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Organizing to support a future-oriented strategy: the wedding of foresight & research

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30th June – 2nd July 2010
Manchester Business School
Manchester (UK)

Organizing to support a future-oriented strategy: the wedding of Foresight & Research

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In the stream of works showing the importance of a future-oriented strategy to face uncertainty and identify future possible scenarios for innovation, this paper presents a case study that explores how a company can organize its R&D function with the aim to look deeper to the future. Separating the R&D, adding features of foresight to the organization, favouring external networks, even building an organizational and managerial system to support these strategic decisions, can have a deep strategic value in driving tomorrow innovations and in guiding companies investigating and preparing for a complex and uncertain future. In fact, in a context of future-oriented strategy, Research, having failed its wedding with Development, can find a new partner for a strategic wedding in Foresight.

1. The organization for future-oriented strategy and innovation

Studies showed how *half of present industrial problems require long-term research and a strong attention to the changes of the context*. Long-term profitability is related to investments in R&D (Fagerberg, 1987) and long term research and vigilance on PEEST context (Miles, 2002; Hamel, 2007 and Kotler and Caslione, 2009). That is why it is important to find a way to monitor, update, and revise strategies facing uncertainty, to identify future possible scenarios for strategy and for innovation and to be as more prepared and as readier as possible for changes and for future possibilities.

The strategic management literature has continuously underlined this necessity to take into account the possible future evolution of the environment during strategic processes and the consequent need of environmental scanning (Daft and Weick, 1984; Daft *et al.*, 1998; May *et al.*, 2000); the problem of understanding and developing scenarios (see Ansoff, 1976; Andrews, 1965; Porter, 1980; Grant, 1994; D'Aveni 1994 and Stacey, 1995), related also to decision making (Nutt, 2007).

Corporate Foresight (CF) is the process used by companies to identify weak signals and information from the periphery, anticipate emerging markets and trends and manage innovation to prepare for an uncertain future (Wack; 1985; Becker, 2002; Day and Schoemaker, 2004; Müller, 2008). Preliminary conclusions suggest that foresight is relevant to corporate strategy (Schwarz, 2008). CF helps companies to be given a vision to try to understand the complex forces that drive the change, to accordingly support the decision-making process and

strategy and to nurture R&D for innovation (Burmeister *et al.*, 2004; Fink *et al.*, 2000; Kaivo-oja, 2006; Van der Duin, 2006; von der Gracht *et al.*, 2010; Vecchiato and Roveda, 2010).

But there is still a missing of real integration of the CF process into the particular strategy and a need to better linkage of information gathering and taking actions in future studies (Reger, 2001; Postma and Liebl, 2002; Chermack, 2004; Van der Steen *et al.*, 2010).

Important sources for foresight are the relationships among building blocks that can be seen as possibilities but that are still unrelated in the present. This perspective suggests that our ability of foresighting is connected to the ability to identify key building blocks as trends and weak signals and to explore their relationships. Therefore it is an *organizational matter* (McMaster, 1999).

But, in the midst of a changing context, most companies continue to use a strategy toolkit and an organizational structure designed for yesterday's more stable marketplace (Courtney, 2001). As a result, strategies emerge that neither manage the risks nor take advantage of the opportunities that arise in highly uncertain times. Moreover, defined processes and planned activities are suitable for incremental innovation, but old structures cannot support discontinuous innovation, but it is necessary to identify other means (Backman *et al.*, 2007) because uncertainty is higher (Reid and De Brentani, 2004; Crawford and Di Benedetto, 2000). Nevertheless, some companies consider foresight as such a core competence that have built a CF function dedicated only to study advanced models for future projection using logics of anticipation, to individuate weak signals from external sources and understand emerging trends in all the PEEST environment. This function has usually been

named in large companies (e.g. Nokia, Siemens, Deutsche Telekom, Shell, Telecom Italia, etc.) as “Foresight unit”, “Future Centre”, “Future Lab”.

Some general academic works describe some of these companies and try to build a foresight implementation framework from an organizational point of view, e.g. Daheim and Uerz (2008), Rohrbeck (2007) and Rohrbeck and Gemünden (2008). But literature still highlights some important gaps:

- the lack of a description of the functioning of the Foresight Unit and of how to implement it;
- the lack of a clear representation of its objectives and of the links with the other company functions.

and more in general:

- the lack of detailed suggestions on how to design and implement the organizational variables in terms of structure and mechanisms to support a future-oriented strategy.

This paper discusses how the identification of weak signals in the broader business environment, the investigation of the periphery and the early detection of trends and the scenario thinking, including technological but also political-economical developments and social and market possibilities, can be integrated into innovation and strategy processes and the organizational can be coherently designed. Therefore, the aim of the paper is to deeply investigate the structure and the organization of R&D through the “market of tomorrow” lenses: it would like to investigate how a future-oriented company can design its “*innovation engine*”, in other words its organizational structure (e.g. configuration, hierarchy, information processing structures) and management practices (e.g. incentives system, training, promotion, recruitment) for internal- and external-generated innovation, coherently with a future-focused strategy. The case of a ICT hi-tech company, Eurotech Spa, will show - in a context of higher speed and efficiency need, but, especially, of great attention to future trends and innovation as well - how it designed the structure of

R&D, Strategy and other internal functions related to innovation, future studies and decision-making for the future and it supported them with managerial practices.

2. Research methodology

We choose an in-depth case study with single nature and an exploratory character (Eisenhardt, 1989; Pettigrew, 1992; McCutcheon and Meredith, 1993; Hartley, 1994; Gassmann, 1999; Yin, 2003).

It was selected among the companies that implement foresight a case of success that evidences practices that are not yet clearly stated or investigated by literature. This article is therefore focused on the study of a company operating in the ICT industry: Eurotech Spa. The motivations for the choice of this case are related to the three main reasons for selecting a particular case suggested by the research methods literature (Eisenhardt, 1989; Yin, 2003; Siggelkow, 2007): fit, distinctiveness and revelatory nature. These are detailed in Tab. 1.

The units of analysis have been the entire Eurotech organization and especially the areas of R&D and Foresight, and their links (in terms of structure and knowledge flows) with Strategy and Marketing.

The study was carefully designed to ensure high quality and sufficient rigor. To maximize its validity and reliability (Dane, 1990; Yin, 2003), multiple sources of data were used, with the double aim to increase the information basis and to diversify it, implementing an information triangulation. In particular, the channels for data were documents, interviews, panels Delphi and direct observation. The collection of data required 50 circa non-consecutive days of on-site visits, in a time-frame of analysis from 2006 to 2010. See Appendix for details on research sources and protocol.

Table 1. Reasons for the choice of Eurotech as single case-study

REASON	EXPLANATION IN EUROTECH
FIT	<p>It is strongly oriented to the future trends.</p> <ul style="list-style-type: none"> ▪ As its strategy management states, foresight and disruptive/radical innovation are key levers for Eurotech’s strategy. Eurotech is recognised as an innovative and visionary company, as the many awards of innovativeness for its products and its management and employees testify. <p>It has a <i>peculiar organizational model</i> for innovation and a foresight-driven perspective for its R&D and strategy.</p> <ul style="list-style-type: none"> ▪ It is characterized by a <i>strong importance of R&D</i>. In fact, it defines itself as an “idea factory”: the production is outsourced to concentrate the efforts on Research and Development (40% of the investments) and the 31% of the employees are working in R (1,6%) & D (29,4%) (see Tab. 4 for a detailed overview). <p>Its management’s commitment on the spreading of innovation and CF culture is really high.</p>
DISTINCTIVENESS	<p>It is a medium company, but a case of success in terms of revenues, growth, internationalization and especially innovation and “future-fit”.</p> <p>Eurotech distinguishes itself from the main competitors for its leadership strategy due to innovation, to radical/disruptive innovations and to be “future-fitted”.</p> <ul style="list-style-type: none"> ▪ While its competitors are still producing embedded computers, Eurotech considers them only as a basis to gain a “sure” revenue, but it continuously try to offer to the market new radically innovative products. ▪ The important role of Eurotech in the ECT and PCT can be seen in its partnerships with key players in the hi-tech market (Intel, IBM, ...) and its important customers (USA defence for aircrafts, Japan transportation system for busses, Italian safety system for medical surgery, etc.).
REVELATORY NATURE	<p>The company gave the researchers the possibility to directly observe the foresight activities, to participate to the meetings of the scientific committee and to do a Delphi Panel. (see Appendix I for these details on research methodology)</p>

3. Eurotech case study

Eurotech is an Italian middle-size ICT company located in Amaro (Udine, Italy). It was created by 6 people and a capital of ca 25.000 euro in 1992, and has been steadily growing since (ca +50% annually¹). Today it is a leading international group whose main focus is research and development. The Eurotech's live-motive is the growth due to two main levers: the innovation and foresight culture and the acquisition and internationalization strategy.

3.1 Eurotech's innovation future-oriented strategy

Eurotech was born as a "fabric of ideas", with the idea to miniaturize computers to use them in still unexplored applications. This will of innovation can be clearly read in the CEO's words: "*In the first phase, two visions cohabit: a short term one and a long term one, which will be more and more synergic later on. We chose to be a fables company, a 'company of ideas', strongly betting on the new.*"

The company built its first competitive advantage on an established technology niche, it is in fact a leader in the consolidate field of Embedded Computer Technology (ECT). In Eurotech's opinion, the innovation in the ECT field can now only be "sustaining", that is why it decides to innovate differentiating but inside the market standards.

After the first settles, the first revenues (from 1996 onward - and then from 2000 the 40% circa of the revenues systematically) were not spent to continue in this sustaining innovation path, but for the research of possible disruptions, considered as the core of the system: "*The company's core is innovation. Disruptive innovation can be obtained by intuition, foresighting and researching. That is why our first revenues have been soon invested in research; other companies maybe would choose to direct the capitals elsewhere, but they would not build the basis for the growth.*" Therefore, it has focused its research on key high-growth sectors and now it implements cutting-edge technologies, like the emerging field of Pervasive Computer Technology (PCT). Eurotech's current vision is that pervasive will become the new computing paradigm, after mainframes, personal computers and handheld ones. For it, the "internet era" has an enormous potential for telecommunications ubiquity because of the increasing number of micro computers. In this line the CTO states the Eurotech's vision about reality augmentation and invisible technologies: "*We call the Pervasive Computing GRID with the term "computing eso-skeleton" because, thanks to the diffusion and interconnection of computers in a macro and micro scale, it will not be limited to make reality virtual, but to augment it. Moreover, in the same way that happens when we switch on the light and for us the mechanism of electric energy generation and*

¹ A story of acceleration with the phases of incubation (1992-2000), of private equity and acquisitions (2000-2005) and of public listed company and acquisitions (2005-now), the last two when the revenues strongly increase (3.9 mln (2000), 6.4 (2001), 8.3 (2002), 11.7 (2003), 18.8 (2004), 29.8 (2005), 50.7 (2006), 75 (2007), 91.7 (2008), 88.5 (2009)) through acquisitions and targeting its business model on innovation.

transmission is "invisible", in a not far away future the calculation and processing possibilities will be so diffused that it will be not important who does it and how it arrives to us."

Fig. 1 shows the evolution of the Eurotech's products from its view, where ECT are embedded-PC and PCT refers to all the other typologies in the legend. Eurotech depicts its innovation evolution using the Christensen (1997)'s model of innovation. They subdivide the markets into nanoPC and HPC. Historically, one of the reasons why Eurotech decided to open the HPC market, is that it was possible to reconsider some PC technologies that were exiting the previous market. This strategy is clearly important in an industry where the obsolescence of technologies and knowledge is fast. Eurotech sees four main disruptive innovations areas in its history:

- embedded PC: as module PC/104 based on a 32 bit processor Intel 486DX (in 1995 Eurotech was the first company to launch in the market this product)
- HPC: as the product called APEnext (with a calculation power ten times more than the previous model) or the new HPC Janus (a platform that can reach 8 PetaOps with 10kWh and 2 cubic meters).
- wearable PC: as the wrist-worn computer called Zypad or the pendant for monitoring temperature and other physical ;
- sensor network: as for example the product "Vista".

As regards the last three, from 2000 Eurotech vision the new scenario of pervasive computing and consequently decides to focus even more in foresight and research activities to identify, imagine, design and manufacture new products and new applications. "*Eurotech's strategy is now to explore new ways to use computers. For us the emerging "pervasive scenario" is a tantalizing challenge. But to walk a new path, it is necessary to adopt new business models and it requests further investments. In this line, we decided to go public, and to move from a control logic to a guard one. For the new business model, the main strategic line was to give a strong importance to research (12% of the revenues and 40% of employees²), and the consequent reorganization. We tried to combine the innovation through both external and internal paths, to accelerate our growth.*"

Eurotech's history is marked by continuous successes and distinctions for innovation. This can be testified by the many sustaining and especially disruptive/radical new products launches, the awards for innovation, the strategic partnerships and important customers. Tab. 2 show a synthesis of Eurotech's history from the point of view of the strategic lines of innovation, while other tables show the milestones from the main other ones: networking (Tab. 3) and internationalization (Tab. 4).

Eurotech's history has been accompanied by a strategy of market leadership obtained pursuing a strategy of searching for weak signals and possibilities and implement its visions of the possible future scenarios in radical/disruptive innovative products. As the CEO states: "*Eurotech's history has always played along with a vision of the future that slough off from time to time, depending on the phase of growth of the company*". But also of a more sustaining innovation, a more "today" view of the need of new product development. This can be seen as a double spirit of standard of excellence and

² They were 160 in 2005.

disruptive/radical innovation, that is (as reported below) concretely separated as regards operations and organization. As its CEO states: “Eurotech refers to innovation through the famous Pareto’s law 80/20: 80% of sustaining innovation and 20% of disruptive one.

Therefore, Eurotech’s strategic direction is to innovate inside standards but also to define and penetrate new and emerging markets, breaking traditional barriers through innovation.”

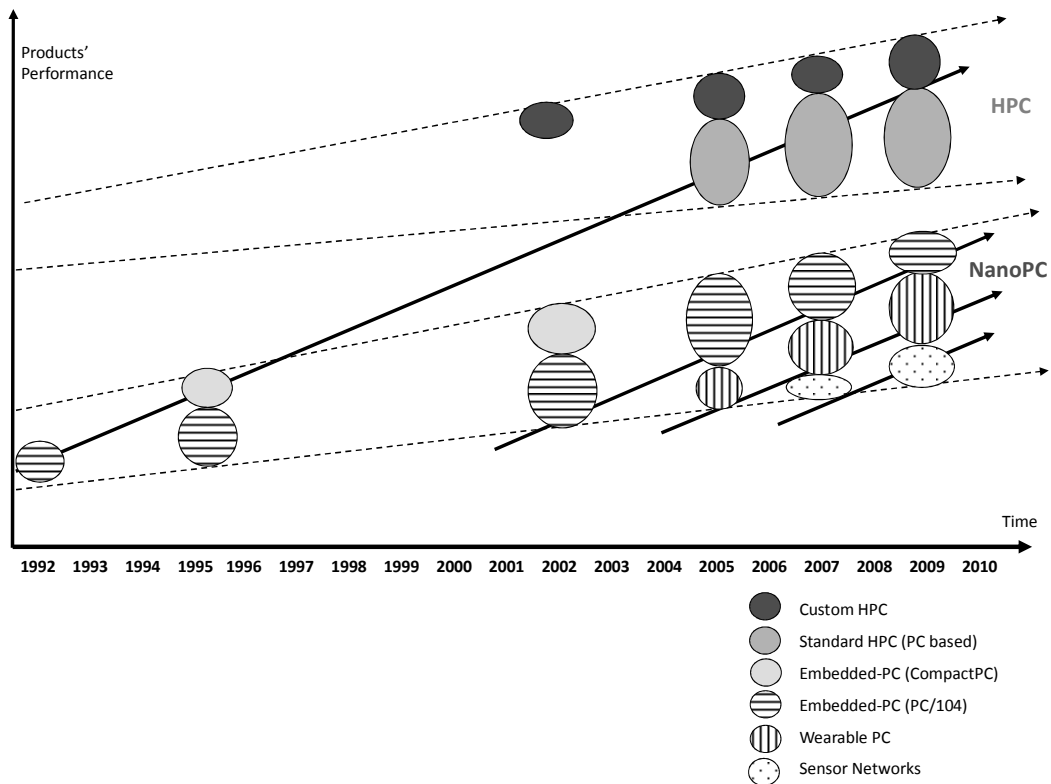


Figure 1. The evolution of Eurotech’s products [adapted from Eurotech internal documents]

Table 2. Main innovation facts in the Eurotech’s history

PERIOD	INNOVATION FACT	TYOLOGY
1995	first company to launch in the market the first module PC/104 based on a 32 bit processor Intel 486DX	Sustaining innovation/technology
1999	new product APEmille, a computer able to elaborate a thousand billion of operations per second (1 TeraOps)	Disruptive/radical innovation/technology
2000-2005	mainly improvements of existent technologies	Sustaining innovation/technology
2006	the first model of wearable computer, a wrist-worn computer called Zypad	Disruptive/radical innovation/technology
2006	award as the most innovative product in the Soldier Technologies Conference 2006 in London for Zypad	Award
2006	Frost & Sullivan award for the most innovative product in the “Ambient Intelligence” category for Zypad	Award
2006	Ernst & Young Italy “Entrepreneur of the year 2006” to Eurotech’s CEO, Roberto Siagri	Award
2007	Eurotech invests in the UGV (Unmanned Ground Vehicles) sector, with the 20% of the Kairos Autonomi company. This technology is used inside the busses in Japan	Disruptive/radical innovation/technology Customers
2007	new HPC product called Janus: a platform that can reach 8 PetaOps with 10kWh and 2 cubic meters. It is the most powerful computer in its category.	Disruptive/radical innovation/technology
2007	new important customers for Zypad: defense in Italy and USA (Airforce), civil preserve in Italy	Customers
2007	new nanoPC product: Vista, a Lab-On-Chip with a miniaturized “electronic eye” that is used in the completely automatic cars.	Disruptive/radical innovation/technology
2008	supplier of a “smart system” for energy in critical situations for the company Lockheed Martin (Fort Worth) for the american fighter aircraft F-22 Raptor	Customers
2008	Zypad awarded as one of the 60 products that will really change the everyday life with the “Well Net tech Award in Milan.	Award
2009	the Platinum Award 2008 for the VDC research group	Award

Table 3. Eurotech's networking/partnerships

PERIOD	EXTERNAL LINK	RESULTS
1998	partnership with IRST (a technological research institute)	creation of the spin-off Neuricam Spa realization of a new generation of devices that integrate camera with processor for the visual recognition: a "smart digital eye"
1998	spin-off Inasset	to deploy a business model based on open source software
1999	project with INFN (the Italian institute of physics)	opening of a still unexplored product line: the High Performance Computer. new product APEmille, a computer able to elaborate a thousand billion of operations per second (1 TeraOps).
2001	collaboration with a research centre of the NJUT (Nanjing University of Technology) in China	research on ICT sponsor of a course on embedded system design.
2001	partnership with consortium LITBIO (Laboratory for Interdisciplinary Technologies in Bioinformatics)	technological partner for architectures and super-calculator systems
2003	collaboration with University of Trento and with ITC-IRST	research activities in the pervasive (ubiquitous) computing
2005	partnership with Finmeccanica Spa	to exploit the frontier technologies in industries like aerospace, defense, transport and energy
2006	agreement with IBM	Eurotech integrates the software IBM Lotus Mobile Connect in the NanoPC devices
2008	agreement with Intel	Eurotech and Intel won an award for co-selling excellence
2009	member of the consortium PROSPECT	link with the main HPC customers (Julich Supercomputing Centre, Barcelona Supercomputing Centre and Leibniz-Rechenzentrum Garching.)
2009	partnership with DynaVox Xpress™	production of vocal generation devices to help patients with particular pathologies (SLA, paralysis, etc.)
2009	contract with GE Healthcare	to supply platforms for medical devices to permit to manage the clinical case histories

Table 4. Eurotech's internationalization/acquisition

PERIOD	ACQUISITIONS	MARKET	AIMS	
1997	first collaborations with European distributors and commercialization in USA, Asia and Australia	commerce	to distribute internationally	ACQUISITIONS WITH THE MAIN AIM TO OPEN UP TO NEW MARKETS
2001	acquisition of IPS (Italy)	industry	to complete its product lines	
2003	Parvus (Salt Lake City, UTAH, USA)	defence, aerospace, transportation	to consolidate and amplify the presence in USA and to acquire know-how	
2004	Vikerkaar (Finland - renamed as Eurotech Finland)	industry, transportation	to guard north Europe markets and China	
	Erim (Lione, France - renamed as Eurotech France)	defence, industry, transportation	to enter in a strategic market	
2005	Arcom Control Systems Ltd. (Cambridge, England - renamed as Eurotech England)	industry, networks, transportation	to acquire know-how	ACQUISITIONS WITH THE MAIN AIM OF INNOVATION
	Arcom Control Systems Inc. (Kansas City, USA - renamed as Eurotech USA)	industry, transports		
2006	Applied Data Systems Inc. (Maryland, USA - with the 65% property of Chengdu Vantron Technology Ltd (China))	industry, commerce, medicine		
2007	65% of Advanet Group (Advanet (Okayama, Japan), Spirit 21, Vantec e Advanet R&D)	industry, medicine, transports		
2009	Union Arrow Technologies (UAT) - Japan	networks		

3.2 Eurotech's organization to support future-oriented strategy and innovation

In general, *the internal organization must be coherently designed for internal-generated innovation*. Key inputs to innovation depend in fact on suitable formal and informal organizational structures, human resource management practices, control and communication mechanisms and motivational tools (Colombo and Delmastro, 2008). It is not only important to design the internal organization for internally generating innovation, but, even more in a context of opening up for possible futures detection, it becomes increasingly important to *design internal organization for external knowledge sourcing*.

The future-oriented innovation strategy of Eurotech is strictly bounded to an internal organization for internal-generated scenarios and innovations and an external

organization based on partnerships and networking. This system is supported by strategies linked to acquisitions, internationalization and minority interests and by specific choices from the top-management on soft-factors for the cultural diffusion of CF.

The core system

A basilar building block of Eurotech innovation is the R&D function. As a matter of fact, Eurotech adopts the model of a "fables company" and for this reason it defines itself as the "ideas company". This means that the production is outsourced³ to strongly focus the efforts on Research & Development. This is true both from an

³ The only processes that are internally hold are the ones for which there is no economic convenience in outsourcing them, as for example prototype production and product tests.

investment point of view both from a human resources one. In fact, R&D represents the 40% of total investments and on Eurotech group is employing 564 people, 32% ca of which in the “innovation engine” (data of December 2009).

The units and functions employed in the innovation, foresight and strategy activities are mainly five: Research, Development, Strategy, Marketing and Foresight. Tab. 5 shows the employees’ breakdown basing on the organizational function distinction.

Table 5. Eurotech employees’ breakdown

ORGANIZATIONAL FUNCTIONS/ UNITS	HEADCOUNT	%
Foresight*	4	0,7%
Research	18	3,2%
Development	157	27,8%
Strategy	15	2,7%
Marketing	18	3,2%
Other**	352	62,4%
TOTAL	564	100,0%

* Employees who come from research (1), strategy (2) and marketing (1) and who do both activities (foresight and research, foresight and strategy and foresight and marketing). The scientific committee is not employed, but it’s by token.

** Industrial Operations, Sales, General & Administration

Research and Development separation

In general, much innovative work must be only loosely coupled with the regular development activities (Hautchel *et al.*, 2001; Koen *et al.*, 2001; Nobelius, 2004). In Eurotech the Research is conceptually and operationally but also physically separated from the Development, and the company considers this choice as a best practice and a basis of its organizational model. From a conceptual point of view, Development is in the area of the “today’s customers” and Research in the area of the “tomorrow’s customers”. “Development is tactic and Research is strategy. Actually Development attends to develop “already existent” products with a more short-term focus, that is at the direct income connected with what is desired by today clients. But as Morita, the ex-CEO of Sony, said: if you ask the customers you will be always behind in this world. The Research should therefore have a more medium-long term focus. In which scenario will the competition take place? Will the technology be different? And the man interaction with it? And what will the customers of tomorrow desire?”

Eurotech refers to the Christensen (1997)’s classification of innovation types and considers the Development more related to sustaining innovation while

the Research more related to disruptive and radical innovations. So Eurotech sees them separated in the way the one is more connected to the markets’ actual needs (market-pull) and has to focus inside the “customers’ acceptance area” and the other has to work outside from that area because is more pushed by trends in the PEEST. As shown in Fig. 2, Eurotech divides its organization basing on the technology-push or market-pull innovation approaches. From the words of the CTO: “The first approach starts from what technology is able to give, whilst the second starts from what the market demands or is able to absorb. They are two opposing approaches - but they can be effectively combined. For a company like ours, which bases very much its success on technological innovation and on anticipating demand, it is essential that research is driven by a technology-push approach. Only with this approach is it possible to maintain technological leadership and continue developing state-of-the-art solutions. The development part is a different matter. In order to effectively launch research results on the market, it is important to focus on an approach that indeed starts from what the markets want or may appreciate. In a word, the right approach for development is market-pull.”

From an operations point of view, this means that Research and Development follow the technological curves in completely different phases, and they have necessity of different organizational structures and moreover of different people with different ways to think. In the Research the knowledge is created by completing the ideas coming from external sources or by transforming the scenarios coming from foresight activities in a product concept. The Development functions re-engineer the concepts coming from Research, or try to satisfy the needs of the market coming from the marketing or from other Development units at the Group companies level. The documents referring to technologies and products in the Foresight and Research are more codified favouring the “what”, the scenarios and the product concept respectively, while in the Development they are codified favouring the “how” of the product design and of the production process. The end users give feedback to the Development, while Research receives inputs from Foresight and its knowledge network. Therefore, from a structural point of view, while the Development is more connected to the Marketing Unit or to the other Development units, the Research is more related to the Foresight Unit. “Research has to imagine products for the customers of tomorrow, 3-5-10 years forward. That is why Research needs to receive inputs from the Foresight Unit. We search for weak signals through networking, exploring weak ties, connecting experts from different fields, and so on, in order to understand trends and to imagine scenarios... These are useful as a starting point, a context where researchers can conceptualize new ideas and innovate. The innovations are often disruptive ones, because the researchers think of a product for a future that now it does not exist, but that is a potential.”

From a physical point of view, the Research is a separated unit, called ETH-Lab, directed by the CTO (Chief Technology Officer) and located both in Amaro (Udine) and Trento, while the Development is dislocated in all the single companies in Europe, USA and Asia. And also the hierarchical control of the activities is centralised for Research but decentralised for Development. “In order to maintain an effective hold over research, it is important

that control is centralised at parent-company level. Development is decentralised and distributed among the various Group companies. By so doing, each of them can conjugate a given product idea in the best way, understand/exploit local specifics, and turn research results into a commercial success.”

The Eurotech system for innovation can be recognized in the two levels of corporate and company. In the corporate level, the parent-company Eurotech Spa is connected to the Research centre and the Foresight Unit, while Development is decentralized at the group companies level. (see Fig. 3)

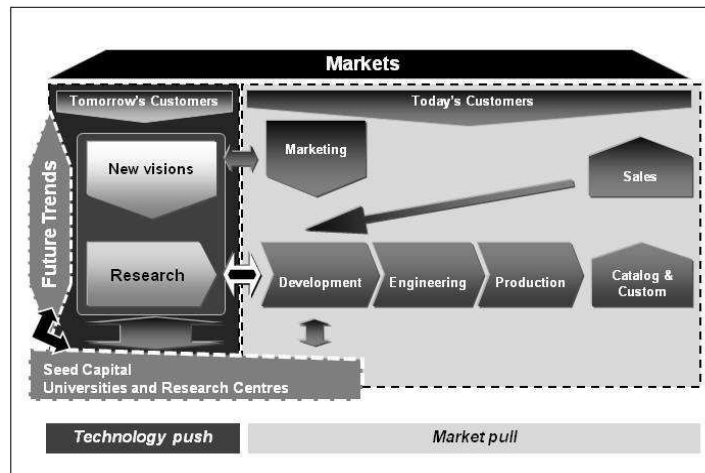


Figure 2. A representation of the Eurotech organizational model [source: Eurotech internal documents]

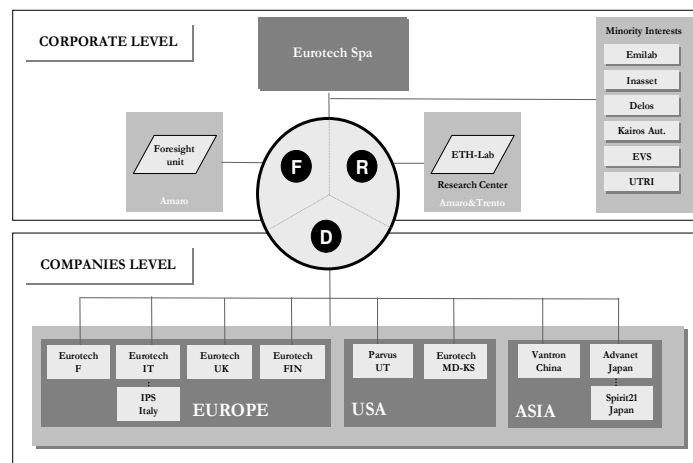


Figure 3. Eurotech group structure

Foresight

The foresight activities in Eurotech have the main aims to anticipate changes and imagine possible related scenarios. These are tried to be obtained by analyzing weak signals and early warnings, intercepting and understanding trends, collecting and mixing the opinions and the experiences of experts. The foresight process outputs are generated both from external both from internal side.

The tools are many and various: for example web-based research, database analysis, “visionary books” readings, Delphi panels, roadmaps, scenarios, wild cards, general creative and foresight techniques, sector-related or innovation fairs attending, etc. Anyhow, the CF in Eurotech is mainly founded on informal methods without an explicit and clear pattern and defined rules. The management believes that concretely these activities have to be let free, without a completely structured methodology. “Foresight is not only a matter of

methodologies, but of linking different and previously separated knowledge and of intuition and imagination.”

Also the organization is structured with the general rule 80/20 applied to the ratio internal/external sources of foresight, so these activities are organizationally supported by two teams: one internal unit, called the Foresight Unit, and one ad-hoc team, the scientific committee. The one is a continuous monitoring and supervising unit formed by employees, while the other meets three/four times a year and is formed by experts paid by token. Thus the process, free of codified norms, is more flexible to adapt and moulding itself to the company objectives and issues. This 80/20 rules is applied also for R and D: while with R the reasoning is similar to the one of F, the D concentrates in the stable technologies and dedicates to the external only the 20% of the resources, to maintain the control over technologies.

Eurotech supports its peculiar aptitude toward peripheral vision, disclosing readiness in sensing the new trends

mainly from the technological foresight type, but also the customer foresight and competitor one. To favour explorations and investigations conveyed by different sources, Eurotech has a *scientific committee*, a team of experts with the function to discuss these ideas through a multidisciplinary perspective. It was born in 2000, with the aim to support the research and to be linked to the foresight unit's activities, to be dedicated to the study and identification of future technological scenarios evolution and to garrison, manage and develop the Eurotech's "knowledge network". It has been ideated as an open space collector of experts from different fields, in which they can imagine and shape joint futures derived from their own provenience disciplines and in which they can generate, discuss and refine through brainstorming insightful ideas coming from their scientific domains. The scientific committee is composed to cover different and precise areas: some ones are strictly connected to the ICT industry, as informatics and electronics, but also other unrelated areas, such as physics, biomedicine, economy and sociology. The activities trigger is primarily Eurotech CTO, being in Eurotech's strategy the perspective of Research the most important for the foresight outputs. The well-known mechanisms are the cross fertilization and cross pollination (Lapierre and Giroux, 2003) and the accessibility at the cognitive diversity (Miller *et al.*, 1998), essential to enlarge and enrich perspectives and knowledge backgrounds. The committee has also the functions to check the state of the art in technologies and markets, to identify new trends and opportunities in their fields, to consolidate the collaborations with their research institutes and to assist and suggest the Foresight unit and the Research.

The *Foresight Unit* is the real "avant-garde" group in the company, directly directed and reporting to the CEO, and focusing a good part of its time, resources and efforts to scent and wind weak signals. They try to make sense of new industry sector trends and of new possible technology development directions. "*In order to truly innovate you have to have a person or a small team that thinks ahead; you need a small portion of the organization constantly projected into the future.*" The foresight analysis are not only focused in the core business areas, but also in other ones to predict and to gain insights on unexpected events from different fields and to sense weak signals from neighbouring areas, the so called "white spaces" (Reger, 2004). It is formed by four top managers: the CEO, the CTO, the Marketing manager and a Strategy manager. The Foresight Unit activities are heavily interrelated with other functions. The Eurotech Foresight activities do not remain only a future exercise, with no correlation to practice, but there is a strong integration inside the company from an innovation and from a strategic point of view. The future researches are strongly interrelated first with the research directions and to the decisions as regards the research investments, then with marketing to investigate the possible future customers needs and the possible impacts on them, and finally with the strategy to support the decision-making and the direction of the vision and of the future strategies. The link with Marketing is due to the fact that marketing activities can support foresight ones, providing for example reports of the actual socio-economical situation or investigating sociological changes, for example in the behaviour of the customers. The link with Strategy is due to the fact that

foresight activities have to be directed and coherent with the foresight strategy and the more general business strategy, and most of all they are an important source of relevant and strategic information for the company decision-making. The link with Research is the link with innovation: Foresight is one of the preliminary phases, which provides inputs and insights for the research activities. Foresight draws possible scenarios of the future where new possibilities for technology and innovation can arise: research generates therefore new ideas that are suitable for that peculiar "possible world".

Finally, we can observe in Fig. 4 the knowledge fluxes among units/functions in a case of foresight-generated innovation and in Fig. 5 the general fluxes among the functions.

Networking

The companies use both internal and external ideas as input for the innovation process and use both internal and external market paths for the development of innovative products/services. Knowledge is diffused and innovation is the result of an interactive and distributed process (von Hippel, 1988), and firms searching for innovation can open their boundaries and rely also on external actors (Chesbrough, 2003, Laursen and Salter, 2006). A typical problem related to the research theme refers to the huge investments required in relation of an unknown commercial success rate. Moreover, investing on Research does not imply any assurance of the fact that products will successful join the market. Eurotech pursues its solution to this problem creating, establishing and exploiting collaborative networks with universities and research centres and with key partnerships with important players of the ICT industry (ex: IBM, Intel, etc.). Thus, in the Eurotech organizational model these external knowledge networks cover a core strategic value. These partnerships match with multiple aspects, not only on a technological basis but also on a sociological one, in order to cover a wide range of perspectives and orientations, and to investigate also the impacts on an economic-managerial level on customers groups. The networking perspective is clearly strategically related to innovation and future-oriented strategy. In fact, from 1998 the company began to invest in activities of scouting of spin-off with important research centres and universities. "*We ask universities not to solve a problem, but to help us to see the future.*" From 2001, the company strategically reorganize its configuration for innovation, reinforcing its external network for collaboration and building an internal structure to promote it. Tab. 3 shows Eurotech's networking.

The Research and the Foresight are supported by harnessing an external network. In fact, both the R and the F are prompted to *openness and brokering* (mainly of technology), with other units and with people who are experts in one of the PEEST areas and watch over the future. This point of view is supported by networking, what Eurotech calls "the network of the knowledge". "*To make the technology-push approach more effective and efficient, the network of outside relations with the "network of knowledge is vitally important. This permits parallel exploration, at limited cost, of several alternative paths. The centre of gravity of technology-push research is therefore very much skewed towards the outside world,*

with a target outside/inside ratio of 80-20. We avail for the 80% of external collaborations to explore alternative paths and to consider many and different factors together. The roots of the tree of knowledge are the Research and the Foresight. The scientific committee are the first branches of our "tree" to supply us directly with ideas and to connect to other branches and leaves. The rest 20% is done by the internal resources: the Foresight Unit."

Different is the point of view for the Development: "Development is connected with what the market requests or is able to absorb. Whilst research benefits from the simultaneous existence of several open fronts, development has to converge towards a product or product family - and it is therefore advisable to limit dispersion of energy and outside interference. Another peculiarity of development is that it necessarily features the entry into play of the specifics of sectors and geographical areas - and centralised control would not permit adequate understanding/ exploitation of such specifics."

The support system

Internationalization

Eurotech's international acquisition strategy has the double scope to acquire innovative companies in fields where it is low competent and/or to expand in new countries (e.g. USA and Japan) and in new markets (e.g. the defence one). A main pillar of the Eurotech supporting activity for innovation is the partnership and collaboration with other companies. As remarked by it CEO, Eurotech adopts an *acquisition strategy* to establish this kind of strategic research-focused partnership in order to acquire complementary competencies or gain access to new external cognitive and knowledge diversity. This strategy of internationalization and acquisitions can be seen as a support to the internal organization of Foresight and Research: it helps in building the external network for amplifying the possibilities to detect new opportunities.

Tab. 4 shows the main acquisitions of Eurotech and highlights the aims of this strategy in internationalization and innovation: to open up to new markets and to cover areas of previous low know-how. In particular, since 2005 the internationalization perspective has been more strategically connected to innovation reasons too, and not only for opening up to new markets. For example the last acquisition, Advanet, permitted Eurotech to strengthen its capabilities and know-how in machine automation (Nikon and Canon), process control (Mitsubishi Heavy Industries), transport infrastructures (Mitsubishi Heavy Industries and Matsushita Electric Industrial.) and medical application (Hitachi Medical Corporation e Toshiba Medical Systems Corporation).

Minority interests

New growth opportunities can come also expanding activities in new business. A frequently used tool of multinational companies is corporate venturing and investments, and Eurotech applies this activity to foresight. It in fact has *minority interests* in other companies, which from the foresight perspective are industries with potentialities and that can be suitable for the scenarios Eurotech imagines in the future. They are defined as "*seeds of innovation*" on which Eurotech bets

for the future. "They are real options on innovation and future markets." For example, in the Eurotech scenario of a stronger man-machine interaction, it is important to invest in technologies that favor the automatization and the miniaturization. In this line, the investments in Kairos Autonomi (25%) was strategically important from the automated drive systems and in UTRI (21%) for the autonomous devices and miniaturized robot airplanes (UAV technology for surveillance in civil and military context, as anti-arson), from which they won the 2006 European award "Euroleader Award - Space & Satcom Navigation Sector".

Soft-factors

Soft-factors are also important to support the Eurotech strategy and organization for innovation, as:

- *culture*: the will to open the organization towards external sources and actors to enhance readiness in sensemaking activities of speed and direction of sector changes in technologies, clients, competitors, environments, etc. Eurotech shows a peculiar aptitude toward peripheral vision, disclosing readiness in sensing the new trends mainly in the technology level, by explorations and investigations conveyed by external sources.
- *top management commitment* (and CEO leadership): As a matter of fact, the CEO and the other management themselves devotes part of their daytime monitoring and researching new emerging and disruptive trends, even participating in many conferences and forums that talk about the future. This heavy commitment has the target from one side to increase the stock and the network of knowledge and from the other side to spread the concept of Eurotech as foresight and innovative business-oriented company both internally to its employees both externally to its stakeholders. Therefore, the Eurotech senior management commitment on the spreading of CF culture is really high and they are very concerned and convinced of the potentiality of CF for innovation. This is in line with what emerged from the CF literature, which underlines the need for a strong commitment by top management to promote a high-rise and spread in the organization.
- *climate*: the climate arranged in Eurotech is characterized by a deep and heavy acceptance and propelling commitment by the top management and by the foresight-oriented teams. Eurotech board is trying to make sense of strategic value conveyed by CF approaches to its stakeholders, favouring the interaction through environments where foresight actors are deployed in order to develop a potential of capabilities and sensibilities by which intercepting new trends and weak signals.
- *communication*: the communication activity on CF is continually and frequently carried out. We encountered two main channels, the formal and informal ones. Formal communication takes mainly place in committees, workgroups and conferences; informal communication in social and informal interactions and events as well as through informal networks.

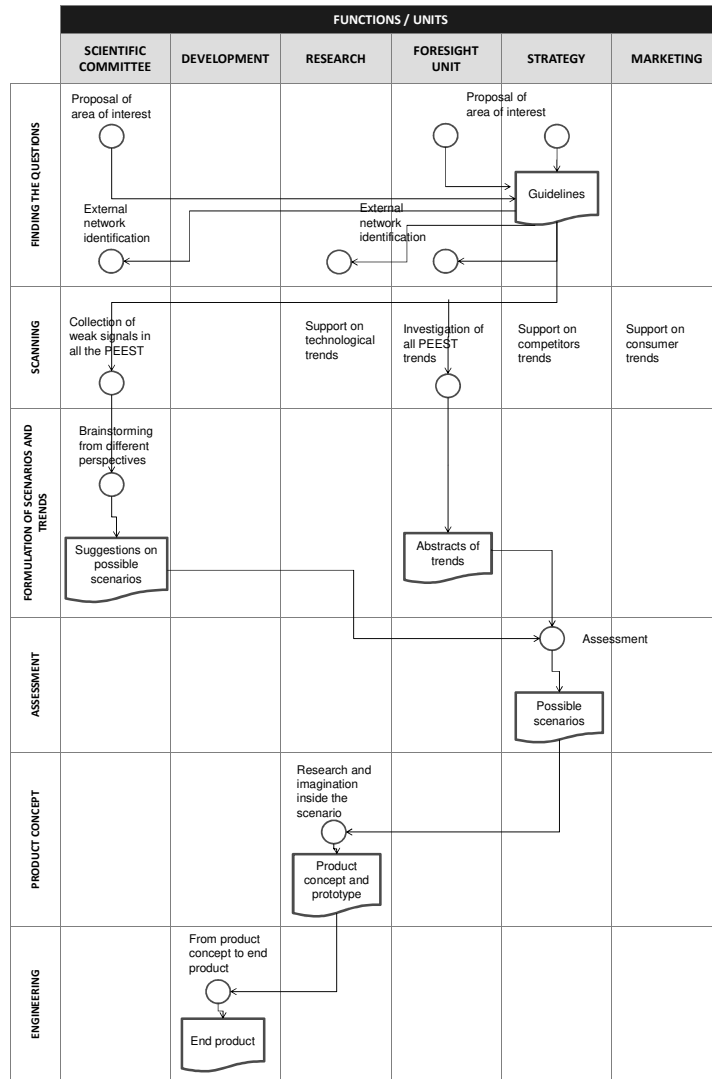


Figure 4. Fluxes of knowledge in a foresight-generated innovation

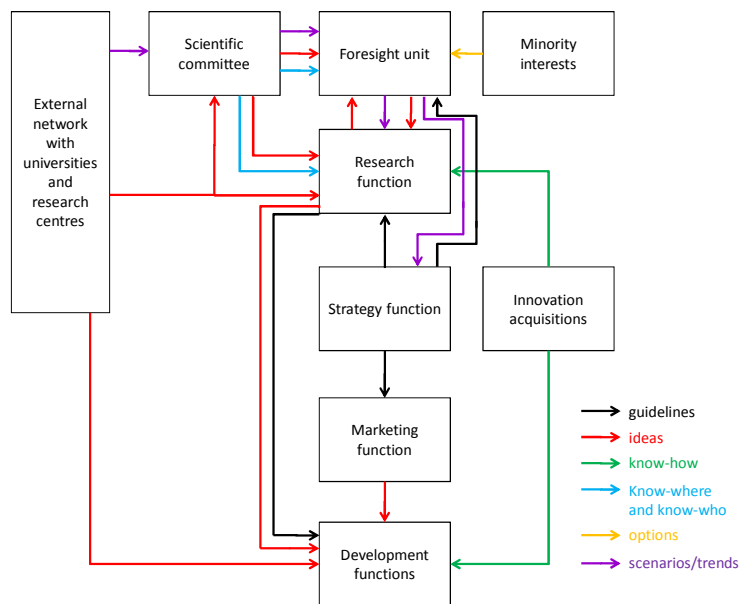


Figure 5. Fluxes among functions

4. Discussion

The Eurotech case describes how the foresight can be applied with the aim of comprehending in advance the strategies to continuously innovate and develop new products. This capacity of being and becoming sensitive to the trends and weak signals leads to greater attention, availability, willingness and readiness to listen and to react strategically and innovatively to internal and external changes in the PEEEST.

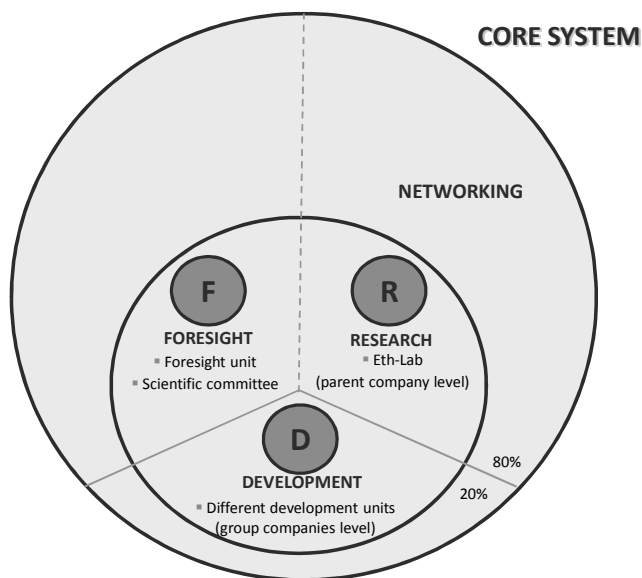


Figure 6. Eurotech's core system for innovation

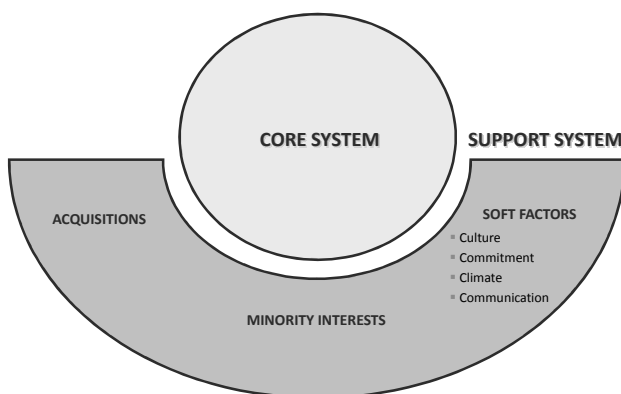


Figure 7. Eurotech's system for innovation

Tab. 6 shows a synthesis of the organizational variables and managerial practices following the research protocol. Fig. 6 and 7 show the future-oriented strategy and innovation engine in Eurotech, based on a core system where Foresight and Research are strictly linked together and to an external network in order to imagine possible scenarios and future products, and to give to Development the concept idea to prototype and manufacture. The support system is formed by acquisitions for innovation, minority interests and soft factors. These strong links

enhance the sensemaking (Weick, 1979) aptitude adopting a networked organizational model characterized by core hubs in which information flows are conveyed together with new trends and proposals from peripheral units.

Table 6. Organizational variables in theEurotech case

VARIABLE	CHARACTERISTIC	EUROTECH
STRUCTURE	Organizational unit/function definition	Definition of Foresight unit basing on objectives of long term innovation and strategy
	Organizational unit/function dimension	Reciprocal adaptation, small unit of CF
COORDINATION	Specialization	Permanent and institutionalized nature of the CF unit and its relationships with other functions
	Training	Employees are trained for CF activities: they learn about specific methodologies and past projects
DECISION PROCESSES	Vertical centralization	Foresight activities directly refer to CEO Low vertical decentralization
	Horizontal decentralization	Wide horizontal decentralization because there is a strong involvement of other functions
NETWORK	External relationship	Strong importance of external relationships for foresight and research
CONTROL SYSTEMS	Procedures formalization	Procedures are not strictly formalized
	Internal cohesion mechanisms	Importance of the scientific committee
TECHNIQUES	Foresight techniques formalization	No formalized techniques, because the company would like to leave room for imagination

From an organization viewpoint, the case study suggests to characterise and support the future-oriented innovation and strategy by building a dedicated unit strongly connected to Research (Foresight Unit), by favouring internal relationships (e.g. scientific committee) and external networks (e.g. collaborations with universities and research-centres and R&D partnerships) and by supporting with acquisition strategies to buy high-competence companies covering own low know-how fields and minority interests to have "bets" on the future and by soft-factors.

Moreover, the case analysis suggests the R and D separation and describes the key links among CF unit and the other functions, in particular R and D, distinguishing them from the market of today and market of tomorrow perspectives. As a matter of fact, here the Foresight Unit is really peculiar and evidences strong links with the Research function, as much that in our opinion we can talk of a "wedding" between them and a separation

between Research and Development. F in fact has the main aim to nurture the R and to orient it basing on trends, while the R gives feedbacks to F suggesting the possibilities of investigations and the real practicability.

The *separation of Research and Development* is a debated topic among scholars. The literature has acknowledged the organisational and managerial differences between Research and Development. In this line, highlighting the contradiction creativity/efficiency and distinguishing Basic and Applied Research from New Product Development (NPD), three main works (Leifer and Triscari, 1987; Chiesa, 1996 and 2001) propose the separation of R and D. The first authors highlighted the differences between R and D, indicating that D units are characterized as having more routine jobs, more inter-unit dependence and coordination and more communication outside the work unit but less within the larger organization, and are less tightly structured than R units. The works of Chiesa (1996, 2001) confirmed these differences, highlighted them in terms of culture, organization and people and found also the main disadvantage in integration and communication issues between R and D. Anyhow, the integration/separation of R&D is still a contemporary management issue, in particular referring to the different countries cultures, approaches and policies (Jain and Rivers, 2000; Whatmore, 2002), the globalization and the internationalization (e.g. Gassmann and von Zedtwitz, 1999; Chiesa, 2000; von Zedtwitz and Gassmann, 2002; von Zedtwitz *et al.*, 2004; van Ark *et al.*, 2008) and the integration with other functions as strategy, as manufacturing (e.g. Cagliano *et al.*, 2000; Mariani, 2002) or as marketing (e.g. Griffin and Hauser, 1996; Becker and Lillemark, 2006), so much that the different performance measurement system for R and for D has been underlined and studied too (Chiesa and Frattini, 2007 and 2009). As the Eurotech case shows, the separation of Research and Development can be useful in a situation with an external context of rapid obsolescence of knowledge due to the accelerated changes of the PEEST environment in the specific industry, with an internal strategy of strong attention to future possibilities and with a need of balance between sustaining and disruptive/radical innovation. In this line, the foresight can be linked to the concepts of *ambidextrous organization*, in a temporal (Tuschman and O'Reilly, 1996), structural (O'Reilly and Tuschman, 2004) or contextual (Gibson and Birkinshaw, 2004) level.

The study highlights how the attention to innovation and to the market of tomorrow can be linked to a special R&D organization and strategy configuration and supporting processes. Furthermore, in Tab. 7 we can see the differences among F, R and D in Eurotech.

Finally, the Foresight Unit finds itself linked to Research, to feed it, but key links are also with Strategy, for the decision-making about the directions aligned to trends, and with Marketing, to investigate also the customers of tomorrow's needs. Fig. 8 shows schematically the main interactions among CF unit and other functions: while the strategy can be found in the middle between the market of today and the market of tomorrow perspectives, R&D can be linked to strategy; but then, as we have discussed above, R is much more on the tomorrow perspective and D vice versa, so we can theoretically divide them (and as we saw in the case

study, some companies practice the R&D separation); the marketing function can be more be found in the right part of the scheme, because it is more connected to the investigation of the present and future "customers of today" 's needs.

5. Conclusions

In this paper, we propose a case study that explores how Eurotech organizes its R&D function with the aim to look deeper to the future, explains the implementation of the R&D separation, highlights the activation of a Foresight Unit (with the main aims of driving the vision, orientating the decision making and nurturing the research activities) and discusses the organization and management of supporting processes and tools for a future-oriented R&D and strategy.

In many cases, as the Eurotech one, it is opportune to separate Research and Development in order to concentrate not only on the market of today and to foster foresight activities. There are in fact some contexts where the divergence of R and D, as regards different focuses (market and technology respectively) and temporal orientations (market of today and market of tomorrow), is even stronger, e.g. high-tech or pharmaceutical industries. Moreover, CF could have a deep strategic value in driving tomorrow innovations. In particular, it can be seen as a function strongly linked to the Research one: foresight is focused on a long temporal horizon, and can feed the research by anticipating trends and giving new ideas of business. In fact, CF allows a visionary company to activate systematic processes of exploration, of sensemaking and monitoring of the key trends that can potentially have an impact on business.

The present work underlined the potentiality of the logics of anticipation of weak signals and trends from internal and external sources. The findings have implications in both academic and managerial fields. From an academic point of view, the work represents a value in terms of the conversation on R integration/separation because it can be an answer to the R and D separation dilemma from the point of view of a future-oriented strategy; in terms of future-oriented strategy conversation, because it is a first tentative to build an integrated framework that helps understanding how the foresight activities can be useful for strategy and disruptive/radical innovation, how they relate to R&D and how they can be a support for Research. Moreover, it gives actionability of the foresight activities: it lets understand how to put into practice and to operate them, with a description of its implementation and of the most advanced practices to support it, in order to achieve an organization for future-oriented strategy and innovation.

From a practitioners' point of view, it is a basis for managers who would like to understand how to structure the "innovation engine" in order to give attention to the market of tomorrow and how to implement CF in their enterprises. It can guide them in this process thanks to the suggestions on the core and support levels.

Further work in this direction is surely needed. The research can be extended first through a multiple case analysis in order to increase the research panel, to permit

comparison and cross-analysis, and to further detail and complete the proposed framework. Then a survey research is needed in order to investigate the causal relationship between the uncertainty and complexity of the context and the R&D organization and the potential correlations among the four CF organization levels.

Decoupling the R&D, adding features of foresight to the organization, even building an organizational system to

support these strategic decisions, could have a deep strategic value in driving tomorrow innovations and in guiding companies investigating and preparing for a complex and uncertain future. In fact, *in a context of future-oriented strategy, Research, having failed its wedding with Development, can find a new partner for a strategic wedding in Foresight.*

Table 7. Main differences among Foresight, Research and Development

		ORGANIZATIONAL UNITS		
		DEVELOPMENT	RESEARCH	FORESIGHT
GENERAL CHARACTERISTICS	MISSION	Development	Discovery	Anticipation
	FOCUS	Products	Technology applications	Trends
	DRIVER	Market evolution	Technology evolution	Politics, economics, society and technology evolution
	TEMPORAL HORIZON	Short term	Mid term	Long term
	PERFORMANCES	Efficiency and speed: bring a new product into the market efficiently and speedily	Effectiveness: discover something new	Effectiveness: investigate and understand trends
	END RESULTS	Plannable	Unpredictable	Unpredictable
ORGANIZATION	ACTORS	Developers	Scientists (specialists in a certain area) and technologists	Scientists, technologists, sociologists, scientists in politics and economics... (experts in one of the PEEST)
	ACTIVITY FORMALIZATION	High	Low	Very low
	INTERNAL LINKS WITH OTHER FUNCTIONS	Strong integration with marketing, links with research, production and strategy	Strong integration with foresight, links with strategy and development	Strong integration with research and strategy, links with marketing
	EXTERNAL LINKS AND COOPERATION	Potential external links with external development centres	Links with external technical centres of excellence, with research centres and universities	Many links with technology intelligence centres, sociological scanning centres, with research centres and universities

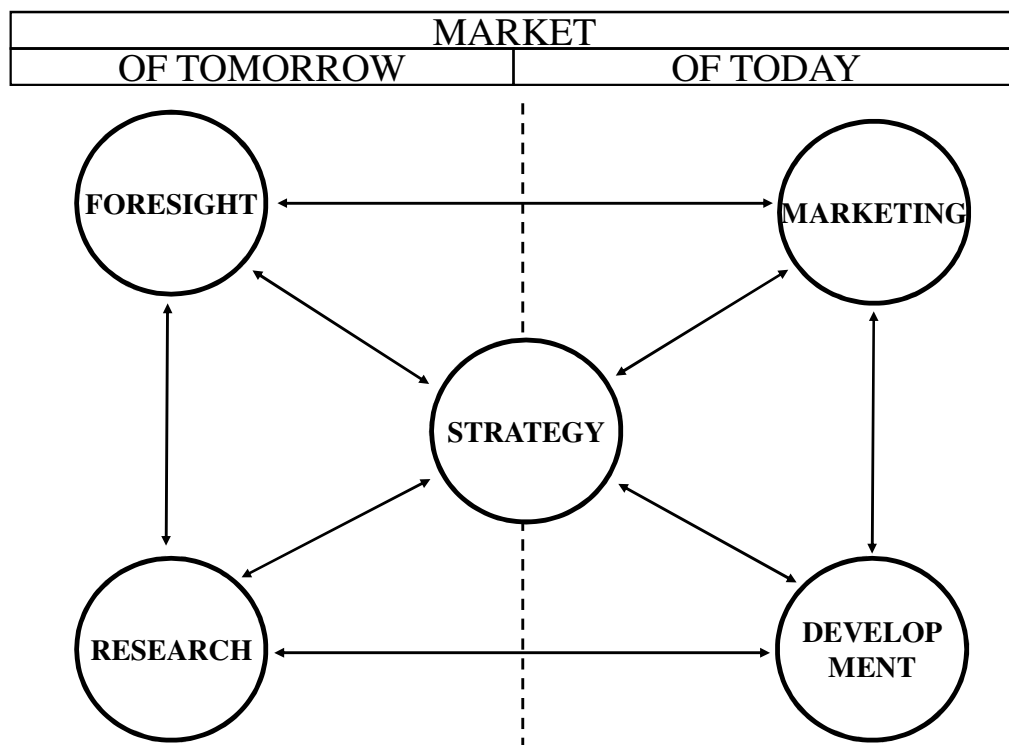


Figure 8. Interactions among Foresight unit with other functions

6. Appendix: Research sources and protocol

Company documents. Copies of company documents on R&D organization and strategy, websites and other official documents were investigated. Also the company press review was considered. They were coded according to the areas of the analytic protocol proposed below.

Interviews. The case study was conducted in 24 face-to-face interviews with key informants: they were direct semi-structured interviews with company employees, in order for them to narrate stories and state opinions and for us to gain multiple perspectives and to investigate the whole organizational network and foresight system. First, interviews were conducted with the most important foresight actors of the company, who helped in giving an overview on foresight activities, then thanks to these interviews we selected other interviewees for more focused perspectives (see

Tab. 8 for details). As convergence of opinions from multiple researchers enhances precision in findings and different insights add richness to data (Eisenhardt, 1989), each of the two investigators were present in every interview. To assure the coherence and the consistency, a standard interview protocol was developed to be checked and to guide the interview, also if the initial interview guidelines were updated and enhanced over time, integrating and building upon the results of interviews already analyzed. The guidelines were constituted of three main sections:

1. description of the business model and of the innovation strategy;
2. description of the R&D organization (i.e. R and D separation; their characteristics, organizational models, etc.), in particular internal configuration, network, actors, integration mechanisms;
3. description of the managerial and organizational supporting activities (i.e. foresight activities).

Table 8. List of interviews, including position, number of interviews to the same interviewee, duration of each one and focus (the person's contribution in the context of the case study)

#	POSITION	N	D	INTERVIEW TOPIC
1	Founder and CEO (and foresight unit member)	3	187m	Overview on foresight activities
			152m	Reasons for peculiar choices of organizational structure
			211m	Results: how foresight is translated in strategic and innovation choices
2	CTO (and foresight unit member)	3	134m	Overview on foresight activities
			89m	Knowledge flows among functions
			65m	Functioning of Research function and its links with Strategy, Foresight and Development
3	Strategy manager (and foresight unit member)	4	152m	Overview on foresight activities
			141m	Organizational structure and management practices
			78m	Knowledge flows among functions
			180m	Results: how foresight is translated in strategic and innovation choices
4	Scientific committee member 1	3	92m	Overview on foresight activities
			100m	Description of scientific committee activities
			125m	Description of identified trends and relation with strategy and innovation
5	Marketing manager	2	58m	Functioning of Marketing function and its links with Foresight
			41m	Managerial practices for foresight
6	Strategy employee	2	108m	Functioning of Strategy function and its links with Foresight
			70m	Managerial practices for foresight
7	Researcher	2	110m	Functioning of Research function and its links with Foresight and Development ones
			167m	Products and innovation
8	Development employee	2	67m	Functioning of Development function and its links with Foresight, Research and Marketing
			130m	Products and innovation
9	Scientific committee member 2	2	82m	Description of scientific committee activities
			100m	Description of identified trends and relation with strategy and innovation
10	Scientific committee member 3	2	82m	Description of scientific committee activities
			91m	Description of identified trends and relation with strategy and innovation

To guide these sections, we rely on the organizational variables and managerial approaches of Mintzberg (1989).

Panel Delphi and direct observation. The researchers had the possibility to directly observe the foresight activities, the R&D organization and (one of the two) to participate to the scientific committee as observer. For example, they participated in a panel Delphi when the uncertainty and complexity of the context or the alignment of the vision and of the strategy with future trends were evaluated by a wide panel of experts (CEO,

CTO, board members and company stakeholders). Often, informal discussion takes place on future trends and activities, giving the researchers a feeling for what "really happens" in the company, and being immersed in the activities helped to better interpret documents and understand the issues raised in the interviews.

Case analysis were conducted following the recommendations of Eisenhardt (1989), McCutcheon and Meredith (1993), Miles and Huberman (1994) and Yin (2003). Moreover, given the qualitative nature of the study, to perform it in a rigorous way, the two

researchers autonomously (basing on documents, interviews and observation) evaluate the case and wrote their comments, and subsequently they shared their opinions to obtain a convergent assessment. Gaps and conflicts were resolved by further reviewing the transcripts and by consultation with the interviewees. Finally, informants reviewed and confirmed the case results to ensure the investigators' comprehension is correct. Such feedbacks from informants are essential to prevent observer bias (Lincoln and Guba, 1985) and in establishing the credibility of an interpretation (Wallendorf and Belk, 1989).

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