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Deliverable 6.3

D6.3: User Experience Evaluation

WP6: Use case evaluation and ethical considerations

T6.3: Qualitative evaluation of user experience and feedback

Version: 1.0

Dissemination Level: PU

Table of Contents

List of Figures

List of Tables

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Executive Summary

Deliverable D6.3 is a public document of the AI-PROFICIENT project delivered in the context of WP6 "Use case evaluation and ethical considerations" and, more specifically, T6.3: Qualitative evaluation of user experience and feedback. It is the final version of deliverable D6.3, and the aim is to summarize the user experience and feedback related to those use cases where AI-PROFICIENT services have been deployed. The methodology used is as per description in D6.6 (AI-PROFICIENT Validation Methodology).

The key conclusion of this task, detailed below in this deliverable, is that both industrial partners, Ineos and Continental, positively rate both the quality of the AI algorithms developed for their relevant use cases, as well as the interface deployed to communicate the AI-results with the end user. This conclusion is based on a limited evaluation period, especially at Continental where the use cases found late deployment (October 2023). Hence further assessment will be required in the months to come.

1   Introduction

1.1 Scope of the deliverable

The deliverable describes the approach and results of the qualitative evaluation of user experience and user feedback. The methodology used is outlined in Deliverable 6.6 (AI-PROFICIENT Validation Methodology).

The deliverable disregards use cases for which no AI-PROFICIENT services have been deployed prior to November 1st, 2023.

The relevant use cases are:

Continental

- Use Case 2: Restart Setup
- Use Case 3: Released extrusion optimization
- Use Case 5: Tread blade wear
- Use Case 10: Quality analysis tool

Ineos Use Case 2: Geel Image Recognition

1.2 Approach of the evaluation

Surveys have been carried out amongst the different users who interact with the HMI (Human Machine Interface). The questions focus on the impact of the developments on daily work, the easy use of the applications, their usefulness in solving day-to-day problems, etc.

The following table shows which codes will be used to construct the identifiers.

UX_ID	ID	Meaning
Qualitative	QUA	Qualitative
Identification of the industrial site	C	Continental
	IC	Ineos Cologne
	IG	Ineos Geel
Use Case	UCX	Use Case Number
Identifying ID	X	Number

Table 1 : Identifiers for User Experience

A set of questions has been developed, tailor made to the specifics of each use case at Ineos or Continental. The questionnaires are detailed below:

UX_ID	Description	Result
QUA-C-UCX-1	Do you think that AI displays helpful information for your job?	
QUA-C-UCX-2	Do you think the AI provides information at an optimal periodicity?	
QUA-C-UCX-3	Do you think AI provides enough information in advance to be useful?	
QUA-C-UCX-4	Does the solution capture the feedback from the user?	
QUA-C-UCX-5	Does the solution display information to the relevant user in an understandable way?	
QUA-C-UCX-6	Do you believe that AI provides accurate information?	
QUA-C-UCX-7	Does the proposed solution reduce the number of corrective actions to be taken by the operators?	
QUA-C-UCX-8	Do you think that the information provided by AI improves the process in any significant way?	
QUA-C-UCX-9	Do you think the recommendations provided by AI could negatively impact another segment of the production process?	
QUA-C-UCX-10	Do you think that the information provided by the AI helps to understand the line's functioning better?	
QUA-C-UCX-11	Does the system offer explanations of the recommendations so that trustworthiness in the AI system is ensured?	

Table 2 : Qualitative Evaluation Questions of Continental

UX_ID	Description	Result
QUA-IG-UC2-1	Is the AI-PROFICIENT tool easy to handle/manipulate on the work floor?	
QUA-IG-UC2-2	Is the AI-PROFICIENT tool reliable ('photo first time right')?	
QUA-IG-UC2-3	Does the AI-PROFICIENT tool reduce human errors?	
QUA-IG-UC2-4	Would you be in favor of deploying the AI-PROFICIENT tool in other similar use cases?	
QUA-IG-UC2-5	Do you trust the AI-PROFICIENT tool?	

Table 3 : Qualitative Evaluation Questions INEOS Geel UC2

On each question, a rating was given from 1 to 5.

- Strongly disagree 1
- Disagree 2
- Neutral 3
- Agree 4
- Strongly agree 5

For Ineos, the tool used to gather user feedback was Microsoft Office Forms as shown in figure 1 for Ineos Use Case 2 (questions as per local legislation in native language).
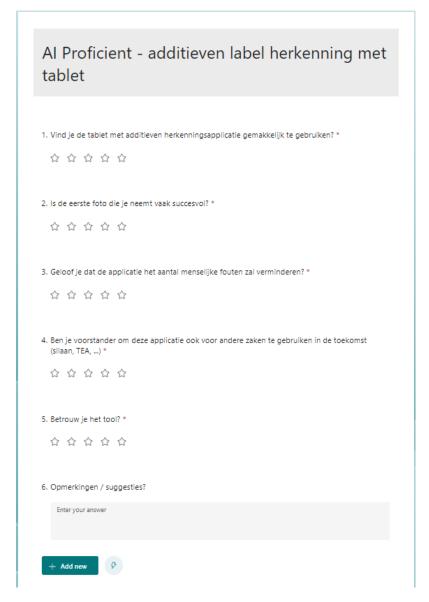
Figure 1: Office Forms questionnaire Ineos Use Case 2

The Continental use cases only found deployment in October 2023. This made Microsoft Forms surveying not the appropriate tool given the limited evaluation period within the time frame of the project. Specific evaluation meetings were organized to capture user feedback.

1.3 Qualitative Evaluation Final Result

For each use case, one number aggregating the feedback on all the questions is calculated.

Each time significant modifications are done to the AI-PROFICIENT Service (even beyond the 3-year time frame of this project), a new survey can be done and an aggregated number will be calculated. This serves as an indicator on the impact of the changes made and can trigger further actions for improvement.

2 Results

2.1 Continental Use Case 2

Go live date AI-PROFICIENT Service: October 4th, 2023

Target audience of survey (roles): Combiline Process technician

> The process technician is responsible for the proper functioning of the machine and corrects/analyses problems that the main operator cannot correct/analyse on his own.
> He is also responsible for creating recipes and will be able to judge whether the optimizations proposed by AI-PROFICIENT's services are relevant.

Time span of survey: From October 4th to October 31st.

Number of participants to the survey: 2 technicians

Summary table of feedback per question:

UX_ID	Description	Result
QUA-C-UC2-1	Do you think that AI displays helpful information for your job?	4.0
QUA-C-UC2-2	Do you think the AI provides information at an optimal periodicity?	4.3
QUA-C-UC2-3	Do you think AI provides enough information in advance to be useful?	5.0
QUA-C-UC2-4	Does the solution capture the feedback from the user?	2.0
QUA-C-UC2-5	Does the solution display information to the relevant user in an understandable way?	4.0
QUA-C-UC2-6	Do you believe that AI provides accurate information?	NA
QUA-C-UC2-7	Does the proposed solution reduce the number of corrective actions to be taken by the operators?	2.5
QUA-C-UC2-8	Do you think that the information provided by AI improves the process in any significant way?	NA
QUA-C-UC2-9	Do you think the recommendations provided by AI could negatively impact another segment of the production process?	NA
QUA-C-UC2-10	Do you think that the information provided by the AI helps to understand the line's functioning better?	2.0
QUA-C-UC2-11	Does the system offer explanations of the recommendations so that trustworthiness in the AI system is ensured?	2.0

Table 4 : Qualitative Evaluation Result Continental UC2

Final Result (aggregated number): 3.2

Actions identified – lessons learned:

Due to the limited time available for evaluating the use case, the decision was made to rely on historical data for the assessment.

QUA-C-UC2-1: Helpful information is displayed to improve the start of the Combiline.

QUA-C-UC2-2/3/5: For the optimized recipes, the service is providing enough information and before the line starts. This gives to the operator the needed time to adjust the settings.

QUA-C-UC2-4: On the Human Machine Interface, there is a function to get the feedback from operators. Unfortunately, so far this function is not integrated by the services.

QUA-C-UC2-6/8/9: Due to the short testing time, it is complicated to evaluate (despite evaluation with historical data are promising) if the propositions given by the services are correct enough to improve the starting up of the line.

QUA-C-UC2-7: The current solution is not yet optimized, and the operator still needs to switch manually from AI starting parameter to nominal production parameter, this is increasing the number of operator actions.

QUA-C-UC2-10/11: There is no explanation about the chosen optimized settings suggested by the service.

2.2 Continental Use Case 3

Go live date AI-PROFICIENT Service: October 4th, 2023

Target audience of survey (roles): Combiline Process technician
> The process technician is responsible for the proper functioning of the machine and corrects/analyses problems that the main operator cannot correct/analyse on his own.
> He is also responsible for creating recipes and will be able to judge whether the optimizations proposed by AI-PROFICIENT's services are relevant.

Time span of survey: From October 4th to October 31st.

Number of participants to the survey: 2 technicians

Summary table of feedback per question:

UX_ID	Description	Result
QUA-C-UC3-1	Do you think that AI displays helpful information for your job?	3.4
QUA-C-UC3-2	Do you think the AI provides information at an optimal periodicity?	3.7
QUA-C-UC3-3	Does the solution display information to the relevant user in an understandable way?	3.7
QUA-C-UC3-4	Do you believe that AI provides accurate information?	3.2
QUA-C-UC3-5	Does the proposed solution reduce the number of corrective actions to be taken by the operators?	No result
QUA-C-UC3-6	Do you think that the information provided by AI improves the process in any significant way?	3.3
QUA-C-UC3-7	Do you think the recommendations provided by AI could negatively impact another segment of the production process?	3.5
QUA-C-UC3-8	Do you think that the information provided by the AI helps to understand the line's functioning better?	3.4
QUA-C-UC3-9	Does the system offer explanations of the recommendations so that trustworthiness in the AI system is ensured?	2.5

Table 5 : Qualitative Evaluation Result Continental UC3

Final result (aggregated number): 3.3

Actions identified – lessons learned:

QUA-C-UC3-1/8: In a positive way, the AI provided innovative suggestions for settings that would typically not have been explored.

QUA-C-UC3-2: When analysing historical data, AI provides information at an optimal periodicity, which should be confirmed through online tests for validation.

QUA-C-UC3-3: The Human Machine Interface offers two result views: one designed for operators and another for process technicians. Both views present information in a comprehensible manner.

QUA-C-UC3-4: The top-ranked suggested setting is the one we believe will significantly influence the relaxation extrusion, providing confidence in the accuracy of the model. However, this finding needs to be confirmed through online testing for validation.

QUA-C-UC3-5: The optimization of relax extrusion is not currently within the operator's scope, and as a result, AI will not enhance this aspect.

QUA-C-UC3-6: The offline data show promising results, but testing in production with specific settings that have not been tried yet is necessary.

QUA-C-UC3-7: Relax extrusion is indeed sensitive, and modifications to certain adjustments can have a significant impact on the geometry of the product.

QUA-C-UC3-9: There are no explanations provided for the recommendations.

2.3 Continental Use Case 5

Go live date AI-PROFICIENT Service: October 4th, 2023

Target audience of survey (roles): Combiline Process technician
> The process technician is responsible for the proper functioning of the machine and corrects/analyses problems that the main operator cannot correct/analyse on his own.
> He is also responsible for creating recipes and will be able to judge whether the optimizations proposed by AI-PROFICIENT's services are relevant.

Time span of survey: From October 4th to October 31st.

Number of participants to the survey: 2 technicians

Summary table of feedback per question:

UX_ID	Description	Result
QUA-C-UC5-1	Do you think that AI displays helpful information for your job?	4.0
QUA-C-UC5-2	Do you think the AI provides information at an optimal periodicity?	4.0
QUA-C-UC5-3	Do you think AI provides enough information in advance to be useful?	3.8
QUA-C-UC5-4	Does the solution capture the feedback from the user?	3.5
QUA-C-UC5-5	Does the solution display information to the relevant user in an understandable way?	4.0
QUA-C-UC5-6	Do you believe that AI provides accurate information?	No result
QUA-C-UC5-7	Does the proposed solution reduce the number of corrective actions to be taken by the operators?	3.7

Table 6 : Qualitative Evaluation Result Continental UC5

Final result (aggregated number): 3.8

Actions identified – lessons learned:

QUA-C-UC5-1: The AI provides valuable information about the current blade weariness and generates multiple reports to assist operators, technicians, and maintenance teams.

QUA-C-UC5-2/3: The service provides real-time information, enabling operators and maintenance personnel to decide whether the blade should be changed or not.

QUA-C-UC5-4: The solution considers operator feedback and generates detailed reports based on the provided inputs.

QUA-C-UC5-5: Two levels of information are offered to both operators and maintenance personnel through the Human Machine Interface, ensuring that the content is optimized to be relevant and understandable.

QUA-C-UC5-6: Online tests will determine the accuracy of the information provided by the AI

QUA-C-UC5-7: Accurate weariness measurements will enable the shift from curative to predictive maintenance, optimizing the timing for blade replacements.

2.4 Continental Use Case 10

Go live date AI-PROFICIENT Service: October 4th, 2023

Target audience of survey (roles): Combiline Process technician
> The process technician is responsible for the proper functioning of the machine and corrects/analyses problems that the main operator cannot correct/analyse on his own.
> He is also responsible for creating recipes and will be able to judge whether the optimizations proposed by AI-PROFICIENT's services are relevant.

Time span of survey: From October 4th to October 31st.

Number of participants to the survey: 2 technicians

Summary table of feedback per question:

UX_ID	Description	Result
QUA-C-UC10-1	Do you think that AI displays helpful information for your job?	4.0
QUA-C-UC10-2	Do you think the AI provides information at an optimal periodicity?	3.2
QUA-C-UC10-3	Do you think AI provides enough information in advance to be useful?	3.6
QUA-C-UC10-4	Does the solution capture the feedback from the user?	1.5
QUA-C-UC10-5	Does the solution display information to the relevant user in an understandable way?	3.6
QUA-C-UC10-6	Do you believe that AI provides accurate information?	3.5
QUA-C-UC10-7	Does the proposed solution reduce the number of corrective actions to be taken by the operators?	3.3
QUA-C-UC10-8	Do you think that the information provided by AI improves the process in any significant way?	3.2
QUA-C-UC10-9	Do you think the recommendations provided by AI could negatively impact another segment of the production process?	No result
QUA-C-UC10-10	Do you think that the information provided by the AI helps to understand the line's functioning better?	3.5
QUA-C-UC10-11	Does the system offer explanations of the recommendations so that trustworthiness in the AI system is ensured?	3.5

Table 7 : Qualitative Evaluation Result Continental UC10

Final result (aggregated number): 3.3

Actions identified – lessons learned:

Due to the limited time available for evaluating the use case, the decision was made to rely on historical data for the assessment.

QUA-C-UC10-1: The service provides the operator with a set of corrective parameters for any current or upcoming deviations, helping the operator's daily tasks. While by using historical data we have confirmed that the deviation is accurately predicted, there was no opportunity to confirm the relevance of the suggested corrective machine settings.

QUA-C-UC10-2: AI-PROFICIENT is providing data at an optimal periodicity when deviation has been detected (60% of the time).

QUA-C-UC10-3: As for the other UCs, there are two information levels. The one for the operator has up to 5 optimized machine settings (with an average of 3) suggested by AI, which is positive.

QUA-C-UC10-4: On the Human Machine Interface, there is a function to get the feedback from operators. Unfortunately, so far this function is not integrated by the services.

QUA-C-UC10-5: On the Human Machine Interface, the suggested parameters are displayed in an understandable way.

QUA-C-UC10-6/8: The evaluation with the historical data gives confidence to the result we could get by the services. Needs to be validated by online tests.

QUA-C-UC10-7: The action given by AI will avoid further corrective actions. Needs to be validated by online tests.

QUA-C-UC10-9: This cannot be evaluated with historical data.

QUA-C-UC10-10: AI can generate novel and innovative suggestions that may not have been considered before. This needs to be corroborated with online data.

QUA-C-UC10-11: Characterisation and ponderation of the influent parameters are given but there is no explanation of the reason why those parameters are influent (the causality between influent parameters and they effect on product parameters is missing).

2.5 Ineos Use Case 2

Go live date AI-PROFICIENT Service: April 5th, 2023

Target audience of survey (roles): plant operator

> No distinction is made between a console operator and a field operator as all Ineos Geel operators are part of a rotation scheme in which they act one given period as a console operator, and another given period as a field operator, hence each operator can comment on his/her user experience with the AI-PROFICIENT tool from both perspectives.

Time span of survey: given the individual work regimes of each specific operator within the 12 hour shift system, the time span of the survey was from July 17th of 2023 till August 31st of 2023.

Number of participants to the survey: 32

Summary table of feedback per question:

UX_ID	Description	Result
QUA-IG-UC2-1	Is the AI-PROFICIENT tool easy to handle/manipulate on the work floor?	3.5
QUA-IG-UC2-2	Is the AI-PROFICIENT tool reliable ('photo first time right')?	3.3
QUA-IG-UC2-3	Does the AI-PROFICIENT tool reduce human errors?	3.1
QUA-IG-UC2-4	Would you be in favor of deploying the AI-PROFICIENT tool in other similar use cases?	3.3
QUA-IG-UC2-5	Do you trust the AI-PROFICIENT tool?	3.9

Table 8 : Qualitative Evaluation Result INEOS Geel UC2

Final result (aggregated number): 3.4

Actions identified – lessons learned:

QUA-IG-UC2-1: the scoring is acceptable though shows room for further improvement. The opportunity lies especially in the combined use of gloves (mandatory) and the tablet. This challenge was identified upfront, and use of a voice controlled device can be considered in a next phase as a potential add on to the tablet.

QUA-IG-UC2-2: since the deployment of the service in April 2023, multiple updates have been implemented to improve the reliability of the tool. It is expected this will carry on in near future in an attempt to maximize tool reliability.

QUA-IG-UC2-3: it's the operators current assessment that this tool is likely to reduce human errors, though needs to be confirmed after having used the tool for a longer period of time

QUA-IG-UC2-4: a score of 3.3 reflects some reservation to deploy similar services more widely in the manufacturing community, though it is assessed to be a rather positive indication that the operators are open to explore further use. As this is a new service in a rather conservative industry, a higher score was not expected.

QUA-IG-UC2-5: this is a very positive result, trusting AI services needs to grow. It's surprising that after just a few months of using the service, the confidence level is already scored at 3.9 out of 5, which is a boost to explore further use cases.

3 Conclusion

The performance of the AI algorithms, both on Continental and Ineos, is seen as positive and promising. The output is of added value and in line with expectations. In the specific case of Continental, the suggestions made by the tool are often novel and are worth further investigation.

In terms of usability of the tool and interface developed, both industrial partners are happy with the output.

For Ineos, the tool shows a good performance in an industrial environment (well readable, easy to manipulate when wearing gloves).

For Continental, the fact that all service outputs are available on the same Human Machine Interface (with multiple layer operator/manager) is also really appreciated and makes the AI suggestion standard and easy to interpret.

The rather late development of the services does require further assessment of the tools in the months to come, beyond the time frame foreseen under the AI-PROFICIENT project.

4 Acknowledgment