This document is classified as *FORMAT* Public

D4.3 SMALL PROJECT: ASSESSMENT – TEAM EXPERIENCE

by
Mahmoud Rabie (PNO)

Abstract

This document represents the assessment of the case study of vacuum forming in the FORMAT project based on investigating the team experience through interviews, a questionnaire and a preliminary monitoring of similar/related non-FORMAT studies. The FORMAT builders and user participated in an online questionnaire and individual online-interviews which were a direct application of the evaluation metrics and scoring card previously published in deliverable 4.1. Each participant extended his/her answers to give recommendations for the improvement of the methodology, case-studies and deliverables. These participations were clustered by the researcher into main four categories according to SWOT analysis to represent the strengths, weaknesses, opportunities and threats. Although in swot analysis opportunities and threats are external due to the environment, most of the participant recommendations and warnings were directly related to the case-study activities. Therefore, other two categories of external opportunities and threats were added to recommendations based on preliminary study of similarly related studies in thermoforming, plastic machinery and appliances manufacturing.

©FORMAT Consortium Members. All rights reserved.

Approval status

Author:	**Mahmoud Rabie**	**PNO**	**RER**
Approved by:	**Gaetano Cascini**	**PoliMI**	**Project Coordinator**

Dissemination

PU

Document details

Issue Date:	**.02.2014**
Contract n°:	**PIAP-GA-2011-286305**
Project n°:	**286305**

Revision table

Issue	Issue date	Modifications
0.1	03.02.2014	Draft
1.0	31.03.2014	Final issue

Electronic file details

Master file location	FORMAT collaborative space
Filename	FORMAT_Deliverable4.3_31March2014.doc

©FORMAT Consortium Members. All rights reserved.

0. Index

0. Index....3
1. Introduction....4
2. How this assessment was done? 4
2.1. Online Interviews 4
2.2. Questionnaire 4
2.3. Small Review....5
3. Strengths of the methodology and the current case study....5
Replicability....5
Expertise 5
Advances to other TF methodologies....5
Gained experience 6
4. Recommendations for improvements from the builders and user....6
4.1. Difficulties faced....6
4.2. Opportunities for improvement....6
4.3. Threats to be avoided: (Builders and user recommendations) 7
5. Questionnaire results: (Scoring Card)....8
6. How this case-study compare to others?....9
6.1. Introduction....9
6.2. Recommendations for improvements: 9
6.3. General threats to be avoided (for appliances manufacturing technologies) 10
7. Summary and Conclusions....10
8. Bibliography....11

©FORMAT Consortium Members. All rights reserved.

1. Introduction

As task 4.2 (vacuum forming case study) was about to close to an end, it was necessary to carry out an assessment according to the metrics defined in deliverable D4.1 [1]. Such an assessment was required to be done in an objective manner dedicated to producing as many constructive feedback as possible. For this reason it was required for this job not to be assessed by one of the builders, users, nor the beneficiaries that contributed to the vacuum forming case study. Therefore the application of the metrics was carried out at PNO consultants, being acknowledged about the activity, but also not biased by the way the case study was implemented. However, the support of FORMAT researchers at the rest of the partners was the main factor of completing this task by contributing to a series of online interviews and a questionnaire.

Part of the assessment was extended to include recommendations about the FORMAT methodology through the team experience. This work shall also help to produce indications for preliminary directions of improvements to be applied in the following case studies as well as the framework of subsequent task 4.4.

2. How this assessment was done?

2.1. Online Interviews

Online interviews were run individually with seven builders of the methodology and one user. Each interview had a duration of 30 to 60 minutes. Most of the questions were based on Annex I of deliverable 4.1 (evaluation metrics), while extra questions were added to explore the participants' experience the case study and the FORMAT methodology concerning: personal evaluation, team experience, strengths, difficulties and recommendations for improvement. The answers were used to qualitatively describe the evaluation fields of deliverable D4.1 [1] (practical use, drawbacks and replicability). Nevertheless; the evaluation field "Value of outcomes" was not possible to assess because of non-availability of the Beneficiaries to interview. Therefore, this evaluation field was estimated in a separate questionnaire sent to the builders and users. A simple SWOT analysis (strengths, weaknesses, opportunities, threats) was noted from the responses of interview participants.

2.2. Questionnaire

Seven FORMAT members have anonymously participated in one online questionnaire, whose questions are based on Annex II (scoring card for beneficiaries) of deliverable D4.1 [1]. Each answered question received a score between 0 and 4. The meaning of each score is noted as follows:
0 = no answer
1 = definitely no
2 = more no
3 = more yes

©FORMAT Consortium Members. All rights reserved.

4 = definitely yes

While calculating the average, if a question was not answered, the participant was not counted in the average calculation of the answer score. On the other hand, another score was added for the questions that received a balanced answer between more yes and more no (2.4 – 2.6 = neutral). Finally, an extra question was added to collect participants' comments

2.3. Small Review

The study was complemented by a small review of the FORMAT Deliverables (D4.2; D3.2) case-study, and sessions documentation. This was compared with the public parts of a few relevant market research studies, articles and statistics on the web which are related to plastic forming, and appliances technology. The goal was to find relevant opportunities and threats by monitoring the environment outside the FORMAT Project and the case study under assessment.[2-8]

3. Strengths of the methodology and the current case study

The following evaluation was extracted from the interviews with the builders and user of the case study of vacuum forming technology.

Replicability

All interview participants agree that a different team using the methodology can reach the same results but under some conditions (collective suggestions of FORMAT researchers):

- Relying on the same information
- Dependence on the right documentation
- Having similar skills to the builders
- Use the same techniques and methods

However, only 50% agreed that students can accomplish the same in a student project with the adequate training.

Expertise

The availability of the technical experts at Whirlpool was seen mainly as a positive point. On the other hand the expertise used in the case study was considered to be mainly technical, although some expressed an existence of environmental and economical experience.

Advances to other TF methodologies

The methodology is practical and can be used in real situations/case studies. This was expressed because it is developed on real case studies. Also thee methodology is seen by developers to be straightforward by having a defined linear flowchart and defined stages and gates in straightforward steps. In addition, compared to other TF methodologies, FORMAT methodology advances by having the combination of state of the art techniques as process modelling, Network of Contradictions and evolutionary trends.

©FORMAT Consortium Members. All rights reserved.

Gained experience

During the case study, the team continuously increased the team dynamics. Therefore, All participants agree that the next case study will take a shorter time due to the gained experience in applying the methodology and knowing other team members better.
The user agrees the case study will help the beneficiary to take a more confident decision.

4. Recommendations for improvements from the builders and user

4.1. Difficulties faced

Most of the participants (88%) think that the time and efforts spent in the whole process was more than expected, as most of the time was invested in the meetings. In general, more time was invested in stage 3 rather than stages 4 and 5, which could have been one of the reasons for the difficulty in stage 5 to condense and synthesize the overall results.

Another faced problem was having no enough quantitative data at Whirlpool to serve the quantitative analysis (regression) and extrapolate the trends, which resulted in a non-balance between qualitative and quantitative techniques in the case study (more qualitative). In addition, some participants (38%) faced a difficulty in receiving information to be circulated by other team members.

4.2. Opportunities for improvement

The interview participants provided a various recommendations for the improvement of the performance of in the case studies and in the methodology in general. These recommendations are represented as follows:

- **Organization of the meetings:**
  the participants recommended a less numbers of the meetings (sessions) in which a less number of participants is involved (key players). Also performing face to face meetings when possible rather than online could help a better efficiency in interaction, results and a shorter duration.

- **Experts involvement:**
  planning of expert involvement at the early stages could help in the case study organization and efficiency in retrieving information. Involving more economical experts was also recommended (opinion of 88% of participants) as well as some marketing; social, political and generalist experts (who know about many fields)

- **Information retrieval:**
  The case studies need more information extraction from various sources (from suppliers, customers, experts, web, patents, etc.). This was expressed by participants as the more available the information is, the less the time spent by the methodology builders and users to search for information. Once the

©FORMAT Consortium Members. All rights reserved.

information is known, it should be **saved and immediately circulated** among other FORMAT participants.

- **Possibility of less time consumption** in next case studies:
  All the participants confirmed that due to an improvement in the team dynamics after this case study, the efficiency of team members relatively increase due to the mutual learning of each other.

- **Recommendations for stage 3:**
  Various builders provided different recommendation for stage 3. These recommendations are:
    - Some sub-stages can be done in parallel (MP, System operator, Drivers/Barriers)
    - Spend less time; using some results of stage 3 as examples in the Handbook
    - Reduce efforts by IDEF (Integration DEFinition family of modeling languages)
  - **Recommendations for stage 4:**
    - Increase focus (time and effort) on stage 4
    - Involve more of technical procurement information (prices)
    - Involve the prices of crude oil as a related indicator to resins and plastics prices

  - **Recommendations for stage 5:**
    - Requires more time and focus
    - Make sure the results are correct (validation)
    - Validate by comparing results of many tools
    - Increase confidence in replicability by testing and validation

  - **General recommendation for gates:**
    Using the gates to check previous stages and control next steps

  - **Recommendations for the FORMAT Handbook:**
    - Train the users,
    - Train the trainers
    - integrate the case study experience into the FORMAT Handbook
    - keep it simple and explain every stage with clear examples
    - Provide a step-by-step layers depending on the readers experience (click a layer for more details)
    - Provide two versions/products : FORMAT-*Pro* and FORMAT-*light* products depending on the user's experience

4.3. Threats to be avoided: (Builders and user recommendations)

- scarce involvements of the decision makers / beneficiaries (need to be involved at the beginning, middle and end of case study to guarantee meeting their expectations and correct the course of the case study)
- No involvements of clients of Whirlpool
- Time consumption in stage 3
- Information feed to stage 4 (requires more information retreival)

©FORMAT Consortium Members. All rights reserved.

- Time shortage in stage 5
- Ability to access, remember and exchange data with others (require some improvements)
- Validation in stage 5 requires the use of many tools to compare results

- Not involving experts in plastics industry (reporter's comment)

5. Questionnaire results: (Scoring Card)

The scoring card (annex-I in D4.1) [1] was planned to be a method to measure the beneficiary's satisfaction about the "value of outcomes". As this was not possible in the moment, the questions were given to the builders and users to estimate the value of outcomes and to improve the scoring card itself. It will also be a good reference when compared to the beneficiary's answers.

The questions had multiple choice answers that were given a corresponding mark: These marks were as follows:
Definitely no (1); *more no* (2); *more yes* (3); *definitely yes* (4)
Each answer was averaged by the number of participant answering it. However, if a question was not answered, it took a (0) mark. Therefore, the participant was not counted in the calculation of the relevant mark average. After the average calculation, the average mark having a value between 2.4 and 2.6 were considered as "neutral"

Table 1 shows the questions of the scoring card and the relevant averaged answers.

Table 1. Scoring card and participants responses.

Questions	Averaged answer
Were the **objectives** set for the project appropriately addressed by the methodology?	3.7 - definitely yes
Does **the output** of the methodology provide an **answer to the required questions**?	3.1 – more yes
Does the methodology **overlook** any important factors?	2.4 - neutral^{+}
Are the results adequate to analyze the impact on the **technical** performance of the analyzed technology? *	3.1 – more yes
Are the results adequate to analyze the impact on the **economic** performance of the analyzed technology? *	2.5 – neutral
Are the results adequate to analyze the impact on the **sustainability** of the analyzed technology? *	2.7 – neutral to more yes
Are the **results unexpected** or surprising in some way?	2.4 – neutral
Do you think that you would not have arrived to these conclusions without doing the forecast?	3 – more yes
Can you accept that the result is likely to be correct?	3.4 – more yes

©FORMAT Consortium Members. All rights reserved.

Are the recommendations, based on the output, useful for decision-making?	2.9 – more yes
Did the forecast help to gain new insights about the environment of the company?	3.1 – more yes
Did the forecast help you to reduce uncertainties in projects or strategies…or to adapt to such uncertainties?	2.7 – neutral to more yes
Did the forecast lead to a better understanding the market (potential customers, customer needs, competition)?	2.9 – more yes
Does the forecast improve the capability of the company to accept or adopt alternative perspectives towards the future?	2.8 – more yes
Do you value the result in terms of usefulness and non-obviousness?	2.9 – more yes
Are the efforts needed for the whole methodology acceptable compared to the output it provides?	2,6 - neutral

6. How this case-study compare to others?

6.1. Introduction

It was not easy to find other case studies for TF of vacuum forming because it is a very specific topic and when found it had an expensive price. However, the published parts of these studies on the web in addition to other general studies and articles in the plastics industry helped the recommendations in this part

6.2. Recommendations for improvements:

The following tools and variables have been studied or mentioned by the some compared articles and reviews in similar topics (plastics industry, machinery and market)

- Experts needed:
  To involve in the case study some external interviews with manufacturers in the thermoformed plastic industry (ask the specialist).
  Is the thermoforming machinery sector generally growing or declining (and in particular vacuum forming machinery)?
  Interviewing industrial leaders (in plastics machinery for example) to give their views about industry trends, supply and demand outlook, global growth initiatives.
- Investments and sales trends of vacuum forming equipment could be helpful information to be extracted either from experts or some other sources (internet)
- Viewing raw materials pricing statistics in the last 10 years
- Addressing Drivers and Barriers of the market growth of thermoformed plastics
- Researching current market trends and projecting market needs of in the coming years
- Measuring global trends by getting information from the “quarterly business survey for processors” from the SPI processors council (the plastics industry trade association) also from there, information about thermoforming equipment ordering
- Using or being inspired by other modelling techniques could provide a possible development in stage 3, for example: Porter’s five force model analysis for the forces that shape industry competition [9]

©FORMAT Consortium Members. All rights reserved.

- Micro and macro factors essential for the existing market players
- Value-chain analysis
- Projecting a technological growth map **over time** for the technology growth rate
- Connect with some relevant statistics for plastics, appliance market and industrial growth in Europe (Eurostat)
- Some variables that could be interesting for the builders:
    - To Include housing and real estate activity (new home start) as an indicator (direct effect on the market household appliances)
    - to include the effects of new-products introduction in the market (the customers buy more when more new products are released to the market)
    - To relate the effect of offshoring and outsourcing processes on the margin profit

6.3. General threats to be avoided (for appliances manufacturing technologies)

The same reports and articles in the previous section have mentioned some variables that could have a negative impact on beneficiary.

- Fluctuation in the currency market (some reference to economic indicators and currency forecast could be helpful; such as http://forecasts.org/economic-indicator/)
- Fluctuation in plastic prices due to crude oil and energy costs
- Whirlpool is a user rather than a developer of the vacuum forming machine, which could require asking experts from vacuum forming machinery industry
- Some rising trends like for example biopolymers and bioplastics* might need to be taken into account to be prepared for disruptive trends
- What are the challenges in increasing durability and weight-bearing capacity of thermoformed products?
- What external threats could harm the beneficiary?
- What are Whirlpool competitors doing?

7. Summary and Conclusions

The methodology has several **advantages** that make it unique in comparison with other state of the art technology forecasting methods. The builders, user and assessment reporter provided various recommendations to improve the efficiency and contents of the case studies. This will require categorizing of the recommendations depending on the priorities and possibilities of engaging on the short or long term plans in FORMAT. The main recommendations were:

- The need of reducing time consumption and using more economic expertise and variables. This need has been expressed by all the participants of the assessment.
- The balance between quantitative and qualitative techniques is expected to improve upon more availability of information.
- The case study has provided effective **replicable results** using various techniques.
- More efforts are required to synthesize the **results in stage 5** (validation and assessment).
- A **more detailed assessment** shall be based on this one to inspect the FORMAT and case studies documentations, deliverables and sessions.

©FORMAT Consortium Members. All rights reserved.

The reporter suggests: applying some **documentation design** for the results to be filled in (from quality management auditing field) so it will be easier to access information and integrate the results. Also, structuring in advance the **methods to be used in stage 5** could help the builders to provide their results in a form that serve stage 5 techniques.

Summary of the results analysis
The participants' experience, opinion and recommendations can be clustered in a SWOT representation. 4 of the categories were expressed by the opinion of interviewed participants, while extra two categories about other non-Format studies have been included by the reporter.

Strengths (team) Replicability – availability of technical expertise – Practical methodology – straightforward - state of the art "modeling; NoC; evolutionary trends" – team mutual learning (improved team dynamics)- the case-study supports a more confident decisions	**Weaknesses** (team) Long overall duration– scarcity of historical data - difficulty of obtaining information – required more efficient circulation of information between team members
Opportunities1 (team) Recommendations for improvements from the builders and user of the methodology.	**Threats1** (team) Problems pointed out by the builders and user of the methodology
Opportunities2 (reporter) What factors are investigated by other forecasters of vacuum forming and appliances? Recommendations from the reporter	**Threats2** (reporter) What are the external threats that can affect the forecasted technology and the relevant market?

8. Bibliography

[1] Vanherck K., "Evaluation Metrics", Deliverable D4.1, FORMAT project, 2013. [Online]. Available:http://www.format-project.eu/deliverables/public-reports-and-white-papers/evaluation-metrics/view
[2] http://www.transparencymarketresearch.com/thermoformed-plastics-market.html
[3] http://www.plasticsindustry.org/IndustryGroups/IndustryDetail.cfm?ItemNumber=6663
[4]http://www.plasticsnews.com/article/20130219/DATA/302199998/injection-molders-market-review-and-outlook-2013-n-america-firms
[5]http://www.plasticsnews.com/article/20130404/NEWS/130409948/us-injection-press-sales-still-on-the-rise-plastic-manufacturing
[6]http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Manufacture_of_rubber_and_plastic_products_statistics_-_NACE_Rev._2
[7] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Comparative_price_levels_of_consumer_goods_and_services
[8]http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Sustainable_development_-_consumption_and_production
[9] Porter M.E., "The Five Competitive Forces that Shape Strategy", Harvard Business Review, January 2008, p.86-104. [Online] http://hbr.org/2008/01/the-five-competitive-forces-that-shape-strategy/ar/1

©FORMAT Consortium Members. All rights reserved.