.
There are huge shifts in world demographics, leading to increasing demand for high-end goods and services; the evolution of new technologies in automotive and related fields; and increasing national and international regulation.Pirelli Tyre SpA is the holding operating company of a group active for over a century in the design, development, production and marketing of tyres for various types of vehicles. The group offers a complete array of products, particularly focused in the segments of high and ultra-high range characterized by high technology and high performances. In these segments, the group achieved a leadership position with reference to both car and motorcycle tyres. Today Pirelli products are perceived as synonym of quality, emotion and high performances. The group is the world's fifth largest operator in terms of turnover in the tyre market with strong presence in EU and South America.

To stay ahead, Prestige and Premium car designers must constantly refine and improve their models' performance – placing intense demands and increasing complexity on the tyre manufacturers who supply them.

Pirelli is among the few tyre makers with a clear focus on Premium; we patented process technologies able to deal with rising complexity and variety while keeping cost under control. Most of the world's largest tyre makers produce high-end tyres, but none are so dedicated to the Premium sector as Pirelli is.

Almost every car produced by a Premium carmaker requires a different tyre. Engineers develop exactly the tyre needed for each type of car. Our managers have the big task of expanding the range but keeping costs under control: with demand in different climates and innovative technologies such as run-flat and self-sealing, the breadth of products continues to expand. For example, varying winter climates in Germany, Canada, Russia and Japan each require different tyre technologies. In order to manage such complexity, Pirelli introduced a TRM process

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The realisation of innovative and characteristic products has been made possible thanks to the commitment of the R&D group and through the continuous technology transfer of the experience accumulated in motosport competitions into the product. Pirelli develops radical innovation also in production process technologies as introduction of MIRS - Modular Integrated Robotized System and CCM - Continuous Compound Mixing systems).

3. R&D function Organization

The Research and Development (R&D) of Pirelli Tyre exploits the most advanced know-how on technological components. The result of this intense research in the materials, design, profiles, tread patterns and processes areas, allowed to increase the level of product performance and the tyre safety
The technology centre in Milan coordinates the activity in all the technology centres abroad (the main ones are located in Germany and Brazil).

R&D is organized by Business Units: CAR, MOTO, TRUCK&AGRO. In addition to the main three, there are a few other supporting Units (known in Pirelli as Areas) such as: 'predevelopment and Research', ' Materials Development', 'Process Development', 'Testing' R&D is also supported by various international Initiatives of 'Open Innovation The function counts about 1000 employees.

3.1 An "Open Innovation" R&D Model

At the heart of the Pirelli Premium story is an ever-evolving technological process that takes raw materials such as rubber and steel and turns them into high performance products to meet the exacting requirements of carmakers and car drivers.

To be a leader in the tyre business, it is not enough just to count on in-house resources. That's why Pirelli chose to use an Open Innovation Model: today its external collaborations account for more than 150 projects with universities and suppliers. Among research projects in the fields of innovative materials and technologies, Pirelli is looking at silica derived from rice husks and selective de-vulcanisation technology to make scrap tyres reusable.

On top of that, there are about 100 collaborative development projects with carmakers. Many of these are Joint Development Agreements focused on the most advanced areas in each part of R&D, from materials to electronics.

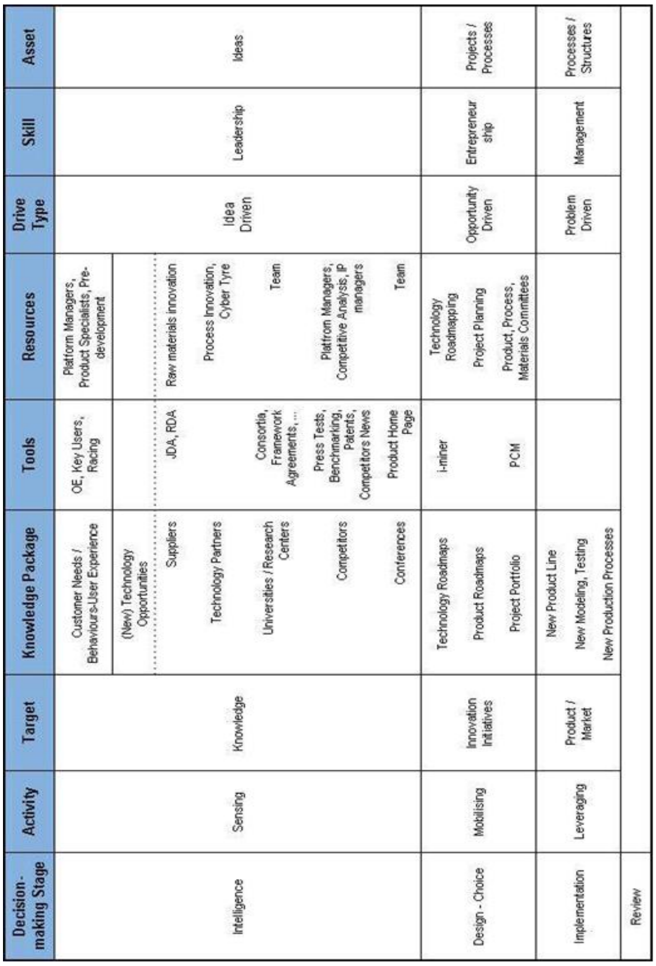
Formula One is excellent advertising of course, but it also motivates research, enhances speed of change and flexibility and encourages talent.

Pirelli R&D function counts about 1400 employees worldwide.

4. The innovation approach

Pirelli Tyre R&D function is very wide and complex. What became necessary was to translate the motto 'today we work as a team' into actions, building an overall system, that could integrate all the R&D Units.

In this sense, Technology Roadmapping (TRM) has become one of the pillars of Pirelli Tyre Innovation Plan. TRM constitutes and consolidates the basis for all strategic planning activities in R&D, increasing the efficiency and effectiveness of decision-making. It avoids the repetition of mapping objectives and innovative ideas already known, allowing to focus efforts on the updating and revision of the steps to taken ahead. TRM also represents a system of decision support (as decisions are made on the basis of a broader understanding Context) (Kostoff, Schaller, 2001 - p. 135).



Decision-making Stage	Activity	Target	Knowledge Package	Tools	Resources	Drive Type	Skill	Asset
Intelligence	Sensing	Knowledge	Customer Needs / Behaviours-User Experience	OE, Key Users, Racing	Platform Managers, Product Specialists, Pre-development	Idea Driven	Leadership	Ideas
			(New) Technology Opportunities: Suppliers	JDA, RDA	Raw materials innovation			
			Technology Partners		Process Innovation, Cyber Tyre			
			Universities / Research Centers	Consortia, Framework Agreements, ...	Team			
			Competitors	Press Tests, Benchmarking, Patents, Competitors News	Platform Managers, Competitive Analysis, IP managers			
			Conferences	Product Home Page	Team			
Design - Choice	Mobilising	Innovation Initiatives	Technology Roadmaps	i-miner	Technology Roadmapping	Opportunity Driven	Entrepreneurship	Projects / Processes
			Product Roadmaps		Project Planning			
			Project Portfolio	PCM	Product, Process, Materials Committees			
Implementation	Leveraging	Product / Market	New Product Line			Problem Driven	Management	Processes / Structures
			New Modeling, Testing					
			New Production Processes					
Review								

Figure 1. Pirelli Innovation Approach (from Doz, Santos, Williamsson, 2002).

Another strategic objective of TRM is the transfer of knowledge, know-how and technology through the links identified by the Roadmaps along the different dimensions of the R&D organisation. Researchers in different functional areas, technologists and design specialists, people who are in charge of the development of new products (in different business units), are connected and organised in order to reach product performance targets in specific market segments.

This means defining a technology foresight process to help identify critical technologies and find possible external partners to work together on the different innovation projects sharing resources (Roadmap).

To implement what explained, it is necessary to think about systematic innovation. Pirelli has covered this aspect building a comprehensive database. This tool has to be consistent, robust, free of redundancies in the concepts and duplication of information. The concrete output of design and implementation of this database is to have an effective, readable and logical network to add easily (and appropriately) new pieces of knowledge. Over time the technological know how contained in the database will form an integral part of the Company.

5. The innovation system

To support this 'strategic thinking' of Roadmaps, Pirelli has developed a system composed by two main tools conceived, designed and developed internally

The first tool is a Project Portfolio Management system (PPM in the following) a database for collecting all R&D Projects.

The second tool, Innovation Miner (i-Miner in the following), is a relational database containing all the data about new technological ideas, linked by unequivocal ties.

Those tools, are connected each other in order to coordinate the whole R&D portfolio: the strategic planning of R&D is a goal to be pursued through the alignment between technological innovations and new products development, according to the Company's strategic objectives.

Thanks to the System, Pirelli is able to fit in the dynamic automotive industry and to anticipate the state of the art about technologies that will characterise the sector in the future.

6. How to build the System: methodology

In order to implement an Innovation System based on TRM, it is necessary to perform a preliminary activity that helps revealing the current knowledge level and the knowledge location.

Therefore the information collected have to be organized and connected properly to build the actual Roadmaps. Here below the stages adopted in Pirelli:

1. Internal Benchmarking:. The first activity was to plan interviews with Project Managers of three business units (Car, Motorcycle and Truck&Agro) to collect information about product development projects (in order to build PPM and feed it) and product performances targets to be achieved (in order to feed the i-Miner). The second activity was to plan interviews with Managers from different functional Area to collect information about existing business processes adopted by the Company in order to build the i-Miner database and feed it.

2. Design and implementation of the new organizational process and information system.

7. Tool Creation

7.1 PPM

In order to implement a Roadmap system, all the R&D projects have to be included into PPM. A sound understanding of what the Company is doing represents the basis to validate the 'road', with special focus on timing, activity milestones and people involved in the projects.

The architecture of this tool follows the rules suggested by the literature.

7.2 i-Miner

Forward looking technological maps are the main output that can be extracted from the i-Miner database are technological forward-looking maps.

In order to obtain a proper design of the database, some brainstorming sessions with the Area Managers were organized with the purpose of:

1. identify the Product Performance parameters, with indication of product platform, in extent of gaps and the deadline necessary to fill theme;
2. collecting technological ideas for each technology area: what has to be put in place to improve or innovate products.

The objective is to build a kind of prospective Roadmap (not retrospective) (Kostoff, Schaller, 2001 - p. 136).

The meetings themselves were occasions for discussion and clarification of mutual concerns and opportunities immediately capitalised by the participants.

In fact, each Area Manager presented to all the other participants the needs expressed by the customers and markets in relation to the product performance, or technological ideas and their main impact on the performance itself.

After the before mentioned brainstorming session, the macro-structure of the database has been shaped in a way to include all the relevant variables involved. The database tables have been set bringing order between the concepts, either at the level of fields (e.g. clear distinction between technologies and product performance targets) or at the level of values within the same field (e.g. performances in the same field partially overlapping).

In order not to duplicate the information in the database, some parameters have to be standardised; as an example:

1. units of measure (eg: time targets expressed in number of years, performance gaps expressed as a percentage);
2. language adopted (English).

To design the proper mapping of technological ideas ('technology mapping'), an in-field detection approach has been followed. Each idea, has been recorded with details concerning. In particular:

- the estimated timing (year) for the technology to be validated and made available for the industrial application in the product;
- the likelihood of success in the development of the technology (in relationship with the use in the product) is the reciprocal of the risk associated with the technology;
- the description of the idea and of the technological approach;
- the tyre components to which the technology is linked to;
- the phases of the production process significantly impacted in case the technology came into production;
- the resources necessary for R&D (internal: Pirelli, university or research centre, supplier, customer or any other technology partner);
- any projects already scheduled and active in the project portfolio management;
- impacts on the product objectives which constitute the main added value.

Technological ideas and each of the elements described (components, steps, resources, projects, impacts on the objectives) are linked each other in a ' many to many-like relationship '.

Focusing on the preparation of lists of performance characteristics, it should be clarified that, a 'product objective' is the crossing between a feature and an application segment (i.e.: the improvement of braking on wet for the highway trucks segment). In this way it is possible to assign an unequivocal value to the objective in terms performance gap and timing.

During the mapping of individual technologies made with Area Managers, numerous potential impacts of the technological idea regarding product performance or applications not yet highlighted have emerged,

The process of Technology Roadmapping developed by Pirelli is thus presented as characterised by an approach that is not exclusively 'market-pull' or 'technology-push' but definable in terms of the integrated approach. In this sense it is possible to speak of a 'bi-directional matching ', able to facilitate the operational integration between people engaged in product development and people who deal with more science, applied research and innovative technology.

Eventually both structure and contents of the database, were approved by the head of the Department.

The documents resulting from the brainstorming activity and the prototype of i-Miner have been made available in the Company intranet shared with controlled access.

7.2.1 i-Miner: data structure and content

The i-Miner has been chosen to become the whole knowledge management model in Pirelli. A deeper description of the i-Miner here follows. The relational database is made of about 11 tables (see Fig 2.)

Figure 2. Innovation Miner, an ICT tool supporting the Technology Roadmapping: structure of the relationships among the different tables in the tool.

The first table built is the 'product platform table' called SEGMENTS (see Table 1.) reporting the Business Units a specified product segment belongs to. A product platform is responsible for the development of new tyre sizes designed for a specific application or market segment.

In general, the size developed by a platform share the same priorities in terms of target performance and the same set of car makers, in case it is developed for an Original Equipment. Technology Roadmap can facilitate the sharing of information between different platforms. At the moment 29 different product platforms have been defined (12 for the business unit Car, 7 for the Motorcycle, 10 for the Truck).

SEGMENT_ID	SEGMENT_X	BU_ID
1	UHP	2
3	HP	2
...	...	2
5	SUV	2
...	...	2
19	H - highway	3
20	ST - Trailer	3
21	...	3
16	...	5
17	SCOOTER COMMUTING	5
18	ENDURO & OFF	5

Table 1. The table "SEGMENTS" relates segment (e.g. Ultra High Performances or High Performances) to the corresponding Business Unit (Car, Motorbike, Truck&Agro.

The second table called FEATURES shows the product characteristics (see Table 2.) gathered from the list of relevant tyre performances. Main performances are: safety (eg, integrity and braking on dry and wet surfaced), handling, vibrational comfort, internal noise in the vehicle, environmental performance, costs for end customers (e.g. rolling resistance). The list also includes specific features for particular applications imposed by the regulations (i.e. cost and weight of the tyre). In total 42 relevant items have been identified.

FEATURE_ID	FEATURE_X
1	WEIGHT
2	SIDEWALL ASPECT
3	ROLLING RESISTANCE
4	MILEAGE
5	WEAR REGULARITY
6	WET HANDLING
7	DRY HANDLING
8	DRY BRAKING
9	INTERNAL NOISE
10	STIFFNESS
11	WET BRAKING
...	...

Table 2. Product characteristics (FEATURES) gathered from the list of relevant tyre performances.

The table of objectives (called OBJS) collects an indication of the performance gaps (at platform level). They are parameters corresponding to the percentage of improvement over the best current reference for that performance, and with the year when it is required that the gap is filled. This table collects the target demanded by the market or derived from the competitor analysis. Hundreds of potential targets have been identified.

R&D defines the technological ideas as tools to generate innovation and competitive products.

Few hundreds of technological ideas were collected (TECHS). For each idea, the following information was singled out: title, description in details, application area, estimated time of availability and the success likelihood (proportional to the risk of failure). It was no simple to determine the 'cost' of the idea: it has been made the choice to assign a heavier weight to the potential impact on products than to the estimation of development costs. However, despite the choice, it is still open the issue of how to manage the R&D costs related to technologies. The most likely hypothesis is that a budget estimation (in FTE) could be used.

Another table (RESOURCES) shows different types of resources (see Table 3) available to R&D for developing technological ideas. They can be internal or external to Pirelli R&D. Involvement of suppliers of innovative materials or cooperation with customer car makers and competitors, within agreements or joint research projects are examples of external resources. Researchers can then be assigned to partners (industrial or technological) also outside the tyre chain, as holders of know-how and critical protagonists of interesting phenomena. Also universities could be considered as resources: Pirelli has active collaborations with numerous universities, structured in a wide range of forms (e.g. single contract framework agreements or PhD scholarships).

RESOURCE_ID	RESOURCE_X
1	PIRELLI
2	SUPPLIER
3	CUSTOMER
4	COMPETITOR
5	PARTNER
6	UNIV/RC

Table 3. Different kinds of resources available to R&D for developing technological ideas.

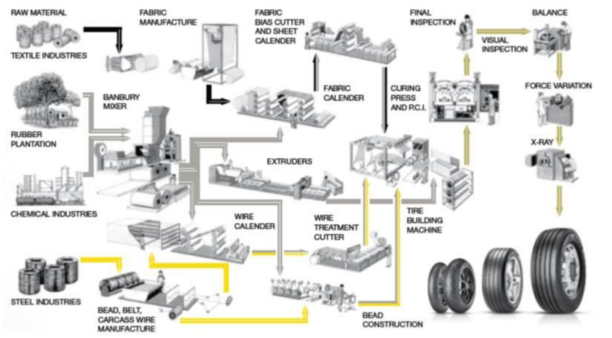


Figure 3. the industrial process for creating a tyre is very complex and articulated. It consists of about 16 different phases.

Table of ALLOCATIONS relates technologies to resources. This 'many to many' relation goes beyond simple taxonomy. The table associates each technology to one or more resources (the result is about 200 records). This means that many technological ideas result from the combination of more different entities subjects.

Next table (see Table 4) shows the industrial production process phases.

As illustrated in Figure 3, the industrial process for creating a tyre is very complex and articulated. It consists of about 16 different phases.

Also in this case, the list of phases should be evaluated using a 'many to many' relationship with technologies. To do this, another table called manufacturing stages impacts (see Table 4), composed of 400 records had to be created.

MANUF_STAGE_ID	MANUF_STAGE_X
1	RAW MATERIALS
2	MIXING
3	...
12	BUILDING
13	CURING
14	FINISHING
15	...
...	...

Table 4: Manufacturing stages. The industrial process for creating a tyre is very complex and consists of about 16 different phases

This table is useful to represent the pervasiveness of technology in relation to industrial processes and to increase the -operational integration among colleagues. The table collecting tyre components (see Table 5) is made of 15 subjects of research and innovative development. The table, in addition, comprises the vulcanisation chambers.

COMPONENT_ID	COMPONENT_X
1	LINER
2	BEAD
3	...
4	PLY
5	BELT
6	...
7	...
8	SIDEWALL
9	TREAD
10	...
...	...

Table 5. Tyre components (see fig. 4 as a reference).

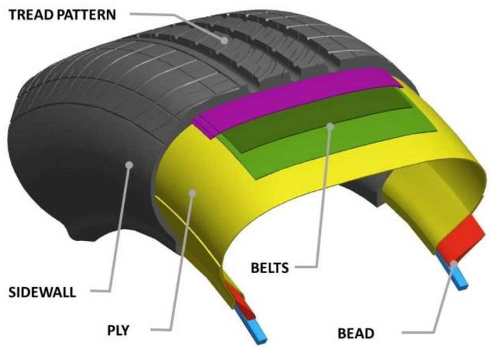


Figure 4. A tyre section schematization with main tyre components.

The association table between technologies and components of the tyre has been named 'shaping' in the sense that each technology contributes to 'shape' one or several components. It includes a lot of associations. It may be interesting for those responsible for the pre-product development, as it returns information about what the components are, on which components they are focusing innovation efforts and which, on the contrary, seem to be neglected.

Although it does not provide any precise indication about the actions to be taken, this table is believed to be a useful basis for a trained and competent strategic decision maker. The table of projects was not created specifically for the miner, but belongs to the PPM tool. This table connects downstream a series of specific data of the projects (development, engineering, material and modelling projects) carried on by R&D.

All the additional information appearing in the project data sheet in PPM is naturally connected to the projects table are: technology centre, area, project manager, time schedule, presence of public funding, type, class, core team, description, activities, critical aspects, number and title, related costs, standard of hours worked; type, number, duration and costs of tests.

The connection is done through the table of the i-Miner called 'set-up'. This table keeps track of the technology availability timings. When the technological idea becomes the object of a R&D project, is loaded into the project portfolio (PPM) and defined in detail. This is also a case of ‘many to many’ relation. The same technology, in fact, may be the subject of several projects (e.g. an internal project in addition to a collaboration with a university, or various internal projects regarding concurrent developments in different technology centres). Similarly, the same project can cover, in an integrated manner, the development of more technologies 'coded' in the i-Miner.

The use of the 'set-up' table allows each project manager to know which performances, business units and market segments are impacted by the project and what the defined targets, times and performance gaps to be filled are. Project Managers are also facilitated in learning the connections between components and phases of the production process.

The same table is useful to check if the ‘core team’ of the project is coherent regarding the involvement of members of product platform impacted by the same technology. Finally, the link between technologies and projects, considered from another perspective, can make explicit all the different sorts of costs related to each project, and allocate them to the correct strategic target.

Now we get to the description of the part of the i-Miner that is the 'heart' of the system.

The table that links technologies and product targets is called ACTION table.

The heart of the i-Miner system is the table of the associations 'many to many' among the specific objectives of products and technologies. It is called the table of 'actions' (ACTIONS) because it identifies the link between the needs and the ways to satisfy them. This table connects then two worlds since, as we have seen, it is related to technologies (production and research) and to the market with its needs and subdivisions.

The effort to connect, in a systematic way, two sets of information as described below had never been done before in the company. Given the table size (4,000 records) everyone could clearly understand the reason.

This explains the limit of other approaches aimed at representing the roadmap in a more simplistic way: they failed in being representative of the true links between what could be done and what should be done by the Company in terms of innovation.

‘Relatively few efforts have focused on fusing together with S&T requirements systematically. There are fundamental reasons why little progress has been made on methodologies to identify the characteristics of these linkages. The pathways between S&T and eventual applications are many, are not necessarily linear or unidirectional, and require significant amounts and types of data. Substantial time and effort are required to portray as accurately as possible these links, and substantial thought is necessary to articulate and portray this massive amount of data in a form comprehensible to potential investors. Recently, high-speed desktop computers with large storage capabilities, intelligent algorithms for manipulating data, and other tools have become available to allow these S&T-capabilities pathways (roadmaps) to be constructed and portrayed efficiently and effectively, and to be used as a basis for more detailed analysis ‘(Kostoff, Schaller, 2001 - page 135).

Through the reports generated by the system, the table of actions allows to do analysis and obtain interesting views which show links between the two sides of the system architecture. For example, it is possible to see interactions between the components and the product performance. This may confirm or, on the contrary, call into question the 'instinctive' mental approach of the product designers when drawing a tyre measure.

Because of the huge amount of data collected about each technology and the difficulties encountered in their classification, it was decided to add a field called 'Roadmap Selection'. This field contains only a ‘binary’ indication (yes / no) to identify if the impact of a technology on a certain target is significant or not. Significant impact means that this technology has to be deeply investigated.

‘An iterative roadmap development process is essential’(Kostoff, Schaller, 2001 - page 135)

8. Use and reporting

In relation to particular issues or concerns, the system can be consulted through ad-hoc queries.

Here below some example of questions that the system could answer:

- ‘Which innovations potentially impact the ‘liner’ component?,
- ‘Which innovations will be involved in a specific phase of production process?
- ‘Which product platforms have formalized a goal of improving the 'handling on wet? ‘

There is the possibility to prepare standard reports, customized by type of stakeholder. For example: report on the technologies associated with a particular platform addressed to the director of the same platform, with an indication of the benefits brought by the technology to the product performance.

Additional synoptic reports could be used. They, therefore, allow 'numerical' assessments able to indicate the priorities. They may include:

- only the goals perspective, to show the view from the market needs;
- only the technology perspective, to show the portfolio of ideas per area or its risk profile (probability of success);
- the actions, to see the overall picture of the impact of technology on performance.

Alternatively, everyone can build its own report suitable for investigating particular correlations; for example between product features and components of the tyre.

Due to the big amount of information in the field, the instruments which mainly help having a clear representation of Technology Roadmapping outputs are table charts (Phaal et a., 2004 - p. 14).

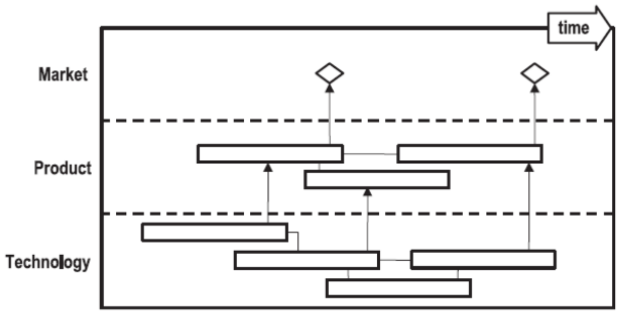


Figure 5. Schematic Technology Roadmap (EIRMA - Working group report, 52, 1997.

EIRMA (European Industrial Research Management Association) suggests a graphic way to represent Technology Roadmapping for tyre industry (see Fig.5). Due to the high number of levels to be considered and the number of bonds (up to over 4.000, as viewed) a graphical representation to share Roadmaps could be unreadable.

Representation, in reasonable size of the complex structural and temporal relationships between the elements, is the main challenge addressed in the literature about the technological Roadmap (Kostoff, Schaller, 2001, p. 133).

Pirelli decided to represent Technology Roadmaps as follows.

The Pareto analysis of the most relevant performances vs number of targets tracked was prepared (see Fig 6).

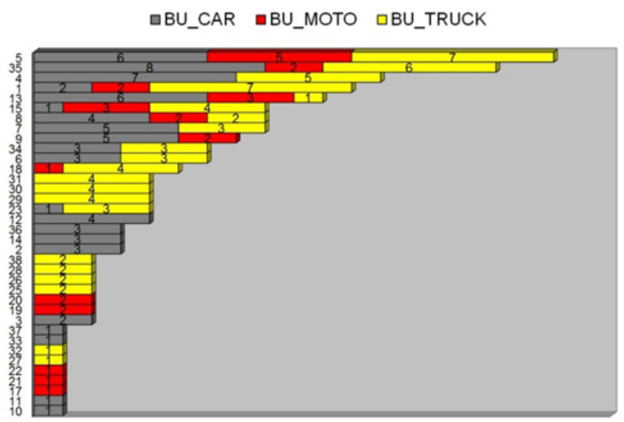


Figure 6. Number of performance gaps - Pareto Analysis by feature - Source: i-Miner.

According to the Pareto Analysis, it was therefore decided to focus on five product characteristics whose gaps are more common and to build for them the Roadmap in the form of visual diagram of Ichikawa. For example, figure 7 shows the roadmap for rolling resistance.

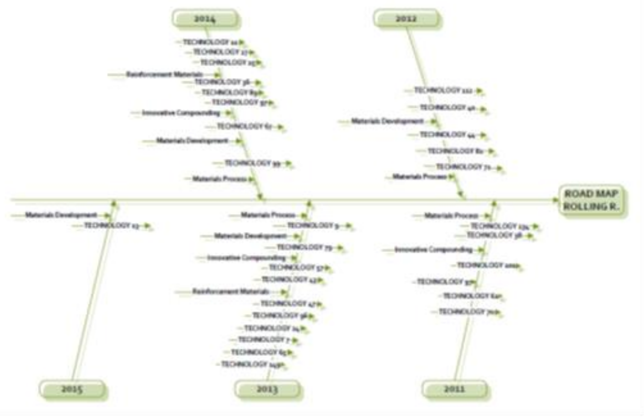


Figure 7. Ichikawa representation of the Roadmap. The picture shows the case for Rolling Resistance.

Each branch represents the year in which technology is expected to be available. Leaves represent the individual technological ideas deed as relevant to the rolling resistance in i-Miner. Ideas are grouped by technology area. Each leaf, of course, may also belong to the Roadmap of other benefits. We believe that these diagrams represent the most significant synthesis (not simplistic) of the work done. This has been presented to Pirelli’s CEO.

All other information related to individual technologies and mapped in the i-Miner are represented on technology boards (in the picture) that form the annexes to the Roadmap of each critical performance (one for each technology).

All boards aggregated form the technologies 'booklet', which is a report of about 180 pages, automatically generated by i-Miner. This report is considered the foundation of the management innovation plan.

Tie the Roadmapping process to a strategic cycle is one of the way to keep it alive into the Company, as also suggested in the literature (Phaal et al., 2004 - p. 21). Pirelli, to do this, has planned to establish an ‘Innovation Committee’ (IC). The aim of this IC is to review periodically the Roadmap and take decisions (and actions) to implement the Innovation Plan suggested by the Roadmaps.

The Committee will meet with a certain periodicity and its annually output will be the ‘Pirelli Innovation Plan’. Other objectives pursued by the IC are: the alignment of the project portfolio (possible stop to projects not finalized the strategic priorities - Portfolio Alignment) and the balance of the project portfolio on the basis of the resources allocated (Portfolio Balancing).

During the Committee, the Roadmap Manager for the five characteristics identified as most important in described above, will be appointed. Their main role is to monitor the progress of the projects generated by the Technology Roadmaps. Another role is to favour a certain level of competition between the project teams in order to stimulate significant improvements.

Each Roadmap Manager is also responsible for updating the information contained into of i-Miner regarding its own Roadmap. Likely, the predominant part of the Roadmap Managers has to come from the ‘product’: in this sense they are more directly involved in process outcomes. (Kostoff, Schaller, 2001 - p. 141)


- PIRELLI PROPRIETARY AND STRICTLY CONFIDENTIAL -
PIRELLI TYRE - TECHNOLOGY ROAD MAPS - TECHNOLOGIES' BOOKLET
TECH_ID: 50
%SUCCES 40
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TIMING: 2015
IDEA_BY: 40_MAT_REINFORCEMENT
IDEA DESCRIPTION
COMPONENTS
PLY
RESOURCES
PIRELLI
SUPPLIER
UNIV/RC
DETAILS
FEATURES
RM_SELECTION: 1
PRODUCT COST
APPLICATIONS
BU_MOTO
SCOOTER COMMUTING
BU_TRUCK
X-ply
MANUF. PROCESS IMPACTS
MATERIALS - REINFORCEMENTS
RAW MATERIALS
CURING
PROJECTS (PCM)
Project Code and name
Project Manager
TIMING
GOALS
SCOPE
ISSUES
[...]
Project detail

Figure 8. Example of technology form.

8. Conclusions

The evolution of the automotive scenario about Premium and Prestige vehicles generates a high level of complexity for a tyre manufacturer partner like Pirelli, in terms of advanced development to give constantly enhanced performances to an ever growing number of products and of radical innovations required (noise cancelling system, self-repairing tyres…) in all the continents in the world. Pirelli also, despite many competitors, develops internally a big part of the production machineries, many of them representing break-through innovations for the tyre industry. The challenge could only be addressed by Pirelli R&D working as a deeply integrated team able to collaborate and cooperate simultaneously (being time a critical competitive factor) at a world-wide level.

The process and the tool Pirelli introduced to focus strategically and integrate this effort is a TRM process integrated with the Projects Portfolio Management and backed by i-Miner and PPM tools, providing a map about where R&D organisation is moving and which direction it wants to follow.

Actually, the fundamental idea is to create a big comprehensive picture of the Pirelli research, innovation and development system articulating in detail all the relevant variables in an integrated system into a relational database system. Activities, ideas and their impacts on products and markets are the components of a system made by entities and relations among them. The resulting map is then full of details and intended to cope with the complexity of the job to be done without reducing or simplifying it. The approach is bottom-up and is able to determine a technology and product strategy that could be then defined as ‘emerging’ one, built on the precise mapping of individual customer (car makers) needs and evolution of technologies in different fields as taken and evaluated by Pirelli technologists.

A central dimension of the TRM model developed and original with respect to reference models provided by the general literature on the matter, concerns the level of product performances, being them the critical success factor in the technology based competitive environment of tyres for high-end applications. The “why” for individual R&D activities is then well highlighted, giving to PPM the role of tracking and managing the “who” and “when” questions.

The approach at the same time allows a complete tracking and avoids redundancies of concepts and information and allows complete flexibility in data access, analysis and visualization to the different stakeholders involved.

The TRM project along with the related i-Miner tool has been developing in a more general exciting opportunity in Pirelli. Following its General Manager Technology motto “Create a single virtual team of specialists who can work together at a worldwide level in real time” a novel work environment has being promoted, enabled by modern available ICT technologies called “R&D Projects & Communities”. Four pillars have been identified as foundations for the new environment: integrated knowledge management, networking and collaboration tools (blogs, forums, wiki…), a powerful semantic search engine and smart user management.

Without entering into details, the novel work environment is well suited for the roadmapping process and integrated with the related tools. The new environment promotes common language development thorough documents classification within predefined categories (metadata), mapping the “why”, “who” and “when” of the specific content and being coherent with the defined fields and values in the i-Miner system.

Common languages together with the power offered by the semantic search engine create strong and potentially unexpected links between the more specific languages of technology researchers in different fields and product specialists belonging to different platforms and BUs, bringing tacit knowledge to more explicit level and contributing to create a target oriented mind-set.

The approach enables a sort of effective technology transfer activity internal to Pirelli R&D organisations. About this point, there isn’t a favourite direction in which the know-how flows, for example from market needs to technology answers, but also technology guys give inputs about possible new performances or performance levels to be achieved by mean of new technologies, giving the opportunity to provide even more innovative and performing products to Pirelli customers.

As an outcome for project managers of Pirelli R&D, the Technology Roadmaps are definitely an opportunity for them to identify, in a formal way, strategic impacts of their projects and then to increase involvement and motivation.

i-Miner tool also includes a PERT analysis approach, enabling the possibility to produce a "research, innovation and development path" for the entire organisation (also in the literature are cited approaches like PERT able to re-define the role of the project manager (Kostoff, Schaller, 2001 - p. 135).

The approach finally enables an organizational change, taking place by the introduction of a fourth axis in the organization matrix (in addition to functions/professional families, B.U.s-products and countries-technology centres in the world): the roadmaps based on individual product performances. This, in our view, represents the magnet at the heart of the paradigm of metanational innovation inside Pirelli, that enables the organization to combine original pieces of knowledge both from market and technology side, generated in distance places in the world, in order to create innovation (Doz, Santos, Williamson, 2001).

The TRM model provided fits like a glove the innovation system in the tyre sector unlikely to be matched by commercially available tools.

In terms of possible future developments, data could be analysed by the sophisticated approach of network analysis, able to visually map more similar or overlapping technologies, for example in terms of profile of performance impact. This would compare closely related ideas perhaps technologically distant but addressing identical objectives. Evaluating this way the affinity between the sets of impacts of technology tells what are the technological alternative paths to pursue the same objectives.

Another future development concerns the possibility of introducing a tool for scenario analysis, declined specifically for technology issues. The main drivers of change have to be identified, progress has to be monitored by constructing internally consistent scenarios, the impact on the company has to be prefigured and possible responses have to be foreseen.

Precise markers of the evolution towards a precise scenario that could trigger actions by the Company would be produced. It would lead the company to position itself strategically accordingly to the possible scenarios and then to define the objectives before than the market.

One more future development concern the possibility to introduce the Technology Intelligence model to constantly update the technology ideas portfolio respecting the "outer" world. Through a systematic technology scanning system - tapping into the relevant sources - all ground is covered and opportunities could be gathered

9. References

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