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DELIVERABLE 2.1:

SURVEY OF INDUSTRIAL ORGANIZATIONAL MODELS AND IDENTIFICATION OF RELATED NEEDS AND REQUIREMENTS

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Abstract
This document summarizes the results of task 2.1 of the FORMAT project, which was approached in two ways. First, the needs and requirements for a Technology Forecasting (TF) and roadmapping methodology were specifically analysed for **Whirlpool**, a large player in the sector of household appliances and the partner that will deliver the specifics of test case scenarios. Then, a survey was created to assess how companies in the manufacturing or related sectors handle R&D and problem solving in general, in which situations they can benefit from a forecasting tool and what requirements they have for such a tool. The main conclusions are that:

- The *objective of TF* is mainly to drive the decision on investment on technologies at top management level and to drive research activities
- Given the pace of new technologies introduction in products or manufacturing processes in Whirlpool, the minimal term wherein results of TF need to be reliable, is 3 - 4.5 years.
- Industries other than Whirlpool showed the same need of having a TF methodology that can bring results in a few weeks and whose results can be used at high management level

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1. Introduction

This document summarizes the results of task 2.1 - *Survey of industrial organizational models and identification of related needs and requirements*, which was described as follows:

"The industrial requirements in technology forecast for household appliances and energy production sectors will be collected. The output of this task will be input for task 2.6: 'Definition of test cases'"

The task was **approached in two ways**.

First, the needs and requirements for a Technology Forecasting (TF) and roadmapping methodology were specifically analysed for **Whirlpool**, a large player in the sector of household appliances and the partner that will deliver the specifics of test case scenarios.

However, the final product of FORMAT should be a tool useful for a **broader range of companies in the manufacturing sector**, who do not necessarily have an organization structure, approach to R&D and available resources that are comparable to those of Whirlpool. A survey was therefore created to assess how companies, ranging from SME to MNE, handle R&D and problem solving in general, in which situations they can benefit from a forecasting tool and what requirements they have for such a tool. The questionnaire is still on-going, but the preliminary results and further approach are summarized in this report.

This document is structured in **two chapters**:

- General requirements for a forecasting methodology for Whirlpool;
- General requirements for a forecasting methodology for industrial companies in the manufacturing and related sectors.

2. General requirements for Whirlpool

In task 2.1, the organization structure and needs & requirements for Technology Forecasting were analysed for the FORMAT partner Whirlpool.

Whirlpool Corporation is a multinational company, leading the market of home appliances.
It sells its products in more than 170 Countries worldwide with different brands, global and local and counts divisions in North America (NAR), Latin America (LAR), Asia and Europe, Middle East and Africa (EMEA). While the headquarter is based in Benton Harbor, Michigan, USA each of the regional division is managed by a regional Vice President and comprises many facilities in different Countries.

2.1. Whirlpool organization structure

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Whirlpool organization is structured with **local and global functions**. The local functions can explore and follow the specific market conditions of the region. The global functions ensure a common vision of the Company and leverage on the worldwide work force with synergetic efforts in product development. In particular, local and global functions exist for each region (i.e., Whirlpool EMEA).

Local functions:

- Marketing and Sales
- Industrial Operations and Supply Chain
- Finance and Administration
- Legal department
- Customer Service
- Human Resources

Global functions:

- Global Product Organization
    - Global Product Business
    - Engineering and Technology (i.e the R&D department)
    - Global Strategic Sources
    - Advanced Manufacturing
    - Global Consumer Design
    - Global Product Safety
- Global Information System

To allow the correct and efficient work of every company department, both the local and global, Whirlpool counts on **cross-functional teams** and **well-structured procedures**. The goal is to ensure the development, production and commercialization of its new products at the right time with the right cost.

Cross-functional teams:

- Product Business Team (PBT), led by Marketing, with the goal of taking decision about resources to be allocated for the development projects. Each product group (Food Stream Solution, Food Preparation, Home Cleaning and Fabric Care) has its own PBT.
- Industrial Operation Committee (IOC) with the goal to drive decisions about industrial investments

Product Development

The **process of design (or re-design)** of new products and launching them on the market follows a structured procedure called **PDE –C2C2.0** that has a **stage-gate** approach.

It is inside these cross-functional decision committees and in the frame of the PDE procedure that a Technology Forecasting methodology can provide the maximum benefit to the company.

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2.2. Whirlpool requirements and needs

FORMAT is intended most of all to develop a forecasting methodology for **manufacturing technologies**.

To drive the research and development of this methodology, WHRIT must keep in mind that all of the efforts in the introduction of new technologies and processes in manufacturing are **aimed at ensuring that the best possible combination of product/process technologies is used**. This means that WHRIT must monitor the new technologies introduced in a product and the way WHRIT can manufacture this in our factories.

While thinking of the output of the forecasting methodology, it must be taken into account that the timeframe for the introduction of new technologies in Whirlpool is:

- 3 years for manufacturing processes
- 4/5 years for product-related technologies

The researchers involved in the development of the FORMAT methodology must also keep in mind that **quality of the final point is a key point** of Whirlpool marketing strategy and that Whirlpool has adapted its production, wherever needed, to follow a **lean approach**. This approach is designed according to the company specifics and called Whirlpool Production System.

A forecast of manufacturing technologies must provide sufficient information to adapt production in a way that ensures the **primary goals for the innovation of the industrial processes**:

- To be ready to fulfil market/product changes
- To sustain Whirlpool Production System (WPS)
- To improve Value through cost reduction and quality increase
- To achieve the desired Manufacturing Excellence

The **objective of a forecasting methodology** must be to:

- Drive the decision on investment on technologies at PBT or IOC level.
- Drive research activities, thus helping managers to decide where to allocate money and resources

According to the team perception, this can be more easily done if the methodology is also giving, as an output, a draw of the path of evolution of a technology

The decision committee is made up of people who not always have a technical background. The methodology will be intended to be used by people working on technologies, but should be easy to communicate, both to explain the way it must be used and, above all, to discuss the results. This will increase the confidence in the results at all the levels of management.

In this respect, requirements for the Technology Forecasting process for Whirlpool, imply that the methodology should be:

- **Easy to use for people involved in innovation (process & product)**
- **Easy to communicate at each company level**
- **Reliable**
- **Repeatable**

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- **Resource-efficient**
- **Adjustable to different situations and boundary condition changes**

3. General requirements for companies in the manufacturing and related sectors

The decision to try and get a broader picture of the requirements and needs for a Technology Forecasting tool of industrial companies, specifically those that are frequently confronted with problem-solving and/or R&D issues, was made for two main reasons.

Firstly, requirements and needs for a technology forecasting methodology of Whirlpool are not necessarily generally applicable to all the companies in the manufacturing or energy-production sectors, which are in fact the targeted audience for the FORMAT project results.

Secondly, the state-of-the-art analysis of forecasting and roadmapping methodologies uncovered a high number of methodologies for forecasting and roadmapping. It is probably unreasonable and unnecessary to analyse the functionality and efficacy of all of these techniques in-depth. Therefore, a logical methodology was sought to make a preliminary selection of these methods and retain only those that are most relevant to FORMAT and that are most likely to be practically useful in a 'real industrial context'.

The project partner PNO is a consultancy firm with a large client base in many industrial sectors and is therefore ideally placed to assess the needs and requirements of a significant number of companies relevant to the FORMAT project. Therefore, during the secondment of Katrien Vanherck (seconded from PNO to PoliMI), a survey was created.

3.1. Building a questionnaire

The **two main objectives** of the questionnaire were:
- To get a broader perspective of the needs and requirements for a Technology Forecasting & roadmapping methodology and tool, for companies in the manufacturing, energy production and related sectors;
- To allow for a pre-selection of state-of-the-art forecasting and roadmapping technologies.

The **main criteria** to be addressed in the questionnaire were initially divided into 5 main issues of forecasting:
- What is the **topic**?
- What is the **purpose**?
- What is the **time span**?
- What are the available **resources**?
- What is the **expected output**?

It was immediately clear that, depending on the situation of the company, different needs and requirements related to those criteria are expected to arise. However, probably some 'clusters' can

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be predicted in advance: e.g., a company with a dedicated R&D department vs. a company conducting R&D on ad-hoc basis; short-term problem solving vs. long-term radical innovation projects; …. The questionnaire should be able to capture such clusters.

3.1.1. Open vs. closed questions

There are many studies, mainly in the domain of psychology, which study the effect of open-ended vs. multiple-choice questions in questionnaires. However, for the purpose of this questionnaire in the FORMAT project, an in-depth study was not considered relevant.

Some considerations were made to decide upon whether a question would be multiple-choice or open-ended. For the sake of result analysis, a fully multiple-choice questionnaire will be more convenient. Also, a responder is likely to need less time to fill in the questionnaire in case of multiple-choice questions. However, another thing to keep in mind is the quality of the answer you can receive.

For many of the questions proposed in the questionnaire, a list of optional answers could be found in literature or could be created also according to the experience gained by the researchers participating to the project. In addition, an option was included to provide an 'other' answer.

For some of the questions, e.g., those related to 'situations in which forecasting would be useful', 'standard procedures followed when starting an R&D project', … it was not entirely clear at the start of the questionnaire what the possible answers should be. To ensure that no valid answers would be left out by steering the responder in the direction of an inadequate list of options, it was decided to leave these as open-ended questions. In a latter version of the questionnaire, when at least until sufficient data could be collected from responders to provide a more exhaustive list of options, also these kinds of questions will be adapted to become multiple choice.

3.1.2. Requirements to approach companies

As a main way to get responses to the questionnaire will be through the client base of PNO Belgium, some requirements were defined by PNO so that the survey would not be perceived as 'bothersome' and 'a waste of time', thus ensuring a high-quality response.

The questionnaire should therefore be:
- Short and concise;
- Clear and easy to answer (sufficient introduction, explanation, examples, no 'required' questions);
- Attractive to the client (benefits: e.g., insight into results);
- Confidential where needed.

3.1.3. Use expertise in forecasting literature

A paper of Kucharavy and De Guio [1] mentions a 6-step approach to forecasting. Even though the first three steps in this approach are meant to identify the requirements, needs and objectives for a

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specific forecasting 'case', this coincides largely with the information that we try to find through the questionnaire for a broader perspective on forecasting.

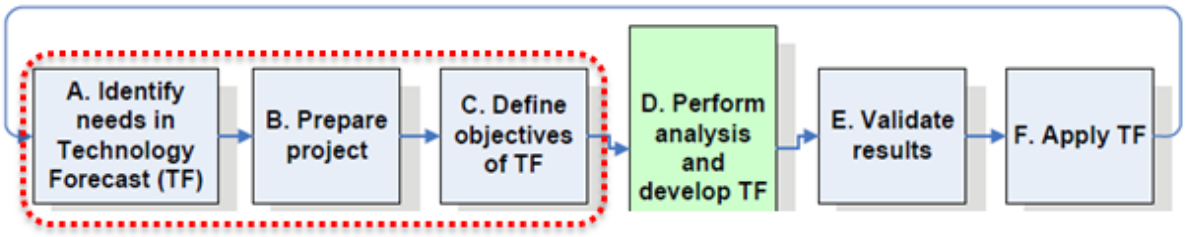

Fig. 1 - 6-steps approach to perform a Technology Forecasting approach proposed in [1]

To make sure that the questionnaire contains all the necessary questions to obtain the needed data, it was reviewed and adapted using the paper of Kucharavy and De Guio as a guidebook.

3.2. Questionnaire: v1.0

At the time of the 2nd ToK workshop at Whirlpool (17-18th December 2012), a final version of the first version of the questionnaire was completed. This version contains, apart from questions on general company data, 27 questions of which 10 multiple-choice and 17 open-ended.

This questionnaire was used as a 'preliminary' version, to be sent out to a limited amount of companies. These first results would then be used as a guideline to increase the number of questions set as multiple-choice.

The questionnaire was prepared in two forms:

- An online survey with a built-in skipping logic: (https://docs.google.com/spreadsheet/viewform?formkey=dElWTTAzdE5MbmhOV1NHNFRsTC1pLXc6MA#gid=0)
- A drastically shortened 10-question version fit for personal or telephone interviews, retaining only the 10 most pressing questions.

3.3. First results (21-12-2012 – 20-01-2013)

For the first version of the questionnaire, 7 responses were collected including the one from Whirlpool Europe. Some very preliminary considerations can already be done from these responses, mostly from the multiple-choice questions.

Situations where forecasting can be useful

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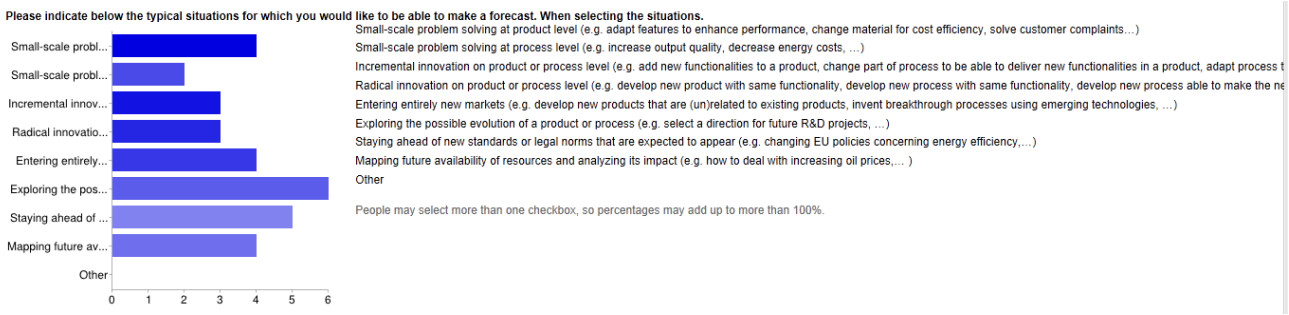
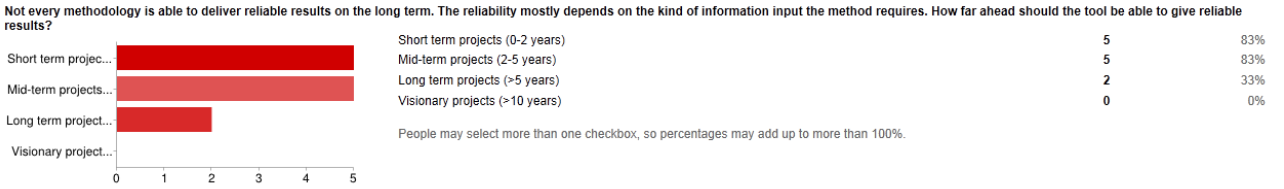
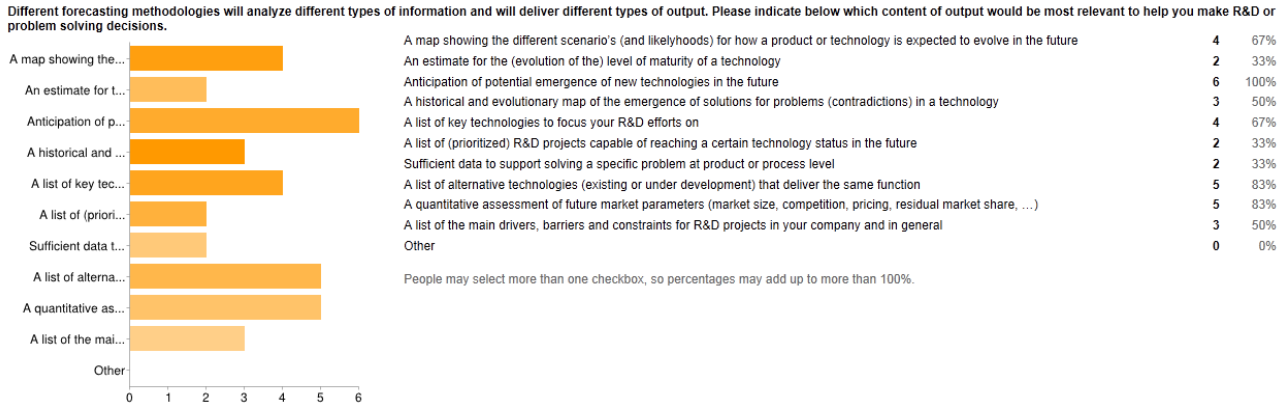


Reliability of results:



Expected output:



The results for ‘situations’ and ‘expected output’ are in contrast with the fact that companies mostly want reliable forecasts for short to mid-term projects, which is more applicable to other situations that would require a different output.

Also, most companies indicated that a forecast should be concluded within a few weeks to a few months but want a result that is useful for the high management level (CEO, MD, …).

3.4. Refining the questionnaire

Through the answers of the 7 responders, we were able to reformulate many of the ‘open’ questions into ‘multiple-choice’ questions.

The results of the questionnaires also indicated some flaws. Even though the introduction to the questionnaire specifies the definition of ‘technological forecasting’ and clearly indicates the goal of the questionnaire, in many cases the responder interpreted ‘forecasting’ as ‘sales forecasting’ or ‘planning’. This, of course, renders a part of the questionnaire (such as the questions assessing

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familiarity with forecasting) useless. Also, the order of some of the questions should be adapted to allow a more logical 'flow' in the answers. Some questions should be answered before another, to ensure a good understanding of the meaning of the question.

A new, refined version of the questionnaire was prepared and delivered to the FORMAT partners for feedback.
https://docs.google.com/spreadsheet/viewform?formkey=dFdHNVVib3o5NVdPdHBlY0ZVWG4tbVE6MA#gid=0

3.5. Next steps

Once the final version of the questionnaire is finished, the survey will be sent out through the professional network of all FORMAT partners as well as to PNO clients, to receive as many answers as possible from companies in sectors relevant to the FORMAT project.

The 10-question version will be adapted to be more in line with the final version.

In principle, there is no end-deadline for collecting answers. The survey will remain available to any company willing to answer for as long as it could still be relevant for the FORMAT activities.

4. Conclusions

The main needs and requirements of Technology Forecasting for Whirlpool, related to their organization structure, can be summarized as follows:

- Whirlpool will use the TF tool for the *purpose* of monitoring the possible changes of technologies introduced in a product, and/or technology used in the manufacturing of the products themselves.
- The *timeframe* for the introduction of new technologies in Whirlpool, and thus also the minimal term wherein results of TF need to be reliable, is 3 - 4.5 years.
- The TF tool should *deliver as output* sufficient information to adapt the production while ensuring to be ready to fulfil market/product changes, to sustain the Whirlpool Production System (WPS), to improve Value through cost reduction and quality increase and thus to achieve the desired Manufacturing Excellence.
- The *objective of TF* is mainly to drive the decision on investment on technologies at PBT or IOC level and to drive research activities, by helping managers to decide where to allocate money and resources.
- The method should be easy to utilize, easy to communicate at each company level, reliable, repeatable, resource-efficient and adjustable.

The survey is now close to being finalized and will be used, even after the conclusion of WP2, to uncover the needs and requirements for Technology Forecasting of SME's, large companies and NME's in sectors that are relevant to the FORMAT project.

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5. Bibliography

[1] Kucharavy, D. and De Guio, R. Technology Forecasting and Assessment of Barriers for Emerging Technologies, International Association for Management of Technology IAMOT 2008 Proceedings

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