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A methodology of technological foresight: A proposal and field study

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ABSTRACT

The study of one's own business future is a distinctive element of a business strategy. Innovative companies are aware of weak signals coming from the periphery and of trends in their industry, and they monitor the coherence between weak signals and trends (the external perspective) and strategic direction (the internal perspective).
The literature today does not provide well-framed and complete methodologies for assessing the coherence among trends, vision and products. Therefore, the authors propose a methodology called "the methodology of future coverage", which measures how much the strategy oriented to the future effectively covers trends and megatrends. In other words, it helps to check the contents and the coherence of the firm' vision and products and those of the trends that will have relevance for the future of the industry, and this process supplies firms with supplementary information on how to improve. The authors tested this methodology and exemplified its use via the Eurotech case study, employing longitudinal analysis.
The methodology can be useful as a tool for diagnosing the coherence between trends and company strategy. Moreover, from a dynamic point of view, it can be used as a tool to check on the company's progress in following up on trends by adapting its strategy over time. Finally, the methodology can be also used as a tool for cross-comparison of the "level of future orientation" among companies in the same industry.

1. Introduction

Literature widely recognises *future studies* as a fundamental element of every strategy [1]. In its vision of economic trends, since the 1980s, it [e.g. 2] has highlighted the relevance of forecasting, but this point is equally true for technological trends (innovation, technology transfer, new products and applications, etc.), cultural and sociological trends (demographic changes, the evolution of consumer tastes, etc.), and political trends (the evolution of norms and regulations, etc.), as underlined by many scholars, among them Porter [3]. Porter highlights that the aim of the strategy is the acquisition and maintenance of competitive advantage in the company's sector, defined as extended competition. This is then *a problem of understanding and developing scenarios for handling industry competition*. Moreover, trends and weak signals detection becomes even more of strategic importance in a context of turbulence [4]. In fact, searching for new opportunities, the innovation-oriented companies need not only to analyse past mistakes or comprehend the "market of today", but also detect the possible scenarios involved in the "market of tomorrow". *This implies the importance to scan the periphery* [5], *to catch weak signals, monitor trends and subsequently analyse the firm's present and potential future paths.*

Given the importance of foresight and forecasts, the problem is now their integration into the choices and decisions of the company [6]. Every company faces the challenge of adapting to its environment and thereby either surviving or failing [7]. The aims of the company system change in response to external environmental factors and internal development factors. An organisation is in fact a complex adaptive system that works depending on expectations and modifies its behaviour as a consequence of learning from its environment, from competitors' behaviour, from the evolution of the industry, etc. *Strategic fit*

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(also called alignment, coherence, harmony) is crucial to a firm's ability to change and adapt to the context. Organisations constantly seek ways to develop both internal strategic fit [8,9] and external strategic fit [7,10,11]. Many scholars underline that an obsession with short-term profits can theoretically generate an excess of attention inside the company and difficulty taking the evolution of the external environment into account and incorporating it into corporate strategy [12]. The strategic management literature has continuously emphasised this necessity to take into account the possible future evolution of the environment during strategic processes and the resulting need for environmental scanning [13,14]. This is a problem of understanding and developing scenarios [3,15–19], which is also related to decision making [20].

Nevertheless there is still a lack of real integration of the foresight process into the particular strategy and a need for a better linkage of information gathering and taking action in future studies [21–24]. Therefore, the main challenges are *to understand in what way trends can have an influence on the company itself, to update and revise strategies for facing uncertainty and to find methods to be more prepared and as ready as possible for changes and for future opportunities*.

The discipline known as *Corporate Foresight* (CF) pertains to the study of these weak signals, of discontinuities between the various PEEST (political, economic ecological, sociological and technological) contexts and of the emerging markets as intended to encourage understanding of future strategy and innovation policies [5,25–28]. The development of forecasts, trends, scenarios, and other forms of analysis about the future requires the study of a complex interplay of different factors. A variety of tools and methodologies have been developed with wide applications both in governmental policy-making and in corporate strategising. For companies in particular, foresight is becoming important in dealing with uncertainty from a dynamic perspective. In our opinion, foresight has a double aim in the company: to feed innovation and research and to strategically guide decision-making and planning [27,29–34]. Preliminary conclusions suggest that methods of using foresight are relevant to corporate strategy; however, their availability and implementation should be systematised and adapted to the particular needs and capabilities of the company in question [35].

Specifically, companies need to develop methods for assessing the "strategic fit with the future", in other words have processes in place for monitoring the coherence and alignment between strategic direction (the internal perspective) and weak signals and trends (the external perspective). In a future studies logic, the literature does not provide us with precise and complete methodologies for how to control this coherence among trends, vision and products. The authors will therefore propose a methodology called the *"methodology of future coverage"*, which measures to what degree strategy is effectively aligned with trends and megatrends. The methodology will be tested using the Eurotech case study via a longitudinal analysis. This methodology is useful because it helps one to verify the contents and the coherence of the vision and the company products and of the trends that will be pertinent in the future and eventually supplies supplementary information to improve them.

After indicating the theoretical background and the research gaps (Section ***2***) and the research methodology (Section ***3***), the paper describes the proposed methodology of future coverage (Section ***4***), which is then tested in a case study (Section **5**); then, finally, we conclude with managerial and academic indications and possible future research developments (Section ***6***).

2. Theoretical background

2.1. Tools and methodologies for addressing the future

The literature offers different papers that review the different methodologies that have been developed in the last 50–60 years in the fields of future studies, foresight, forecasting, strategy for the future, etc. Although there is no standard classification of these methods, they are in general based on four trade-off: top-down versus bottom-up, explorative versus normative, quantitative versus qualitative, and expert-based versus assumption-based [36]. Popper [37] suggests an alternative classification called the "foresight diamond" based on the method's capability (the ability to gather and process information): evidence, expertise, interaction and creativity. Some reviews [38–40] classify the approaches and methods as following a common framework; others [41–48] are more focused on a particular area of future studies, and still others [49] focus more on the practitioners. Finally, there are reviews that highlight the level of use of the foresight methods [50,51].

The literature also presents advancements in traditional techniques: for example, improvements to and alternative means of scenario construction [52] with the Delphi method [53], Trend Impact Analysis [54], dynamic forecasting models [55], the "three horizons" method [56], cross-impact analysis [57], etc. There are also new approaches: for example: the abduction-based method [58], variation analysis [59], war-gaming [60], the application of TRIZ to technology forecasting [61], the quick technology intelligence process (QTIP) [62], the scenario-based assessment model (SBAM) [63], Comprehensive Situation Mapping (CSM) [64], etc.

Although resourceful, most of these recent developments aim to diversify the strategic toolbox but not to integrate the foresight process into the particular managerial strategy. In this sense, a Delphi study [65] suggests how future studies will become more important in corporations and underlines how implementation remains a major concern.

2.2. Need to link foresight and strategy

Strategic management scholars have historically emphasised the focus of strategy on the future [66–69]. Already in the 1960s, Ansoff in Corporate Strategy [15] was describing the decisional flux that helps in managing a company in a context of turbulence and environmental discontinuity (like the American one during that time). For Andrews [16], a basis for economic strategy was the identification of trends, whereas Grant [15], in the resource-based view, underlined the importance of understanding future potentialities. More recently, D'Aveni [18], in his hyper-competition model, has highlighted the need to be ready for the future and quick to adapt to changes, while for Stacey [19], the future is an open system, and the system has to be conducted away from the

equilibrium, where it can change and be truly innovative. Also, Campbell [70] proposes the Ashridge model to create a sense of mission, while Hax and Wilde [71] propose the Delta model for adaptive management in a changing world. The literature underlines this necessity to take into account the future evolution of the environment during processes of strategic analysis. Also foresight literature supports these point of views. Reger [21] claims that the generation of technology foresight needs to be broadly based on the integration of indicator-based concepts into the strategic management of firms. Also, Chermack [72] and Postma and Liebl [73] emphasise the need to develop new means of improving and using scenario techniques and foresight tools as part of a method of making strategic decisions. One proposal comes from Mendosa et al. [74], who claim the need for reliable action guidelines that can be used by organisations in turbulent environments and propose a system for managing wildcards. Van der Steen et al. [24] underline the important gap between future studies and management: the practice in companies is that knowledge regarding the future is hardly used, and most studies of the future are not used by managers and strategists and do not influence the direction of organisational development. The field needs to set aside some of its methodological claims and move towards the field of strategic management. The idea is to connect future studies to management processes and organisational development by means of an intelligent process: the design and professional balancing of several key dilemmas (for example, winning support or urgency, openness of end-results or pre-defined focus, etc.).

Summarising, there is *a need to integrate decision-making into management and strategy* [e.g., 75] *and regard it as a core activity for corporate strategy formulation, and to find tools and methodologies specific for this kind of problem*. All companies define visions for guiding their strategies and produce products (as well as hypothesise about future ones) in their research labs. However, what happens if the vision and the products are not coherent with the future?

Many scholars highlight the importance of the theme from an historical point of view. From the point of view of strategy, for example, they underline the importance of analysing trends [76] and of developing coherence between them and strategic direction [77]. From the marketing point of view, they suggest that marketing itself refers to the understanding of which product typologies the company can manufacture based on the market analysis of actual and potential customers. However, despite this concept as expressed from a theoretical point of view, the indications regarding how to proceed on a practical level remain narrow. The literature proposes, in fact, procedures for the analysis of the scenarios' internal coherence [78] or for verifying the consistence of firm vision [79], but there are no provisions for a complete methodology that addresses the relationship of the company's strategic direction (vision and products) to trends and megatrends in the industry to which the organisation belongs. In other words, the literature does not provide structured and complete methodologies for determining the innovation level of a company or indicate how to verify the alignment between trends and strategy. To address this gap, the authors propose a methodology called the *methodology of future coverage* to analyse the content and coherence of the vision and of products with relevance for the future, thus ultimately supplying supplementary information on how to improve them.

3. Research questions and research methodology

The turbulent environment requires companies to conduct 360° scans of their environment and prepare for an uncertain future, searching forms and methods to anticipate it [80]. It is thus important that companies establish monitoring processes for key trends that can potentially impact their businesses. The present work is meant to help widen the knowledge basis on management and anticipation and propose a methodology based on foresight. This paper attempts to answer to the following research questions:

- *Is it possible to understand if your own business strategy is oriented in the same direction as trends?*
- *How is it possible to measure the coherence among trends, vision and products?*

3.1. Company selection

The company chosen for the case study operates in the ICT industry and is named Eurotech. The motivations for this choice are manifold:

- Eurotech prioritises innovation and R&D strongly. In fact, it defines itself as an “idea factory”: production is outsourced so that the company can concentrate on Research and Development (40% of investment, and 31% of the employees are working in Research (1.6%) and Development (29.4%));
- The authors selected this company from a list of companies that display a very innovative character, a peculiar organisational model for innovation and a foresight-driven perspective on R&D and strategy;
- This foresight-driven strategy (in other words, a strategy strongly oriented towards future trends) is connected to some acquisition choices, which have expanded rapidly[1];
- The commitment of CEO Roberto Siagri and of the senior management to the spread of innovation and CF culture is great.

Therefore, we expected the results of the test to mirror this attitude of the company regarding innovation and the future.

[1] This is a story of acceleration including the phases of incubation (1992–2000), private equity and acquisitions (2000–2005) and publicly listed companies and acquisitions (2005–now), the last two when the revenues greatly increased: 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).

3.2. Research methodology

The research methodology includes an analysis of literature on Corporate Foresight, Innovation Management and Strategic Management, from whence the theoretical proposal of the *methodology of future coverage* was born and tested in the case study. This analysis of the literature highlighted the limited body of knowledge on the theme and its novelty. Because there has been limited previous research on the themes connected to implementation, they must still be explored deeply, considering also the complex system of variables that characterise the observed phenomenon. The case study design is opportune for presenting a relevant overview of the relevance and applicability of the methodology. The single case study is particularly appropriate for completely new and explorative investigations [81–83]. *The object of the case study is the test of the proposed methodology of future coverage*. As described by Yin [84], the case study research design can be used to describe an intervention and its context. Some authors refer to this as a "field experiment". In the test in this study, the intervention is the application of the proposed methodology, and the context is the trends and megatrends in the ICT industry (with a particular focus on man–computer interaction) and the company studied (its vision and products).

Therefore, the case study process has been divided into two main steps:

1. Gathering the data using a structured exploratory study: the investigation of the external environment (trends) and internal environment (vision and products);
2. Testing the proposed method of future coverage: the methodology has been tested within the context of a company to verify its operative feasibility.

3.2.1. Data gathering

The study was carefully designed to ensure high quality and sufficient rigour. To maximise its validity and reliability [84,85], multiple sources of data were used. This enabled us to collect a large amount of information and data and use many different information sources. In this process, we had the double aim of increasing the information base and diversifying it, triangulating our information. The main information sources on the external environment were academic literature and industry reports as well as interviews and panels with stakeholders and experts. For information on the internal environment, we turned to documents, interviews and, predominantly, Delphi panels. More detail is given below:

3.2.1.1. Literature and industry reports

3.2.1.2. Company documents. Copies of company documents on strategy, vision and products were investigated, as were websites and other official documents. The company press reviews were also considered. They were coded according to the areas of the analytic protocol proposed below.

3.2.1.3. Interviews. The case study was conducted using fifteen interviews with experts and stakeholders and twelve interviews with key informants of the company. The first interviews were direct interviews with experts and stakeholders intended to investigate both the external environment and the internal one (for example, the perspective of customers about the products). The second set of interviews were direct interviews with four key foresight actors in the company (the CEO, CTO (and responsible of Research), a strategy manager and a scientific committee member) intended to provide multiple perspectives on and to mainly investigate the company strategy expressed in vision and products. The interviews followed a semi-structured protocol addressing three main issues:

- Trends: The emphasis was trends and megatrends in the ICT sector, with a particular focus on man–computer interaction. We therefore asked about macro-environment forces in the ICT sector, specific trends and megatrends, other general trends and megatrends that can have an influence; uncertainties, weak signals, and patterns of evolution coming from other sectors (cross-fertilisation);
- Vision: A short statement of the vision, an explanation of the vision, a note about where the company would like to be in 5/10 years and where the company (concretely) sees itself in 5/10 years, information on its values, and a description of the firm's patterns of evolution;
- Products: The main product families, the main technical characteristics of the products, and the main meanings of the products.

3.2.1.4. Delphi panel. Based on the case study, some quantitative results emerge (on a scale from 0 to 3) regarding, the alignment of the vision and strategy with future trends. These scores have been chosen by a wide-ranging panel of experts using Delphi analysis. The experts were the CEO, the CTO, three board members, five company stakeholders (three customers and a politician working on the economic development of the region, and the president of the institution working on developing the mountain area) and ten external experts (two professors and researchers in the information sector, two professors and researchers in electronics, two professors and researchers in biology, two sociologists, a professor of economics, and a journalist specialised in the ICT industry).

4. The proposed methodology of future coverage

The strategic management literature highlights that it is opportune that companies understand in which direction they are moving with respect to trends and megatrends in their industry [86]. Because the literature has not supplied companies with a

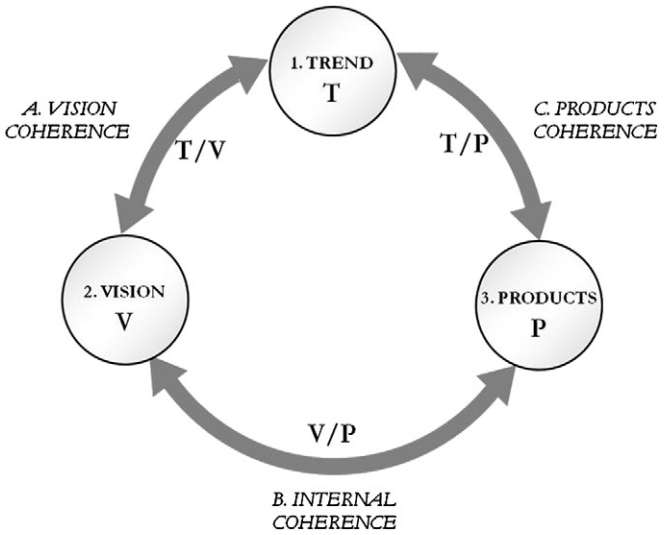

Fig. 1. The framework at the base of the proposed methodology of future coverage.

complete methodology for analysing business orientation, we propose the methodology of future coverage, which suggests the steps that firms can take to understand if their strategic direction is coherent with the trends. The proposed methodology is based on the use of foresight and aims to analyse the coherence between the external environment (trends) and the internal environment (vision and products). Corporate Foresight supports this analysis because it permits one to identify external trends and therefore to proceed in comparing vision and products. In this way, the company can understand if what is happening on a macro level (PEEST) and with competitors and customers is aligned with the internal firm environment on the level of both culture and vision and as related to research and past, present and future products.

Fig. 1 schematically highlights the framework that is the basis of the proposed methodology. Having identified scenarios and trends using Corporate Foresight techniques, it continues with a preliminary analysis of the external and the internal dynamics of the company: these trends are compared with the vision to see if they are moving in the same direction, or in other words, to ensure that the future orientation of the company is coherent with trends. The second step is another analysis (this time a completely internal one): it is the "coverage analysis" of the products in the vision. It determines if the products are consistent with the trajectory intended by the company, or in other words, if the products manufactured today and the products intended to be produced in the future exemplify the future directions that the company has planned for itself as expressed by the vision. Finally, the last analysis is the "coverage analysis" of the products in the trends. This one considers to what degree the company products are aligned with the future of the industry. Therefore, the outputs are three measures: one indicating the external alignment of the vision with current trends, one showing the internal alignment between vision and products, and finally, one indicating the external alignment between trends and products.

The proposed methodology for interpreting company strategy through the lens of Corporate Foresight includes two macro-phases:

1. A characteristics analysis;
2. A coherence analysis.

The *characteristics analysis* investigates the individual factors – trends/megatrends, vision and products (T, V and P, respectively) – and identifies their main characteristics. The *coherence analysis* compares the factors T, V and P, crossing them two by two, thus conducting a trends–vision (T/V), vision–products (V/P) and trends–products (T/P) analysis.

Fig. 1 shows the two macro-phases, the three factors (T, V, P) analysed in the first macro-phase and the three comparisons (T/V, V/P, T/P) in the second macro-phase, while Table 1 highlights the two macro-phases and the six phases of the trends/vision/products coverage analysis.

The proposed methodology uses CF to analyse company strategy, concretised as part of the company vision and products, to determine its level of coherence with industry trends. The analysis indicates the coverage indexes: just as the index inventory/sales,[2] also called the index of "storage coverage", measures to what degree the inventory addresses market demand, the indexes of future coverage indicate to what degree the vision addresses the trends, to what degree the products reflect the vision and to what degree the products reflect the trends.

[2] It is 1/inventory turnover where the inventory turnover expresses how many times a company's inventory is sold and replaced over a period and 1/inventory turnover expresses the period of time that it takes to sell the inventory on hand (in other words, the period of time "covered" by the inventory on hand).

Table 1
Macro-phases and phases of the methodology of future coverage.

Methodology of future coverage	Macrophases	Phases			Output
	Explication of the characteristics of the variables t, v, p	1	Explication of trends	T	Table 1
		2	Explication of vision characteristics	V	Table 2
		3	Explication of products characteristics	P	Table 3
	Analysis of the coherence of the variables t, v, p	A	Analysis of trends/vision coherence	T/V	Matrix A
		B	Analysis of vision/products coherence	V/P	Matrix B
		C	Analysis of trends/products coherence	T/P	Matrix C

4.1. Analysis of trends, vision and product characteristics

The characteristics analysis scrutinises the external and internal environments: the industry trends and scenarios are studied via Corporate Foresight (to consider the external environment), while at the same time, the vision and past, present and future products are also analysed (to evaluate the internal environment). Schematically, this macro-phase is based on the analysis of three factors:

1. The analysis of trend characteristics (T);
2. The analysis of vision characteristics (V);
3. The analysis of product characteristics (P).

For each of these analyses, it is necessary to consider the main principles and characteristics at play, which will then be compared with the principles and characteristics of the other factors.

4.1.1. Analysis of trend characteristics (T)

The megatrends analysis is an analysis of the external context of the company: in other words, the possible developments in scenarios within the industry of reference [87]. The trends analysis depends on the main reference industry and aims not only to investigate the state of the art technologically speaking (new technologies, international areas and competence centres that develop technology, interdependences among industries and different technologies, etc.) but also the overall PEEST environment in which the company finds itself. From a first perspective, the methodology follows Porter [3]'s suggestion that the basic focus of the analysis be the competition in and the uncertainties of the system inside the specific industry. It tries then to favour the identification of weak signals and trends in other industries using experts from different industries (and not always ones that are similar to that of the company) to permit a profitable exchange of ideas and better identification of the scenarios based on a diversity of sources and techniques.[3] We also invited the experts to highlight possibilities coming from weak signals or so-called "fat tails" (or wildcards).

The identification of the trend characteristics occurs in different ways:

- Through a literature analysis of the industry trends;
- Through the use of Corporate Foresight tools (Delphi analysis, technology road-mapping, brainstorming, etc.);
- Through the involvement of expert actors from different industries.

Moreover, cluster tools are used, and redundancies among variables are eliminated.

Normally, these investigations begin with meetings with experts and local operators to discuss the main themes of interest in the analysed sectors and to identify a list of keywords. In particular, research is conducted also into technical and scientific data stores using business intelligence techniques, and the results are classified using text mining and clustering tools. When the output of the research includes a considerable number of results, it is practically impossible to manually analyse individual pieces of information gathered. In these cases, it is necessary to utilise software dedicated to data analysis. This software permits the completely automatic clusterisation of and synthetic knowledge extraction from these sets of results, finding and quantifying in groups of documents (and also in graphical form) the information and correlations discovered, which are sometimes unexpected and of high informative value. These tools provide decision support on a high level and are used in many firm activities including research anywhere there are "mines of information" to explore and analyse. Finally, the clustering tools also permit a statistical analysis of the correlation among the variables to eliminate redundancies. In addition to being asked to define trends, the experts are often asked to evaluate the impact of specific trends on the sector, indicating them to be positive, negative or uncertain.

4.1.2. Analysis of vision characteristics (V)

The term vision is used within strategic analysis to indicate the projection of a future scenario which reflects ideals, values and aspirations of the goal-setters and which provides incentives for action. A statement about vision defines the desired future state of a company in terms of its direction and objectives. Scholars [e.g. 88,89] see the vision characterised by a long-term, future-oriented attribute. Vision, together with mission and objectives, is an important tool for any organisation. Actors act to create a well-

[3] For example, in the case study that we will see in Section **5**, different experts from informatics and electronics (related to the company industry) as well as from economics, sociology and biology were involved.

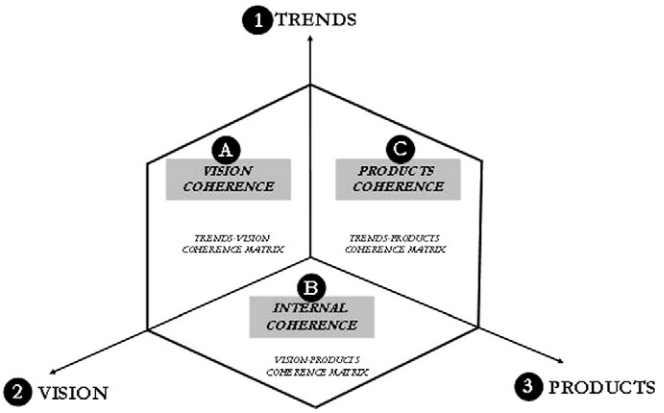

Fig. 2. The Cartesian planes of the coherence matrixes.

coordinated system and strain to reach a determined scenario for the future; vision is essential to establishing an identity, giving a route to follow, and pointing out a horizon, a pathway from the actual situation to a possible future one.

An effective vision, in fact, concerns what the organisation wants to be and provides direction through a series of indications connected to a wide-reaching sketch of a possible future. These few lines will indicate all of the distinctive competences that will allow the company to be different from others. A vision, therefore, represents the desired future state of the business.

As regards the proposed methodology, the analysis of vision characteristics is necessary to understand in what direction the company is moving and would like to move, or in other words, its idea of the future. The vision analysis not only considers the "spot" sentence that is contained in the term "vision" but also more widely investigates an enlarged vision: in other words, the whole vision of the future of the analysed company.

To analyse these characteristics, the help of key people in the company is required. The analysis of vision characteristics is conducted through different channels:

- Official company documents (websites and internal documents);
- Company press reviews;
- Interviews with the company stakeholders (CEO, CTO, CFO, etc.).

Also, clustering tools can be used to eliminate eventual redundancies among the variables in creating a vision.

4.1.3. Analysis of products characteristics (P)

Products are the practical and operative manifestation of the company vision. They are the present state of the company's operations. However, there are also the products in research labs, products around which hypotheses are based, products that will be the basis of the future operations of the company.

It is necessary that the firm's vision and products be aligned if it is to have internal coherence within the company: in other words, coherence between its objectives and vision of the future and what it is actually accomplishing. Thus, it is also necessary that the products be coherent with trends because this means that what the company operationally does moves it in the same direction as the trends.

Also, product analysis is conducted through different channels:

- Official company documents (websites and internal documents);
- Company press reviews;
- Interviews with company stakeholders (CEO, CTO, CFO, etc.);
- An analysis of the technical characteristics of products;
- An analysis of the functional characteristics of products;
- An analysis of the market for products.

Moreover, the analysis can be also conducted from a historical perspective to highlight the historical growth trajectory of the company.[4]

[4] For example, in the case study, we chose to analyse the embedded computers, the most innovative products (the wearable computer Zypad and the supercomputers ApeNEXT and Clù) and finally, the product that prepresented the future of the transportation sector (Vista).

4.2. Coherence analysis: trends, vision and products

The coherence analysis is a triple comparison of the characteristics of the three factors analysed in the first step: trends and vision, vision and products, and trends and products. Coherence is necessary both internally and externally. External coherence is necessary because it is opportune that the vision of the company moves in the same direction as industry trends. It is thus also opportune for products to be aligned with industry trends because this means that what the company does operationally is also moving in the "right direction" of trends. It is then opportune for a firm to enjoy internal coherence so that vision and products will be aligned; in other words, there should be coherence between the firm's own vision of the future and what is actually occurring on the ground.

This analysis is based on the experts' judgment and on the Delphi panel [90]: they expressed subjective judgments on the various intersections among the variables, expressing them both verbally and numerically using scales. The outputs of the coherence analysis are different comparison matrixes as in Fig. 2.

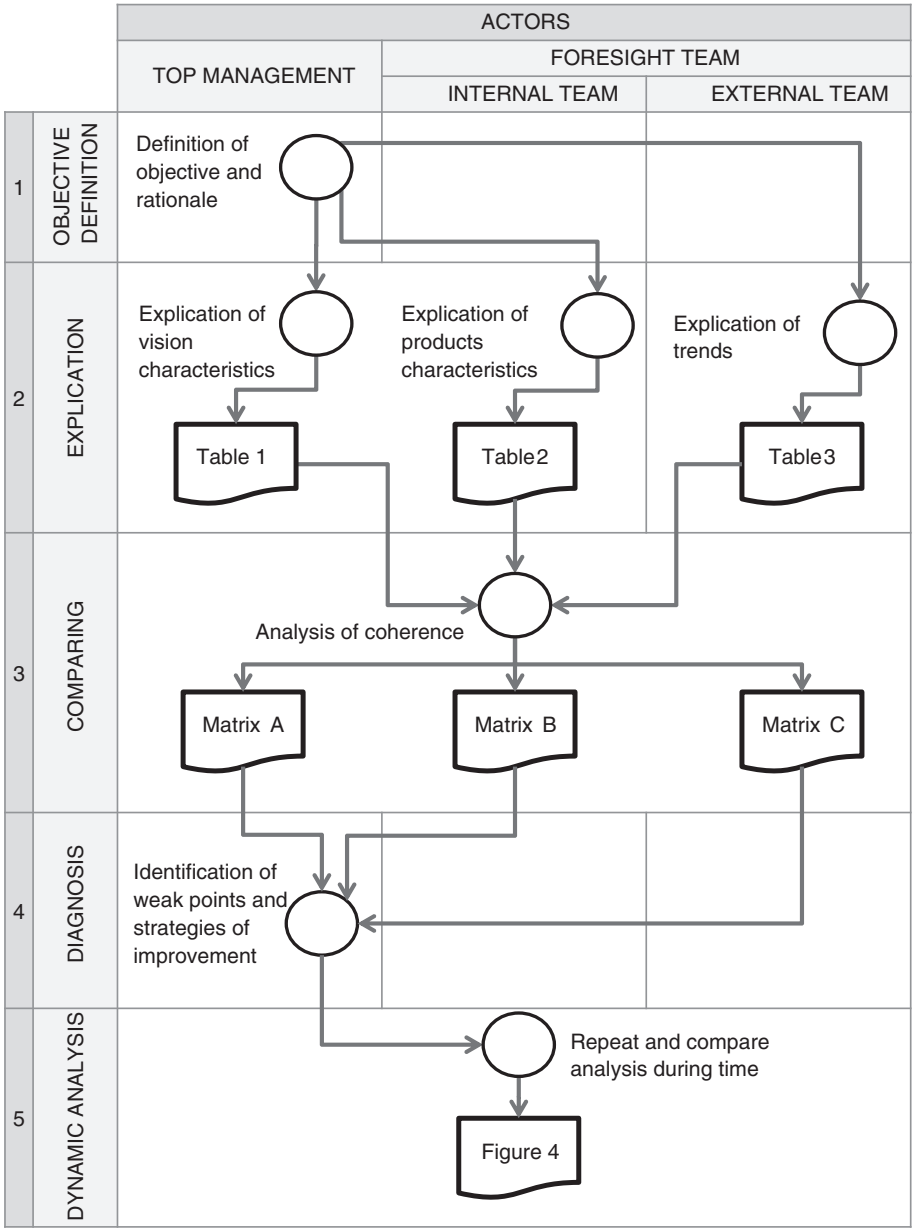

Fig. 3. Process flow of the methodology of future coverage.

Schematically, the T/V/P analysis is conducted using three comparisons:

A. Trends/vision (T/V) coherence analysis (vision coherence): This is an external–internal coherence analysis. The megatrend and trend characteristics are crossed with those of the vision to evaluate the coherence or lack of alignment between the vision and the trends and megatrends;
B. Vision/products (V/P) coherence analysis (internal coherence): This is an internal coherence analysis. The question to answer is, given a company vision, whether company products are coherent with what the vision declares. This analysis is developed from a temporal point of view: the main products existing in the company are analysed, as are the products from the past and future (e.g., those that have not been developed or commercialised yet but that are in the idea phase or have been developed in the form of prototypes);
C. Trends/products (T/P) coherence analysis (products coherence): This is an external–internal coherence analysis. For every product, the characteristics of the product are compared with the trend and megatrend characteristics so that it becomes possible to identify if there are similarities or not. Usually, the analysis considers past products, present products and the most innovative products or the ones that are still prototypes or that are in the research phase. This allows us to understand if the growth direction is aligned with the direction of the trends.

4.3. Process flow

Fig. 3 shows the process flow of the proposed methodology, where each step can be referred to other tables and figures of the paper. The methodology is based on five main steps:

1. *Definition of the objective*. In this first phase, the objective and the rationale are defined, and the team and the key informants are chosen. The interviewees are experts, dependents or stakeholders of the company or experts on the economic sector of reference. There are two separate groups of experts, although some persons can be in both groups. One group works on external analysis (trends), and another works on internal analysis (vision and products). The criteria for choosing the specialists for the external group are that they be able to provide detailed information about actors and dynamics of the sector and that they come from different areas of the PEEST; for the internal group, the criteria are that they be able to provide information about the company and have different perspectives (i.e., they must come from different areas of the company or from different levels of the value chain — e.g., customers can be involved as well).
2. *Explication*. In this phase, the general information on external and internal environment is collected by means of literature and report analysis along with data mining, interviews and other foresight techniques. With regards to the external environment, the respondents are asked what they consider to be the trends and macro-environment forces in their economic sectors, the uncertainties and the weak signals that they see in the sector and in the periphery, and the possible patterns of evolution coming from other sectors/cross-fertilisation. With regards to the internal environment, the variables can be obtained from documents and from interviews with managers who participate to the strategic planning process and in R&D. The respondents are asked to explain the strategy of the company in terms of its vision and products.

   The respondents are then asked to explain and detail the trends at play in terms of the influence of the environment and to delineate the vision and products in terms of specific characteristics. In that way, every influence/force becomes a variable. The characteristics are aggregated based on similarity, with a single variable to be indicated by more than one respondent. They are also aggregated using instruments of data semantics and thematic coding [91,92]. The output of this phase is a list of characteristics of trends and main forces in the environment, a list of vision characteristics and a list of product characteristics. These trends can be grouped into megatrends based on similarities, supplying a list of trends and megatrends. These lists are verified by the experts a second time.
   In a second-round Delphi analysis, the first group of experts is asked to select and assess the key characteristics of the trends and the second group of experts to select and assess the key characteristics of the vision and products of the particular company. The selection and assessment are made based on the degree of influence and uncertainty of each variable. In this way, the variables with the highest degree of importance in terms of their power to influence the respective sector are chosen for the next stage of the method.

3. *Comparing*. In this phase, all of the experts are asked to evaluate the coherence between the different characteristics of the trends–vision, trends–products, and vision–products relationships. Here, a questionnaire can be used (where the experts are asked to give an evaluation of the three coherences on a scale from 0 to 3[5]; the final value is an average of the values), or there can be a face-to-face discussion among the experts, that finally provides a joint evaluation of the three forms of coherence. The rest of the methodology continues algorithmically with the calculation of average values and percentages. For a detailed overview of the meaning of each value, see Appendix A. Finally, the methodology of future coverage returns as final index an "index of future coverage", which indicates the coherence between T and V (and between T and P or V and P in the other coherence matrixes): in other words, how much the strategy for the future effectively "covers" the possible future.
4. *Diagnosis*. Once the quantitative results regarding the coverage of the future have been achieved, the sixth phase becomes their dissemination within the company and their utilisation to diagnose the alignment of the company strategy with future

[5] with 0 indicating no coherence at all, 1 indicating low coherence, 2 demonstrating a sufficient/middle level of coherence and 3 demonstrating a high level of coherence/perfect coherence.

scenarios. In this case, the methodology reveals weak points in the vision and products with reference to the trends, and the top management can use this information to support its decision-making.

5. *Dynamic analysis*. The analysis can be repeated over time to compare past results and identify a path for company growth that is in line with the trends.

5. The methodology of future coverage in the Eurotech case

The present section focuses on the application of the methodology to a case study in a company in the ICT industry that is organised and managed in a particular way with regard to foresight, Eurotech. Eurotech is an international company: its headquarters are located in Amaro (Udine, Italy), and it has 10 controlled companies worldwide (Italy, France, UK, Finland, USA, China and Japan). It opened in 1992 and was quoted in the stock market in 2005. Its 2008 revenue was 91.7 million euro, and it has shown continued growth (+19.9% from 2007). Its principal market is pervasive computation, which can be divided into markets for nano-PCs and HPCs (High Performance Computers).

In the case study, coverage was evaluated with respect to trends and vision, vision and products and trends and products, as schematised in Fig. 2.

The analysis was conducted from March 2007 to March 2008. The external environment analysis, that of megatrends and trends, was conducted in the same period as was the analysis of the company. The vision to which the case study refers is also from that period, and the analysed products have been chosen with a temporal criterion in mind: the analysed products are 1) embedded computers (considered to be "products of the past" in terms of innovation because they are those on which the company was founded in 1992 and in which it has done the most of its past business), 2) supercomputers (products in the HPC market), 3) wearable computers (the most innovative products by Eurotech in 2006 in the nano-PC market) and 4) integrated sensors (a product still in the research and prototyping phase that will enter the market in 2009–2010). Therefore, we can say that the past refers to 2000, the present to 2006 and the future to 2010.

5.1. Analysis of trends, vision and products characteristics

5.1.1. Analysis of trends characteristics (T)

The ICT sector is a particular dynamic and complex environment that transforms itself continuously due to the strong acceleration of technological change [93]. The exponential progress of digital technologies in terms of speed, miniaturisation and connection creates a different environment characterised by a strong uncertainty. The analysis of trends and megatrends highlights how, since the end of the 20th century, we have been experiencing a revolution based on the new digital information and communication technologies. In this sense, the evolution of man and that of computers are converging. This is called "biotechnological evolution". The trend in computers is towards miniaturisation, diffusion and integration into the environment (embeddedness) and so-called "invisibility", creating a new paradigm of ubiquitous computing (or pervasive computing). The trend from an anthropological point of view indicates our entrance into the era of the homo technologicus or homo zappiens, the symbiosis of man and technology. The computer is in fact integrated more and more with man: having transitioned from the personal computer on one's desk to the handheld computer (cellular phone, PDA), we see now that the computer is becoming wearable. In other words, it is becoming apparel, (wearable computer), and in the future, we may see it passing "inside" the man (see research on chips with medical applications).

Table 2 reports the theoretical proposal regarding trends and megatrends that will be used in the coherence analysis. The fifteen trends are been clustered into groups to determine the five megatrends of biotechnological co-evolution. The identification of trends and the choice of combining them into megatrends are both key phases for the results. This is needed to have both a perspective of analysis and detail and both a perspective of synthesis. For a detailed definition of each trend and megatrend, see Appendix B.

Table 2
Explication of trends of the Eurotech industry (T).

Megatrend		Trend	
M1	Acceleration of changes	T1	Acceleration
M2	Technology essentiality	T2	Essentiality
M3	Man–technology interaction	T3	Irreversibility
		T4	Conditioning
		T5	Man–technology transformation
M4	Augmented reality	T6	Expansion and contraction
		T7	Invisibility
		T8	Pervasivity
		T9	Augmented reality
		T10	Connectivity
		T11	Informationalism
		T12	Ipertestuality
M5	Symbiosis	T13	Technology–man transformation
		T14	Organic and inorganic integration
		T15	Convergence

5.1.2. Analysis of vision characteristics (V)

The foundational philosophy of Eurotech is connected with the principle of Mark Weiser [94], the father of ubiquitous computing: "The most important technologies are the ones that disappear, they wave themselves in the fabric of everyday life until they are undistinguishable from it". This is the company's vision and essentially explains that "*the pervasive presence of digital technologies will free our minds from trivial and repetitive tasks, giving us the time to address the essential challenges of humankind: to improve our knowledge of man and of the universe*". In this way, their CEO notes, "*As we enter the new millennium, the pervasiveness of digital technologies is defining a new scenario: the era of distributed information, widespread knowledge, and the digital economy. Human–machine interaction will become constant and more natural, even second nature*".

In the firm's opinion, invisibility can be achieved via the progressive diffusion of technologies and their integration with everyday life, their "assimilation" into everyday objects. The direction of the invisibility from a technical point of view encourages a revolution in ubiquitous computing: the miniaturisation and integration (the embeddedness) of the computers will create "smart dust", with computers becoming smaller and smaller until they become like grains of sand and with computing processing inside. From a conceptual point of view, however, they suggest that we are now entering the symbiotic era of the man–machine interaction. This means that biology and technology are progressively converging. Eurotech believes that computers will disappear; computers are becoming pervasive, and the characteristics that will distinguish them as such are as follows:

- Rapid internet connectivity at every moment;
- Available computation on demand through the GRID network;
- Embedded mini-computers: in the environment, in our clothes; in our bodies;
- Augmented reality.

Eurotech's aspirations are stated in the short phrase "digital technologies for a better world". Their mission is therefore to integrate state-of-the-art computation and communication technologies into miniaturised and user-friendly solutions to make our everyday lives better, safer and more comfortable.

In reality, Eurotech's vision is not limited to these aspects but has instead widened according to different images of future that the firm outlines as possible. They would like to study and develop cutting-edge technologies that can offer innovative solutions that anticipate market evolution and future scenarios. For example, Eurotech sees itself as continuing to be more and more at the "cutting edge of innovation", entering niche markets with high growth potential. As his CEO states, "*Eurotech's strategic direction is to define and penetrate new and emerging markets, breaking traditional barriers through innovation. With this vision in mind, Eurotech has focused its research and development on key high-growth sectors like pervasive computing, to create innovative, integrated solutions (including software, hardware, middleware and support services) that offer the flexibility and scalability needed to capture new market opportunities. This spirit of innovation and standard of excellence have, in a just a few years, made Eurotech a leader in the field of high technology for computer miniaturisation*".

The resulting characteristics of the Eurotech vision and the prolongation of this vision, based on top management and internal foresight team understanding, are indicated in Table 3.

5.1.3. Analysis of products characteristics (P)

The Eurotech market is that of pervasive computation: high-performance computers, embedded computers, network computers, wearable computers, and smart sensors. Pervasive computing includes smart devices (nano-PCs), infrastructures of digital communication and high-performance distributed computers (HPCs), and these together create the environment of pervasive computing. This infrastructure of digital communication is called GRID.

Eurotech Research and Development entails two opposing focuses: miniaturisation, with the study of sensors and small, wearable computers for the processing of information; and supercomputers, because it is necessary that there exist a central processor that controls and further develops all of the information derived from the sensors (supercomputers). The addressable markets for nano-PCs are mainly the defence, transport, medical and industrial sectors; for the HPCs, the principal customers are universities, research institutes and centres for computer science.

We chose to analyse the characteristics of only the relevant Eurotech products. The embedded PCs have been chosen as "products from the past" (those with which Eurotech began its business in 1992); as "products of the present", we chose the wearable computer Zypad to represent pervasive computing and the supercomputers Apenext and Clù to represent HPC; and as "products for the future", we chose the integrated sensor Vista.

In Table 4, we briefly schematise the description of the products considered.

Table 3
Explication of vision characteristics of the Eurotech (V).

Eurotech vision	
V1	Computing directions: supercomputer, pervasive
V2	Acceleration
V3	Network humanising technology
V4	Interconnection
V5	Informationalism
V6	Symbiotic era, homo zappiens

Table 4
Explication of products characteristics in Eurotech (P).

Eurotech product lines		Characteristics
P1	Embedded PC	• Miniaturised computers • Highly reliability for a use in critical environments • Integration of intelligence and connectivity functions
P2	Supercomputer (Apenext, Clu')	• Parallel machines, that give a calculation power of ten and more Teraflops • High computing power • Reduced energy consumption • Reduced occupied space • More accessible technology • Clù is a Personal Supercomputer
P3	Wearable computer (Zypad)	• PC that can be worn in the wrist • High computing power • "Hand free" principle • Constant connection on web
P4	Integrated sensor (Vista)	• Systems of vision, called "digital eyes": combination of computing resources and vision functions (System-on-chip) • Smart miniaturised videocamera able to analyze static or move objects • Applied to the rear-view mirrors of the cars, it can understand other vehicles coming near, and it can signal it to the driver with an acoustic signal (recalling attention and reducing the risk of incidents) • It can also be used as an auxiliary camera for the automatized drive

The visual evolution in the size and direction of Eurotech's products is qualitatively shown in Fig. 4, the embedded PC is referred to as "embedded-PC (PC/104)", the Zypad as "wearable PC", the supercomputers Apenext and Clù as "custom HPCs" and Vista as "sensor networks".

5.2. Coherence analysis of trends, vision and products

5.2.1. Trends/vision coherence analysis

Matrix A schematises the comparisons between trends and vision in the case study, indicating how the Eurotech vision reflects all of the technological trends and megatrends previously studied.

The analysis can be a useful tool to suggest to a company in which directions to move to be innovative and in line with trends. It shows which characteristics of the vision are less comprehensively mirrored in trends: in the Eurotech case, interconnection (52%) and informationalism (60%). It also shows which megatrends are less comprehensively reflected in the vision, like the megatrend of man–technology interaction (54%). We can therefore suggest that the firm should better monitor this megatrend and increase its influence on the vision.

As highlighted by the coverage index of 73%, Eurotech presents rather high levels of alignment between trends and vision and is therefore classifiable as a visionary and innovative company. The analysis of the trends and vision of Eurotech highlight the alignment of the company vision with industry trends and megatrends.

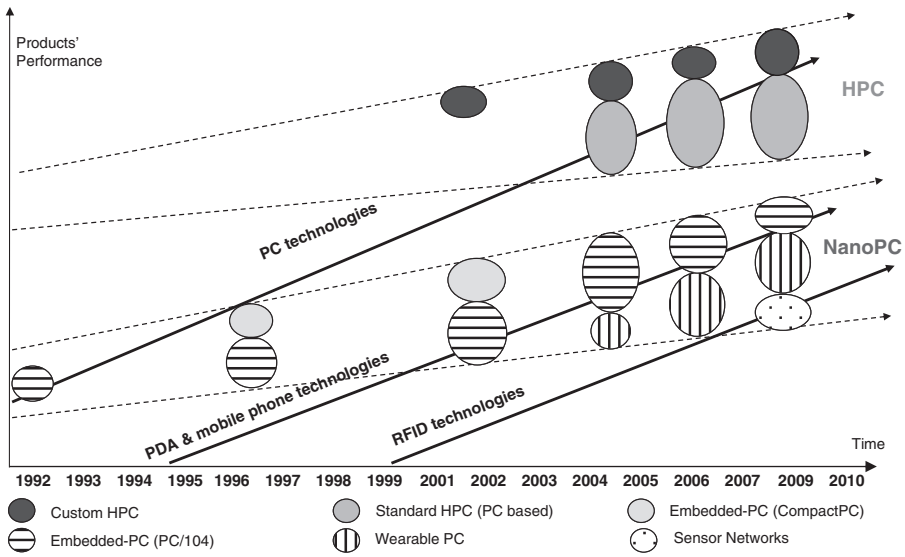

Fig. 4. The evolution of Eurotech's products [source: Eurotech internal documents].

Matrix A
Trends/vision coherence analysis (T/V).

Megatrends		Trends	Eurotech vision												
			V1		**V2**		**V3**		**V4**		**V5**		**V6**		
			Computing directions: supercomputer, pervasive		Acceleration		Network humanising technology		Interconnection		Informationalism		Symbiotic era, homo zappiens		Index
M1	Changes acceleration	Acceleration	3[b]	100%[a]	3	100%	2	67%	2	67%	2	67%	2	67%	78%[c]
M2	Technology essentiality	Essentiality	3	100%	3	100%	3	100%	1	33%	1	33%	3	100%	78%
M3	Man–technology interaction	Irreversibility	1	33%	2	78%	0	56%	0	22%	1	44%	2	89%	54%
		Conditioning	0		3		2		1		1		3		
		Man–technology transformation	2		2		3		1		2		3		
M4	Augmented reality	Expansion and contraction	3	100%	2	33%	2	86%	2	95%	2	90%	2	95%	83%
		Invisibility	3		0		2		3		3		3		
		Pervasivity	3		0		2		3		3		3		
		Augmented reality	3		2		3		3		2		3		
		Connectivity	3		1		3		3		3		3		
		Informationalism	3		1		3		3		3		3		
		Ipertestuality	3		1		3		3		3		3		
M5	Symbiosis	Technology–man transformation	2	67%	2	56%	3	89%	1	44%	2	67%	3	100%	70%
		Organic and inorganic integration	2		1		3		1		1		3		
		Convergence	2		2		2		2		3		3		
				80%[d]		73%		79%		52%		60%		90%	73%[e]

Matrix B
Analysis of vision/products coherence (V/P).

		Eurotech product lines								
		Past		Present					Future	
		P1	Index	**P2**		**P3**		Index	**P4**	Index
Eurotech vision		Pc embedded		Super computer		Wearable computer			Integrated sensor	
V1	Computing directions: supercomputer, pervasive	0	0%	3	100%	3	100%	100%	3	100%
V2	Acceleration	0	0%	2	67%	3	100%	83%	3	100%
V3	Network humanising technology	0	0%	3	100%	3	100%	100%	3	100%
V4	Interconnection	2	67%	1	33%	3	100%	67%	3	100%
V5	Informationalism	1	33%	1	33%	2	67%	50%	2	67%
V6	Symbiotic era, homo zappiens	0	0%	1	33%	3	100%	67%	1	33%
			17%		61%		94%	78%		83%

5.2.2. Vision/products coherence analysis

The internal alignment analysis considers vision and products (Matrix B). For Eurotech, the analysis of vision and products indicates substantial coherence.

We conducted three analyses. The first one considered examples of what we called the "products of the past" (embedded computers) and returned a value of 17%, the second analysed the "products of the present" and returned a value of 78%; and the third considered an example of a product of the future and yielded the highest value (83%). We can note that there are higher coherence values in the last two, which indicates that the actual vision is better mirrored in actual or future products. This analysis can be used as a tool for diagnosis in two ways: to highlight which characteristics of the vision are not found in products, or to highlight which products are more aligned with the vision. From the analysis of Eurotech, we find that all the characteristics of the vision are found in the products and that the products are aligned with the vision to a medium–high degree in the case of the supercomputer (61%) and to a very high degree in the case of the wearable computer (94%). As regards internal coherence, therefore, Eurotech reveals itself as excellent.

5.2.3. Trends/products coherence analysis

The comparison analysis of trends and products was conducted to compare every product family previously analysed with the identified scenarios.

Matrix C shows the synthesis schemes of the trends–products coherence analysis, considering the "products of the past" (value of 26%) and the products of the future (76%). The analysis is indicated to be a useful diagnosis tool, mainly in two directions: the

Matrix C
Trends/products coherence analysis (T/P).

			Eurotech product lines								
			Past		Present					Future	
			P1	Index	**P2**		**P3**		Index	**P4**	Index
Megatrends		Trends	Pc embedded		Super computer		Wearable computer			Integrated sensor	
M1	Changes acceleration	Acceleration	1	33%	3	100%	2	67%	83%	2	67%
M2	Technology essentiality	Essentiality	2	67%	3	100%	2	67%	83%	3	100%
M3	Man–technology interaction	Irreversibility	0	0%	1	22%	1	44%	33%	1	22%
		Conditioning	0		0		1			1	
		Man–technology transformation	0		1		2			0	
M4	Augmented reality	Expansion and contraction	2	19%	3	90%	3	81%	86%	3	100%
		Invisibility	0		2		2			3	
		Pervasivity	1		2		3			3	
		Augmented reality	0		3		3			3	
		Connectivity	1		3		3			3	
		Informatio-nalism	0		3		2			3	
		Ipertestuality	0		3		1			3	
M5	Symbiosis	Technology–man transformation	0	11%	3	78%	3	100%	89%	2	89%
		Organic and inorganic integration	0		1		3			3	
		Convergence	1		3		3			3	
				26%		78%		72%	75%		76%

most innovative and future-oriented products can be underlined, and the trends and megatrends that are not reflected in the products can be underlined.

The most innovative products are indicated by the comparison of the three analyses. The embedded computers show low coherence with trends; this does not mean that the company does not have to rely on these products anymore, but it indicates that they are products suitable for today's market that nevertheless will not be sufficient to secure competitive challenge in tomorrow's. They are in fact the products with which Eurotech began its business in 1992; their development has improved, and they constitute the "hard core" of its business. A judgement can be made regarding the other three products, too: the analysis highlights a "scale of future orientation" among wearable computers (72%), integrated sensors (76%) and supercomputers (78%). These considerations could suggest to a company where and how to invest more to be much more oriented towards trends.

As regards trends and megatrends, we note that the megatrend "man–technology interaction" is less present in the products, with a value of 33% (or 22% if we consider the "products of the future"). On this basis, it seems that there should be research done at Eurotech to improve the products considered, adding some characteristics that address the megatrends.

Eurotech has considered some of the implications explained above, in particular the need to improve its abilities in the realm of supercomputers and to introduce a new product that aims to address the megatrend of "man–technology interaction", and the firm is studying these new lines of thought in the research unit with the aim of building new innovative products. Also, while the efficacy of the method will probably be seen in much greater depth after 5–10 years, its effectiveness is nevertheless also confirmed by the fact that when we were writing this paper (in 2010), Eurotech continued to develop its means of creating innovation and the orientation of its strategy towards the future. A qualitative comparison of Eurotech with its competitors shows that the key to success is the firm's orientation towards the future and M&A strategy.

6. The diagnosis of the firm's anticipation of future trends

The proposed methodology permits us to verify the appropriateness of the firm's strategic direction in reference to trends. The test highlights that the proposed methodology is feasible from an operative point of view because of its simplicity. The analysis confirms how Eurotech is a particularly innovative company; its vision and products are aligned and coherent with the direction of

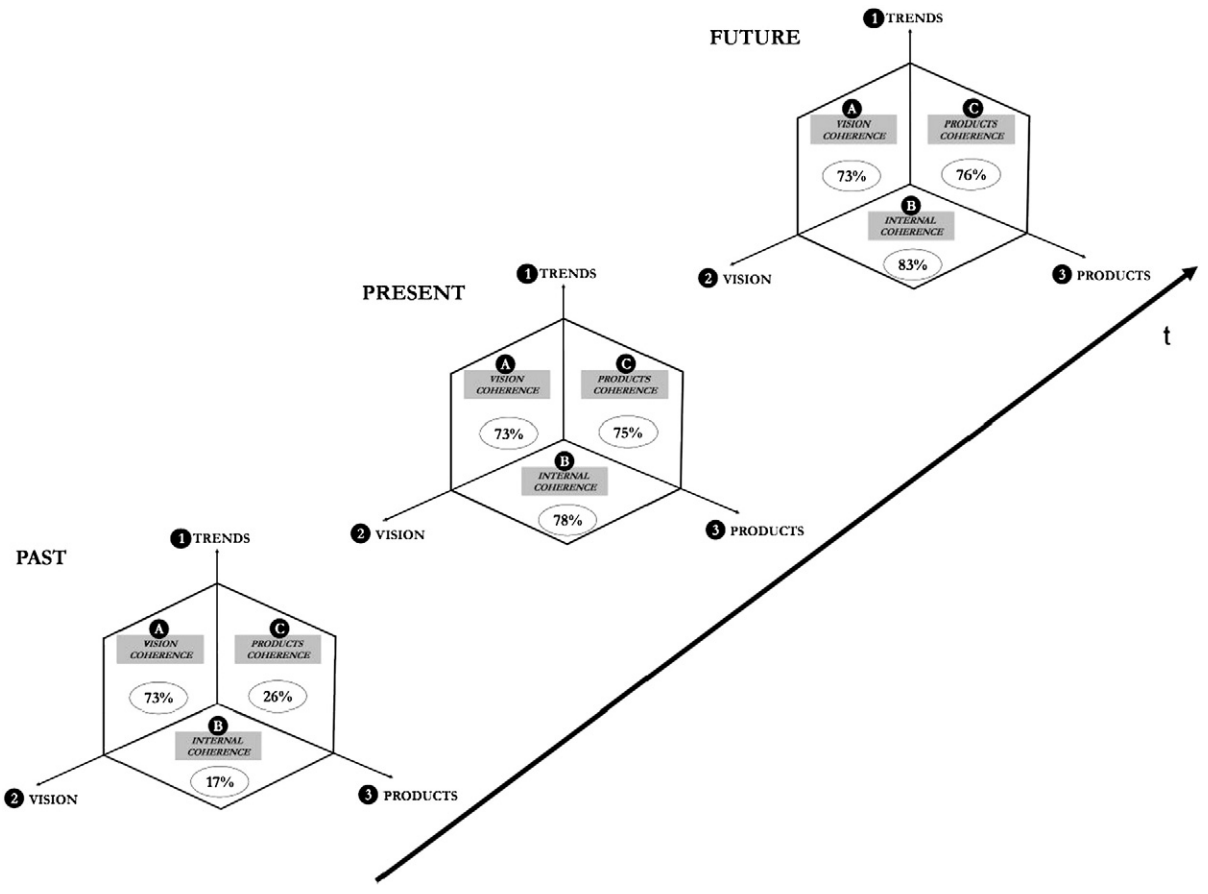

Fig. 5. Dynamic application of the methodology of future coverage to the case study.

growth of the trends in the ICT industry. Moreover, the past–present–future comparison shows how the strategy follows a coherent path: the vision has always been coherent with trends (73%), while products are now more aligned with vision (internally) and trends (externally), as demonstrated by the figures of 17–78–83% for internal coherence (vision/products) and 26–75–76% for product coherence (trends/products). In other words, while vision is already aligned with trends, products have been following a gradual path of alignment. Fig. 5 shows the synthesis from a temporal point of view.

The methodology has implications both for academics and managers. From the point of view of the literature, this work has highlighted the missing links between trends and megatrends and between vision and products; on this basis, the authors have proposed a framework that bridges this gap based on the principles of Corporate Foresight.

From a practitioner point of view, the methodology of future coverage can be used as a "*diagnosis tool*" to supply a rapid clinical outline of the coherence of industry megatrends with company strategy: in other words, how well the strategy takes the future into account. The three indexes of vision coherence, product coherence and internal coherence reach higher values when the company is able to better take the future into account. Moreover, the analysis of future coverage highlights the variables that influence the investigated industry on a higher level (indicating that the trends and megatrends are) and which industry trends are not (or are not as much) mirrored in the vision and products of the company.

The tables permit a schematic visualisation of points of strength and weakness. Where the values are lower, they highlight "alarm bells": in other words, the points where the strategic direction deviates from industry trends. In the case of the megatrends–products relationship, for example, a particular megatrend can be scarcely present in products, or a particular product may not be aligned with the megatrends. Based on this diagnosis, the task of the manager will be to evaluate how to effect a "cure" from the point of view of both vision and products.

From a historical perspective, the methodology is valid as a diagnosis tool, or in other words, as the first alarm bell for the company: the utility of the indexes lies in their ability to signal anomalies that then must be evaluated and appropriately addressed by manager. Hypothetically, we can suppose that a value higher than 66% is a good value, indicating the innovativeness and future orientation of the company, a value between 33% and 66% in the middle and a value less than 33% a low one.

From a dynamic perspective, then, the future coverage methodology can be used as a tool for verifying from the correspondence of trends with company strategy over time. Repeating the analysis with a periodic frequency, the company can come to its strategic path towards the future.

Moreover, the methodology could be used as a tool for comparing the "level of future orientation" among companies in the same industry if there is a wider panel of data.

The study has some weaknesses. The main one is the fact that the methodology is based on experts' judgements. To overcome this weakness, it will be necessary to widen the panel of experts and diversify them as much as possible. Moreover, the research can be based on a wider database, including both further longitudinal analysis of the same company (to verify whether, after 5–10 years, these values can be said to have correctly predicted Eurotech's results) and of clusters of companies in a specific industry (perhaps different industries will prove to have different thresholds). Finally, another weakness is the possibility to have a definition of a stricter scale of the levels of low, middle and high alignment.

7. Conclusions

A successful company is always ready and proactive in facing the social, technological and political–economical complexity embedded in the competitive environment as an emergent and complex phenomenon. The challenge of facing this complexity becomes even greater in an accelerated and dynamic environment. If this turbulence is not managed, chaos overcomes the company. Here lies the importance, the difficulty and the charm of the companies' path in actively monitoring and exploring emerging trends and developing alternative scenarios that reflect potential business opportunities that may arise in the next 5–10 years, and thus in facing the challenges of the future. It is then necessary to develop a pre-alarm system to manage this turbulence. The companies can learn to formulate possible scenarios and imagine, reasoning according to a what-if logic, the actions that may result. They rethink their management and organisation from the perspective of the exploration, perception and monitoring of key trends and align their strategy, in terms of vision and products, with industry trends.

Returning to the research questions, it is possible to understand if your own business strategy is oriented in the same direction as trends, and we supplied the methodology of future coverage in order to explore whether a firm's business strategy is oriented in the same direction as the trends by means of measures of the coherence among trends, vision and products. The methodology indicates if vision and products are coherent with industry trends, indicating that strategy is consistent with industry trends.

The value of the methodology of future coverage lies in its usefulness as a tool for strategic management support: in a context of turbulence, companies need to be aware of the possible evolution of the external market, but this analysis of trends need not stand alone. Instead, such analysis should be integrated into the strategy so that, instead of remaining a mere exercise, it becomes actionable. In this sense, the methodology helps managers to understand if the vision and products of the company are aligned with the trends and highlights points of weakness to assist in the decision-making process. This helps the company to be "ready in advance". In fact, futurists and managers need reliable tools to measure the future readiness of companies, and the methodology fills a gap in our understanding of how to determine a company' readiness for the future. The proposed methodology can become a powerful tool for evaluating future coverage, highlighting possible problems and therefore generating new insights and enhancing decision-making. The methodology is not about "predicting the future" or depicting scenarios, but preparing to understand external evolution and internal fitness to these possible evolution of the PEEST. It is about being ready to understand uncertainty

and complexity and include them in the decision-making process. The process is about developing the company's capacity to navigate the external operating landscape in a responsive way. It can enhance confidence in decision-making and flexibility in dealing with future issues. The advantage arises in clarifying the company's internal situation (vision and products) in reference to a changing external world (also from a dynamic point of view) and preparing a schematic and simple table that visually highlights the points of weakness and strength of the firm, letting the strategic process become better informed.

In our opinion, Corporate Foresight has real strategic value in helping firms to innovate and react to the latent vulnerabilities of an accelerated and turbulent environment. It needs to be supported from an organisational and managerial point of view. The methodology of future coverage can become managerial tool to drive companies to investigate and prepare for a complex and uncertain future.

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Appendix A. Algorithm of percentages calculation

To better demonstrate the meaning of the single values, here we consider the example of the comparison between megatrends and vision (see Matrix A). The other two comparisons follow the same procedure.

The megatrends-vision comparison is an analysis of external–internal alignment. After the identification of the characteristics connected to trends and megatrends and the characteristics connected to the vision, these characteristics are "crossed" to evaluate which one corresponds to the others and therefore to appraise the level of coherence of the firm vision with trends and megatrends.

This evaluation is conducted by experts, who jointly make a discrete evaluation from 0 to 3 of the coherence and alignment of a single characteristic of the vision with a single megatrend (measure *a*): the value 0 expresses null alignment, the value 1 low alignment, the value 2 mid-level alignment and the value 3 high alignment. If the values refer to a single trend or megatrend or to a single characteristic of the vision, they horizontally express (on the last line) the index of future coverage while vertically indicating (in the last column) the index of presence, which demonstrate the influence of trends and megatrends on the vision (or of the megatrends on the products, of the vision on the products, etc.).

The value *b*, which is constructed based on the average of the measures *a*, is both a measure of the alignment of the single characteristic of the vision with the single megatrend and a measure of the influence of the single megatrend on the single characteristic of the vision. From the average of the values *b* in the horizontal row, the value *c* is derived: it expresses the presence of the single megatrend as part of the vision. Based on the average of the values *b* in the vertical column, however, the value originated is *d*, which expresses the alignment of the single characteristic of the vision with the megatrends. Finally, based on the average of the values *c* (vertically), with coincides with the average of the values *d* (horizontally), the measure of the alignment of the megatrends with the vision is originated (*e*).

Table 5
Legend of measures meanings.

Cell	Description	Value	Calculation logic
a	Measure of coherence between the single characteristic of the vision V1 on single trend T1	Value from 0 to 3 that says if and how much (0 null, 1 low, 2 middle, 3 high) the vision characteristic V1 is aligned and coherent with the single trend T1	Built trough experts judgments
b	Measure of coherence between the single characteristic of the vision V1 on single megatrend M1	Value from 0 to 3 that measures how much the characteristic of the vision V1 is aligned and coherent with the single megatrend M1	Calculated through the arithmetic average of measures *a*
	Measure of presence of the single megatrend M1 on the single characteristic of the vision V1	Value from 0 to 3 that measures how much the megatrend M1 is present in the single characteristic of the vision V1	Calculated through the arithmetic average of measures *a*
c	Measure of presence of the single megatrend M1 on vision	Value from 0 to 3 that measures how much the megatrend M1 is present in the vision	Calculated through the arithmetic average of measures *b* horizontally
d	Measure of coherence of the single characteristic of the vision V1 on megatrends	Value from 0 to 3 that measures how much the characteristic of the vision V1 is aligned and coherent with the megatrends	Calculated through the arithmetic average of measures *b*
e	Measure of coherence of vision on megatrends	Value from 0 to 3 that measures how much the vision is aligned and coherent with the megatrends	Calculated through the arithmetic average of measures *d* horizontally
	Measure of presence of megatrends on vision	Value from 0 to 3 that measures how much the megatrends are present in the vision	Calculated through the arithmetic average of measures *c* vertically

From the comparison framework, therefore, two measures are derived: coherence and presence. After having established if the single characteristic of the vision is aligned with the single trend that is part of the megatrend (a), the measure of coherence of the single characteristic of the vision with the specific megatrend (b) is derived. This can also be read as the measure of the presence of the megatrend in the specific characteristic of the vision (b). Grouping data and reading the matrix horizontally, we find the measure of presence of the single megatrend in the whole vision (c). Grouping data and reading the matrix vertically, the measure of coherence of the single characteristic of the vision with the megatrend (d) is originated. Finally, the final value (e) that is obtained expresses both a measure of coherence and alignment of the vision with the megatrends and a measure of the presence of the megatrends in the vision.

For a summary of the explanation, see the legend in Table 5.

Appendix B. Trends and megatrends

The megatrends and trends are explained here in broad terms:

1. *Acceleration of changes*: The speed of technological evolution (the pace of changes in ICT) is continuously increasing.
2. *Technology essentiality*: Technology has been important for man, and with the advent of digital technologies, it is becoming even more important.
3. *Man–technology interaction*: Technology has created numerous changes for man on an anthropological level as well as a sociological one. Man selective catalyses the development of technology. In particular, the experts note the following:
   a. Irreversibility: After a disruptive technology is introduced, the process is irreversible. Computing is disruptive in its way of processing information, permitting not only memorisation but also its development and transmission.
   b. Conditioning: Technology opens up new possibilities for man, but does not made explicit at the beginning all its potentialities.
   c. Man–technology transformation: Man and technology act in a double circle of transformation. Man transforms technology. This has always happened, but with the progressive acceleration of technological development and its progressive incoming to man, this transformation has even greater effects.
4. *Augmented reality*: The direction of technology is towards both expansion and contraction. Technology constitutes for man an extension of his capacities and for the environment the addition of "intelligence" thanks to the network. Technology is a prosthesis that permits the constitution of an augmented reality. In particular, the experts note the following:
   a. Expansion and contraction: Technology works in two direction: contraction–expansion (devices are becoming smaller but permit expansion – for example, in computing, there exists the chain "mainframes – PC – PDA, mobile phones – pervasive" – but this miniaturisation permits expansion because of the diffusion and connection in a network) and expansion–contraction (supercomputers and GRID have provided an opportunity for high computing power, which enables the study of scientific problems connected with micro and nano technology).
   b. Invisibility: ICT technologies are becoming "unconscious" for man; in other words, their use is more and more natural.
   c. Pervasiveness: Digital technologies and their effects are very diffuse, creating pervasive computing.
   d. Augmented reality: For man, technology represents an extension of his abilities. For example, a hammer extends the capacity of the human hand in terms of power, a car extends the capacity of the human foot in terms of speed, and a mobile phone today permits us to extend our ability to communicate. Such extension also exists in the environment: computers are miniaturised and embedded in every device, giving intelligence to inanimate objects, and the environment has now a characteristic of information and communication that lets it be an "augmented reality". In this sense, Intel defines technology as the "sixth sense" of man.
   e. Connectivity: Digital technology permits the creation of a network that surpasses the next-door/far away binary; people are connected to one another and thus are disconnected from their physical space. Technology aims to build networks among people.
   f. Informationalism: Digital technology is more and more based on information input, in that sense, Negroponte defined his "law" (Being Digital, 1995).
   g. Hypertextuality: Technology is becoming more non-linear, dynamic and flexible because follows the "logic of networks" more and more closely.
5. *Symbiosis*: The evolution of man is not only Darwinian (biologic) but also Lamarckian (cultural and technological). It is therefore necessary to consider biotechnological evolution. In particular,
   a. Technology–man transformation: Man and technology act in a double circle of transformation. Technology acts on the environment and man, changing him on an anthropological and sociological level.
   b. Organic and inorganic integration: This includes biotechnological evolution and the possibility of symbiosis (see the new generation — the "digital native").
   c. Convergence: This includes convergence of all digital technologies (with great progress within the realm of NBIC (nano-bio-info-cogno) technology and their integration).

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