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## D4.1 Validation Metrics for CoME

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## Glossary

Acronym	Meaning
MCI	Mind Cognitive Impairment
QoE	Quality of Experience
QoS	Quality of Service
KPI	Key Performance Indicator
ROI	Return On Investment

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# 1. Introduction

## 1.1. Objectives of the Task

CoME provides an **innovative person-centred care approach** for covering prevention, early detection and management of MCI. This approach is always framed by an **independent living environment** that try to ensure seniors' independency for as long as possible, allowing them to take their own health decisions, continually supported by professional and informal caregivers (if allowed by the senior).

To ensure the usability of the platform, the services need to be tested and evaluated by the final users. Since the community members will contain different type of users, e.g., elderly, informal and formal caregivers, with different levels of skills, ages and social levels, as well as with different roles and functions in the system, the platform should be able to meet their needs and therefore it should involve them in the design and development process in the different phases of the project development.

The evaluation methodology consists of, on the one hand, collecting and analysing data through the user's subjective feedback to inform designers and developers about their expectations (qualitative methods). Additionally, the methodology consists of collecting and analysing data collected through the platform itself, e.g., number of users connected to a platform, average interaction time with a platform, amount of data collected via user's wearables, and so on (quantitative methods).

The Validation metrics document identifies the set of prioritized requirements and identifies Key Performance Indicators (KPI) and Quality of Experience (QoE). Furthermore, the evaluation procedure for the detailed protocols is established within the project, as well as the evaluation feedback is gathered through online and face-to-face interviews and questionnaires. The details of users involvement so far are provided in D.2.1 "User Involvement Plan", while the details of the results do far with respect to the user's acceptance and lessons learned are provided in D4.4 "User Acceptance Report".

The evaluation established in this deliverable D4.1 will be focused on the core modules functionalities as well as on the **final services functionalities validation** (Web application/Android app). The objective of this deliverable is therefore the **final validation** of the performance and usability and use experience of the platform from quantitative and qualitative perspective. Nevertheless, some of the indicated metrics and measured have been already started to be evaluated in first and second version of the CoME prototype (as indicated along this document).

## 2. Quality of Experience (QoE) Measurements

The notion of Quality of Experience (QoE) is used to measure the user's experiences with an online service. It allows describing the Quality of the Service (QoS, like speed accuracy and dependability) as perceived by the user by quantifying the subjective experience gained by using the service. Many approaches have been proposed in the literature in order to measure, evaluate, and improve QoE. With regard to CoME, three approaches are presented:

- **Usability Metric:** QoE is how the user perceives the usability of a service when in use, i.e., how he/she is satisfied with a CoME service in terms of usability, accessibility, retainability, and integrity (1).
- **Hedonistic Concept:** QoE describes the degree of delight of the user for the CoME service, which can be influenced by different factors such as content, network, application, user expectations and goals, and context of use, including user's mood (2).
- **Buzzword Extension:** QoE has been defined as an extension of traditional KPIs used in the QoS concepts in the sense that QoE provides information regarding the delivered services from the point of view of an end-user (3).

The QoE will be evaluated with the CoME users using unified questionnaires in face-to-face interviews before and after the use of the platform. This qualitative research methodology will let us know the level of participant's knowledge at any time while we show the web platform.

The results of the questionnaires addressing usability and QoE so far, i.e., for the first prototype (as of Jan 2018), are reported in the CoME "User Acceptance Report" (Deliverable D4.4, "The evaluation process for the first prototype").

## 3. Key Performance Indicators (KPIs) Measurements

Different organizations use the Key Performance Indicators (KPIs) as a measure of performance management to evaluate (success/failure) of their activities, services or products. The list of KPIs is large and the choice depends more on the activity and the goals that one is aiming to achieve.

In order to get the most valuable feedback from the evaluation of the CoME platform, we need to reach users (and all different types of users) and communicate with them to learn more about their preferences about the proposed services.

To evaluate the success of the services, we need to identify and formulate a list of specific KPIs that meet the CoME expectations. Moreover, we need to communicate the KPIs between diverse experimentation environments, harmonize the means of evaluation, as well as compare the outcomes between the different evaluation sites, providing thus a holistic performance indication for the CoME platform, via the harmonized outcomes.

As CoME is a combination of "promoting self-management and enhancing autonomy to older adults, with the support of the professional and informal (like family or friends) caregiver's support, with the usage of tutorials, as well as guidance of prevention and action in risk situations, elaborated by professionals", we adapt the most common KPIs used for its evaluation, which are:

- Promote self-management and enhancing autonomy for older adults;
- Encourage prevention (in case of non-MCI diagnosed seniors) and support to improve the wellbeing of them;

- Improve quality of life for older adults and their carers;
- Stimulate participation to learn, share knowledge, and support each other;
- Create a relationship between caregivers to facilitate experiences exchange;
- Increase and facilitate the supply of formal and informal care for older adults;
- Refining services and objectives to ensure person centred care for older adults;
- Sustain health outcomes to regain independent lifestyles of older adults;
- Increasing the number of people engaged in the platform;
- Improve efficiency of service delivery from new solutions provided where the quality of the service remains the same or improves.

In (4), authors associated most of these KPIs with one or more of the following KPIs: insights, exposure, reach and engagement. Regarding the CoME platform, there are the following KPIs to be employed in the final prototype:

- **Insights and Satisfaction** are related to the user feedback about the services and functionalities proposed by CoME. These feedbacks can be collected through semi-structured pre-post questionnaires (qualitative analysis) and with the data extracted from the CoME platform, mainly the CoME database, regarding the usage the users make of them (quantitative analysis, data like number of times the application is used and for how much time). These data will be successfully analysed by end-user organizations through the use of different algorithms that will allow them to understand the user's attitudes, and reason upon their expectations and perspectives on a particular topic. The analysis can reflect the user's satisfaction, which allows to verify the usefulness of the proposed services and to identify potential adjustments.
  - Note: Initial aspects of the users' insights and factors influencing user's satisfaction have been already evaluated in prototype 1 but it is as of prototype 2 when they will acquire more importance because it is when most functionalities are available to perform a valuable validation. Results from this evaluation will be reported in D4.4 "User Acceptance Report"
- **Brand Awareness and Exposure.** One of the goals of CoME strategy is to create and maintain a positive image among users and to assess their impressions about the proposed services. The duration of activity or time spent by the user with the CoME application and the degree of the involvement with them are accurate KPIs to measure brand awareness, and the impressions or the number of times a content is viewed to measure the Exposure. These metrics can be measured quantitatively by the platform itself. They will not be performed till the final prototype when real users (not technical testing ones) are only in the database and reliable data can be obtained.
- **Reach and interaction with users.** It is important to communicate with users to understand their preferences and the improvements or changes they would like to suggest for the CoME platform. During the co-design phase of CoME as well as in the different trials for each prototype, users will be subjected to a set of unified semi-structured questionnaires after using the platform in order to get insights supporting the operationalization of the previously mentioned KPIs. In order to get accurate and effective results, different questionnaires will be performed depending on: whether the user is a formal caregiver, and informal caregiver or a senior, whether the user is a new income for this trial or he/she has been involved previously in other trials, etc.
  - Note: Initial aspects of users' feedback and interaction design have been evaluated from the mock-up phase and they will be kept till the final prototype. Results from this evaluation will be reported in D4.4 "User Acceptance Report"
- **Web traffic analytics and Engagement.** Web traffic analytics to the website and the CoME platform, give us the possibility to assess the number of users interested in CoME

as well as the number of already registered people and the actions they perform. Several analytics reporting tools such as Google Analytics are used to measure the success of websites almost in real-time. They allow making changes and improvements on the application or website to further guarantee its success. Moreover, these metrics are linked to other KPIs, i.e., the user involvement and engagement. This can be reflected from the actions performed by the user on the CoME platform. It can range from low to medium to high:

- Low engagement: users are using the platform without interacting with it but only for knowledge.
- Medium engagement: users are involved in exercises proposed by the formal caregivers, following recommendations proposed by the informal and formal caregiver.
- High engagement: users are changing their behaviour, and share experience and offering help to other users through the application.

In addition to Google Analytics, a script will be created to obtain information from the CoME DB and to elaborate statistics that quantitatively reflect the level of achievement of these KPIs. This script will be executed at M33 (delivery of the final prototype) and M36 (project end) in order to assess how changes are performed in the last three months of the project. Results from this evaluation will provide us valuable insights about the engagement expected in CoME.

- **Platform Reliability and Profitability.** The assessment of the platform reliability is useful to improve the maintenance effectiveness and efficiency. The identification of the issues causing maintenance effects will help to select the right strategy to reduce risk and improve operational performance due to technological solutions with the least resources and time. Service costs will be adequately addressed in D5.3 Exploitation Strategy, Business Case & Draft Exploitation GA. This service activities will allow us to keep CoME working effectively and to improve profitability and thus, support the business aims which can be assess through several KPIs such as the Net Present Value (NPV) , the Internal Rate of Return (IRR) and the Return On Investment (ROI). These KPIs will be analysed in each new iteration of D5.3.

Regarding the proposed key performance indicators, specific evaluation metrics need to be defined for each KPIs, as follows.

## 4. Key Performance Indicators (KPIs) Metrics

Many measurements can be performed and analysed for CoME as web/mobile application to support elderly life. However, they are not all necessary and they depend on the provided services. KPIs are often expressed as specific measurements such as ratios or averages (e.g., the average number of achieved goals), while they can also represent broader or more general constructs (e.g., influence or engagement). For CoME, we gathered the following metrics (See Table 1) which are associated with the KPIs to ensure that we can effectively reach the right audience.

Key Performance Indicator (KPI)	When is evaluated	Metrics
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<b>Brand Insights and Satisfaction</b>	Evaluated from prototype 2 till the end of the project Note: Initial aspects have been slightly evaluated for the first prototype. Results from this evaluations will be shown in D4.4 “User Acceptance Report”	<ul style="list-style-type: none"> <li>• Number of users satisfied with CoME platform</li> <li>• User satisfaction with the platform</li> <li>• Number of users satisfied with the health information provided by CoME</li> <li>• Number of users who prefer CoME again other apps such as the one provided by Fitbit.</li> <li>• Types of suggestion and recommendations</li> <li>• Sentiment: positive, neutral or negative of the users</li> </ul>
	Evaluated in the final prototype	<ul style="list-style-type: none"> <li>• Influence, i.e., how user’s behaviour can change due to the use of the CoME platform</li> </ul>
<b>Overall brand Awareness and Exposure</b>	They will not be performed till the final prototype when real users (not technical testing ones) are only in the database and reliable data can be obtained.	<ul style="list-style-type: none"> <li>• Number of overall registered users on the platform</li> <li>• Number of new registered users on the platform (e.g., /month)</li> <li>• Duration/Time spent by users using the web platform</li> <li>• Degree of involvement (e.g., number of visits, and when visiting: number of pages visited)</li> <li>• Number of health goals set vs number of health goals achieved (e.g., /month)</li> </ul>
<b>Reach and interaction with users</b>	Evaluated from mock-up phase till the end of the project	<ul style="list-style-type: none"> <li>• Post-trial questionnaire for seniors <ul style="list-style-type: none"> <li>○ Level of understanding of the application</li> <li>○ Level of Usability and accessibility</li> <li>○ Level of satisfaction to recommend the platform to other people</li> <li>○ Level of satisfaction with the steps required to perform activities in the platform</li> <li>○ Level of satisfaction regarding the increase of health self-reliance</li> <li>○ Level of operability</li> <li>○ Level of achievement of preferences for each of the pages in the platform</li> </ul> </li> </ul>
<b>Details on traffic analytics and engagement</b>	Evaluated every six months	<ul style="list-style-type: none"> <li>• Google Analytics (project web: <a href="http://come-aal.eu/">http://come-aal.eu/</a>) <ul style="list-style-type: none"> <li>○ Number of visitor to the site (e.g., daily)</li> <li>○ Number of new visitors to the site</li> <li>○ Visitors segment</li> <li>○ Actions performed by visitors</li> </ul> </li> </ul>
	Evaluated in the final prototype	<ul style="list-style-type: none"> <li>• Google Analytics (CoME platform: <a href="https://come.hi-iberia.es:4572/login.html">https://come.hi-iberia.es:4572/login.html</a>)</li> </ul>
	Evaluated twice	<ul style="list-style-type: none"> <li>• Engagement for seniors</li> </ul>

	<p>towards the end of the project, i.e.:</p> <ul style="list-style-type: none"> <li>• M33. Delivery of the final prototype</li> <li>• M36. Project end</li> </ul> <p>The idea about this is to delete testing users in the final prototype and then perform these metrics in order to get reliable information.</p>	<ul style="list-style-type: none"> <li>○ Registered seniors</li> <li>○ The number of active/inactive</li> <li>○ The age and gender</li> <li>○ The category of users</li> <li>○ The location</li> <li>○ The time spent by users using the platform</li> <li>○ The number of pages visited in CoME platform             <ul style="list-style-type: none"> <li>▪ Engagement (low)                 <ul style="list-style-type: none"> <li>• Complete/Not completed profile</li> <li>• Health and exercises goals</li> <li>• Pairing the wearable device with the platform</li> </ul> </li> <li>▪ Engagement (medium)                 <ul style="list-style-type: none"> <li>• Data for trends</li> <li>• Integration with MyGuardian</li> <li>• Achieved health goals</li> <li>• Informal caregivers</li> </ul> </li> <li>▪ Engagement (high)                 <ul style="list-style-type: none"> <li>• Preferences and privacy settings updated</li> <li>• Reports from formal caregivers</li> <li>• Games</li> <li>• Self-reports performed</li> </ul> </li> </ul> </li> </ul>
	<p>Evaluated twice towards the end of the project, i.e.:</p> <ul style="list-style-type: none"> <li>• M33. Delivery of the final prototype</li> <li>• M36. Project end</li> </ul>	<ul style="list-style-type: none"> <li>• Engagement for informal caregivers             <ul style="list-style-type: none"> <li>○ Registered informal caregivers</li> <li>○ The number of active/inactive</li> <li>○ The age and gender</li> <li>○ The location</li> <li>○ The time spent using the platform</li> <li>○ The number of pages visited in CoME platform                 <ul style="list-style-type: none"> <li>▪ Engagement (low)                     <ul style="list-style-type: none"> <li>• Complete/Not completed profile</li> <li>• Seniors.</li> </ul> </li> <li>▪ Engagement (medium)                     <ul style="list-style-type: none"> <li>• Preferences and privacy settings updated</li> <li>• Integration with MyGuardian</li> <li>• Participation in Forums</li> </ul> </li> <li>▪ Engagement (high)                     <ul style="list-style-type: none"> <li>• Amount of information/content uploaded</li> <li>• Amount of AR content uploaded</li> <li>• Amount of occasional caregivers contacted</li> <li>• Number of help requests from elderly satisfied by an informal caregiver</li> </ul> </li> </ul> </li> </ul> </li></ul>

	<p>Evaluated twice towards the end of the project, i.e.:</p> <ul style="list-style-type: none"> <li>• M33. Delivery of the final prototype</li> <li>• M36. Project end</li> </ul>	<ul style="list-style-type: none"> <li>• Engagement for formal caregivers <ul style="list-style-type: none"> <li>○ Registered informal caregivers</li> <li>○ The number of active/inactive</li> <li>○ The age and gender</li> <li>○ The location</li> <li>○ The time spent using the platform</li> <li>○ The number of pages visited in CoME platform <ul style="list-style-type: none"> <li>▪ Engagement (low) <ul style="list-style-type: none"> <li>• Complete/Not completed profile</li> <li>• Alarms processed</li> </ul> </li> <li>▪ Engagement (medium) <ul style="list-style-type: none"> <li>• Amount of information/content uploaded</li> <li>• Number of threads on discussions/topics in the forum</li> <li>• Integration with MyGuardian</li> <li>• Number of notifications read</li> </ul> </li> <li>▪ Engagement (high) <ul style="list-style-type: none"> <li>• Number of reports sent to seniors</li> </ul> </li> </ul> </li> </ul> </li> </ul>
<b>Platform Reliability and Profitability</b>	<p>Evaluated in each iteration of D5.3 Exploitation Strategy, Business Case and Draft Exploitation GA</p>	<ul style="list-style-type: none"> <li>• The Return On Investment (ROI)</li> <li>• The Net Present Value (NPV)</li> <li>• The Internal Rate of Return (IRR)</li> <li>• Conversion rate</li> </ul>

**Table 1. Key Performance Indicators (KPIs) and Related Metrics**

## 5. Conclusions

The Validation metrics are important to be addressed to assure the success of the newly developed services - the CoME services. This document has identified the set of prioritized Key Performance Indicators (KPI) and Quality of Experience (QoE) metrics that are necessary to be evaluated for the CoME services. The data supporting these KPI and QoE metrics are originating from the online and face-to-face interviews and questionnaires, as well as data collected via the platform itself. Some of the data has been already collected for the first prototype of the CoME and mainly reported in the D4.4 "User Acceptance Report". However, the analysis in this prototype is very slight. It is expected to have more valuable insights from these metrics in the second and final prototype of CoME, when more functionalities are available and qualitative and quantitative validation metrics are more realistic- especially those regarding performance, usability and use experience of the CoME platform.