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BOUNCE

Predicting Effective Adaptation to Breast Cancer to Help Women to BOUNCE Back

Research and Innovation Action
SC1-PM-17-2017: *Personalised computer models and in-silico systems for well-being*

Deliverable D1.2: BOUNCE Requirements & Usage Scenarios

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0.2. Documents history

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V0.1	02.04.2018	Starting version, TOC
V0.2	25.04.2018	First draft, template to gather partners' contribution
V0.3	10.05.2018	Second version with partners' contributions
V0.4	26.05.2018	First complete version send to project internal reviewers
V0.5	30.05.2018	First modified version based on review comments
V0.6	31.05.2018	Second modified version based on review comments
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0.3. Document data

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1. Table of Contents

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2. Executive Summary

The deliverable documents the results of T1.2 'Usage Scenarios, User, Functional & Technical Requirements'. The main objective of this deliverable is to define and present in detail the usage scenarios of the BOUNCE system and to derive from them functional and non-functional requirements for the outputs of the computer model and the overall BOUNCE platform and services/tools. User needs and requirements are examined from both the end users standpoint and the technological standpoint. By this means, BOUNCE ensures that project results will receive high user acceptance.

The deliverable starts with an introductory chapter (Chapter 3) where the adopted methodological framework for analyzing user needs and extracting system requirements is presented. Based on the stakeholder analysis documented in D1.1, the various actors of the BOUNCE system and the target groups are defined in Chapter 4. Target groups in the present analysis are considered the end users, i.e. the individuals that will actually interact with the BOUNCE system and make use of it. These are the healthcare professionals (oncologists, nurses, psychologists etc.), the social workers and the patients. The end-user needs and acceptance survey conducted in the form of interviews within T1.1 'Value Chain Definition and Stakeholders Identification' are analysed to derive user-perceived acceptance, expectations and challenges related to BOUNCE objectives, platform and services/tools. The results of this analysis are documented in Chapter 5. A set of clinical End User Scenarios that are driving the project research and technological developments are presented in Chapter 6. Based on the results of the survey, the analysis of the user scenarios and the identified needs of the various actors, the system requirements have been specified for each service/tool to be included in the BOUNCE platform (Chapter 7).

The identified services/tools can be summarized to the following:

1. Temporary Research Supporting Tool
2. Final Decision Support System
3. Personal Health System - Noona
4. Data Aggregator
5. Data Cleanser
6. Security Service
7. Model Repository
8. In Silico Trial and Prediction Repository

The requirements are presented based on the following agreed-upon typology:

- **Functional requirements:** description of the operations and activities that the BOUNCE service/tool must be able to perform
    - Generic functional requirements: description of generic functional requirements of the service/tool taking into account all major categories of users
    - User interface: description of the operations and interactions that need to be supported by the user interface
    - Access/Control: description of requirements related to access to stored data and control processes over stored data
    - Other processes supported: description of any additional operations/processes that the service/tool must do
    - Data Storage/Format: description of requirements related to data storage and required data format

  - Input: description of data to be entered into the service/tool
  - Output: description of service/tool's reports or other outputs
- **Non-functional requirements**: description of requirements that impose constraints on the design or implementation
  - Software platform: description of the software platform needed to support the service/tool
  - Hardware platform: description of the hardware platform needed to support the service/tool
  - Communication interfaces: description of the required communication interfaces to other systems or devices
  - Software interfaces: identification of the applications with which the subject application must interface.
  - Hardware interfaces: description of any hardware interfaces supported by the service/tool
  - Security and Privacy: description of physical security and access by user role or types
  - Capacity: description of the required capacities and expected volumes of data
  - Performance: may include Response time, Throughput, Expected rate of user activity
  - Reliability: may include Mean-Time-Between-Failure, Mean-Time-To-Failure, Mean-Time-To-Repair
  - Other Requirements: description of any additional non-functional requirements

Brief conclusions are presented in Chapter 8.
Thus, this document provides the required and sufficient guidelines upon which the BOUNCE system architecture and development may be based.

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3. Introduction

3.1. Resilience and breast cancer

Although the mortality of breast cancer in the developing world seems to be decreasing, with five-year relative survival rate for female invasive breast cancer patients rising from 75 percent in the mid-1970s to 90 percent today and in cases of localized breast cancer even reaching 98.5% [1], the incidence of breast cancer in the developing world is still rising [2]. In fact, breast cancer is currently the most common cancer in women world-wide accounting for 28% of the total cancer cases in the WHO European Region. Once confronted with a breast cancer diagnosis, women often feel devastated and filled with uncertainty, anxiety, chaos, hopelessness and despair [3].

The process of successful adaptation to breast cancer and the various accompanying stressors can be conceptually defined as the person's resilience, reflecting the will to 'fight for life' and bounce back. When faced with such potentially life-threatening events each person engages coping strategies that can vary widely on their capacity to provide adaptive solutions and ensure optimal recovery with respect to the disease itself as well as to the patient's overall quality of life. Resilience is a complex construct that can be defined on different levels: an individual's potential, a process, and an outcome. In the context of BOUNCE, extending previous definitions [4,5] (as described in WP2) resilience is conceptualized as " *a conglomerate of dynamic self-regulatory capacities that allow to mobilize and use internal and external resources over time in the face of adversity in order to maintain or promote wellbeing. The construct of resilience is used in three ways: (a) Resilience as a personal capacity or potential; (b) Resilience as an adaptive coping process or change trajectory; (c) Resilience as an outcome of maintaining healthy functioning and subjective well-being despite exposure to adversity".*

Many variables such as intellectual functioning, self-efficacy, optimism, active coping strategies, social support, and biological markers of stress have already been associated with resilience in the literature. Although theoretical contributions regarding resilience models in medical settings have been advanced, to date no one has evaluated the contributing role of multiple psychological, biological and functional variables in predicting the patient's ability to bounce back from the stressful life event of being diagnosed with breast cancer.

3.2. BOUNCE description

There is a well acknowledged, growing need for novel strategies to improve understanding and capacity to predict resilience of women to the variety of stressful experiences and practical challenges related to breast cancer. The fulfilment of this need is a necessary step toward efficient recovery through personalized interventions.

The currently available substantial body of knowledge on the concept of resilience, however, has yet to be translated into a dynamically adaptable, personalized assessment and intervention

planning process tool suitable for routine clinical use, which takes into account all known potentially relevant parameters that may affect illness adaptation. Multiple, complementary and often partially conflicting notions of resilience in the literature represent an important obstacle toward achieving this goal, discouraging attempts to include potentially crucial psychological parameters into computational predictive models. To further add to this issue, typically the clinical relevance of resilience definitions and corresponding measures used in existing research is not empirically tested against crucial illness outcomes.

To this end, BOUNCE will bring together modelling, medical, and social sciences experts to advance current knowledge on the dynamic nature of resilience as it relates to efficient recovery from breast cancer. Clinical, cancer-related biological, lifestyle, and psychosocial parameters will be taken into consideration in order to predict individual resilience trajectories throughout the cancer continuum and eventually increase resilience in breast cancer survivors, help them remain in the workforce and enjoy a better quality of life.

The output of the project will be a unified clinical model of modifiable factors associated with optimal disease outcomes. A prospective multi-centre clinical pilot at four major oncology centres (in Italy, Finland, Israel and Portugal) in the context of which a total of 660 women will be recruited, will be used in order to assess the clinical validity of the model against crucial patient outcomes (illness progression, wellbeing, and functionality).

The vision of BOUNCE is to develop a resilience trajectory predictor that will take into consideration biological, social, environmental, lifestyle, occupational and psychosocial status in order to predict levels of resilience of women with breast cancer throughout the cancer continuum, enable the healthcare professional to suggest resilience-building interventions to those who need it the most and eventually increase illness adaptation toward optimal clinical, well-being and functionality outcomes.

3.3. Task 1.2 description

According to BOUNCE Description of Action, Task 1.2 ‘Usage Scenarios, User, Functional & Technical Requirements’ will undertake the definition of the BOUNCE target group segments/characteristics, in order to facilitate the definition of use cases / usage stories, and their translation into detailed functional and non-functional requirements for the outputs of the computer model and the overall BOUNCE platform and services/tools. Within the context of Task T1.2, translation of user and functional / non-functional requirements to systemic and technical requirements will also take place. The efforts of task T1.2 are documented in the present deliverable.

It is noted that within Task 1.2, the main focus will be on identifying an initial list of systemic and technical requirements (both functional and non-functional). Requirement analysis on technical level will continue within WP5, where the list of system requirements will be further elaborated and finalized.

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3.4. From user needs to system requirements: Methodological framework

The requirement analysis conducted in the framework of the present deliverable includes three types of activity:

- ***Information gathering*** [6]: the task of communicating with users to determine their characteristics and what their needs and requirements are.
- ***Requirements analysis****:* the task of translating user requirements to technical, systemic requirements.
- ***Requirements recording****:* the task of documenting requirements. Various forms have been utilized, such as natural-language text, usage scenarios and (semi-)formal statements.

Information gathering included the following steps:

- **Stakeholder analysis** in order to identify all the users and stakeholders who may interact with the system. This helps ensure that the needs of all those involved are taken into account. If required, the system is tested by them. User groups may include end users, supervisors, installers, and maintainers. Stakeholder analysis will be based on the efforts of T1.1 'Value Chain Definition and Stakeholders Identification' documented in D1.1 'BOUNCE Value Chain'.
- **Interviewing** is a commonly used technique where users, stakeholders and domain experts are questioned to gain information about their needs or requirements in relation to the new system. Within BOUNCE interviews have been conducted in the framework of task T1.1 based on a series of fixed questions with scope for the user to expand on their responses.
- **User Scenarios** give detailed realistic examples of how users may carry out their tasks in a specified context with the future system. The primary aim of scenario building is to provide examples of future use as an aid to understanding and clarifying user requirements and to provide a basis for later usability testing. User scenarios were primarily specified by the healthcare professionals of BOUNCE consortium.

Once the initial set of user requirements and user expectations has been identified, based on the stakeholder analysis, the interviews and the user scenarios analysis, it is important to identify the basic services and tools required for the different user tasks to be accomplished. ***Requirements analysis*** involves the translation of user requirements to systemic requirements, functional and non-functional, for each identified tool/service separately. This task is firmly connected with WP3 'Data Aggregation, Pre-Processing and Availability' and WP5 'Model computational implementation & Integration'.

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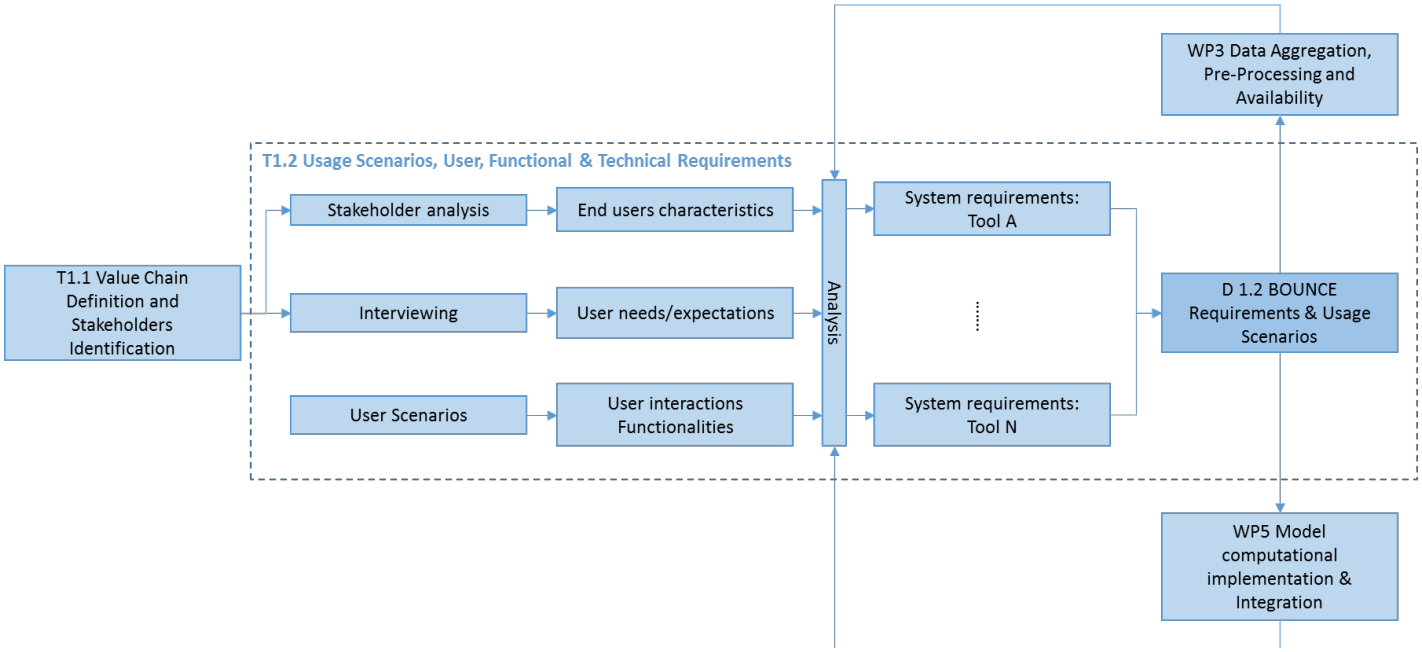

Figure 1: Methodological framework and workflow to derive system requirements and use them for BOUNCE system architecture and development

4. BOUNCE target groups and actors

4.1. Introduction

In principle, the successful development of a system presupposes that its users will receive all functionalities required to accomplish their tasks. Therefore, major factors to take into account when designing a system are the various actors involved, their characteristics and their requirements. Below we present an overview of the drivers behind the design of BOUNCE system, based on the Description of Action and stakeholder analysis conducted within D1.1: 'BOUNCE Value Analysis'.

4.2. Definitions

The two general groups of actors of BOUNCE project are the consortium partners and the end users of the system. The consortium partners can be further categorized into the healthcare professionals, the data providers, and the technical partners, the latter including the model developers, the software developers and the administrators of the final platform. The end users of BOUNCE platform can be identified as belonging to either the healthcare professionals, the social workers, the patients or the IT personnel. Below we list a brief description of the BOUNCE actors (Table 1).

Table 1: Actor's classification according to their roles and concerns

Actor	Role
Software developers	They develop and test the IT infrastructure (development phase)
Administrators – IT personnel	They operate the IT infrastructure (operational phase)
Data providers	The data providers are the BOUNCE clinicians or clinical researchers who will be providing data into the BOUNCE platform. The main tasks of those actors will be to de-identify, upload and annotate data for usage by other users or components of the platform.
Model providers	The model providers are the developers of the predictive models who upload, annotate and execute the developed models.
Healthcare professionals (or clinicians)	A healthcare professional is an individual who provides assessment, preventive, curative, promotional or rehabilitative health care services in a systematic way to individuals, families or communities; an oncologist, a nurse, a psychologist, a health worker or another person trained and knowledgeable in medicine, nursing or other allied health professions, or public/community health. They search and execute models that are already available in the platform in order to address specific clinical questions related to patient's resilience, well-being and clinical outcome.
Social workers	Psychosocial care of cancer patients is most widely delivered by oncology social workers. Social work is an academic discipline and profession that concerns itself with individuals, families, groups and communities in an effort to enhance social functioning and overall well-being. They search and execute models that are already available in the platform in order to find answers regarding patient's resilience and well-being.

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Actor	Role
Patients	They consent to give their personal data for research or for monitoring of their resilience and well-being. They are interested in having access to results of research or BOUNCE system predictions.

Target groups in the present analysis are perceived as the end users, i.e. the individuals that will actually interact with the BOUNCE system and make use of it. The healthcare professionals (oncologists, nurses, psychologists etc.), the social workers and the patients are the actors that will ultimately use the BOUNCE system and, hence, their needs will define the system's functionalities. The interview survey, the user scenarios and the user requirements presented in the following sections involve these target groups. On the other hand, identified services and technical requirements take into consideration all actors listed in Table 1.

4.3. Goals, constraints, principles, concerns of the BOUNCE target groups and actors

Data providers

Data providers are usually clinicians or clinical researchers who share data to be used for their own research, and for the benefit of their patients. The goal of the data providers, inside the BOUNCE platform, is to be able to easily upload and share the data they own. Their main concern is to be able to protect the anonymity and the legal rights of the persons whose data are used in BOUNCE and also to retain, as much as possible, the right to use/update/withdraw these data – in other words, to have clear terms of ownership and control.

Model providers

Model providers come from different domains; they often are IT researchers, physicists, mathematicians, bioinformaticians, biologists, clinical researchers. They develop models using a variety of technologies (outside the context of BOUNCE) and they want to upload, share, and execute them in the context of BOUNCE in order to validate them, or to expand them by finding other models and integrative models. A main concern that they have, similar to the data providers, is to retain control over what they share or its results –in other words, the intellectual property rights (IPR) management. An additional important goal that applies to BOUNCE is to ensure the technical compatibility between the technologies that the modelers use and the ones supported by BOUNCE.

Software developers

As software developers, the IT partners of the consortium have as primary goal to deliver the BOUNCE platform with all the necessary functionality, within the time and budget constraints imposed by their contractual obligations with the rest of the consortium partners and the EC. Their primary concerns are to overcome the IT engineering difficulties and deliver a state of the art infrastructure.

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Administrators

The administrators comprise a subset of the IT partners whose main task is to operate the BOUNCE infrastructure when it enters an operational phase. The primary concern of those users is having an infrastructure that works robustly and the availability of tools that will make their job easier for the management of the whole platform.

Healthcare professionals (clinicians)–Social workers

The healthcare professionals (psychologists, nurses, oncologists/specialist doctors) and social workers have as main goal and concern to address concrete clinical questions. Typically, their concern is not to develop models, but to find and execute already developed tools in order to gain knowledge that will help their patients.

Patients

This user group is involved in the BOUNCE project either indirectly via the use of their personal retrospective data, or actively via the prospective pilot study to be realized within BOUNCE. Their concerns are implicitly shared through the data providers and their legal representatives. The main concern of this user group is for their personal data to be respected and protected against unauthorized uses. To this end, they need to be assured that their data will be used only by persons and purposes specified explicitly in the informed consent documents they sign prior to participation in the study. Moreover, they need to be assured that by giving permission for use of their personal data in this project concrete benefits will have in whatever clinical practice concerns them, and at the same time to be able to benefit from state of the art research and clinical trials that could help them into their individual clinical case. They retain their right to withdraw from BOUNCE research at any time.

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5. End user needs and acceptance survey

5.1. Survey design

A questionnaire, primarily prepared in the context of T1.1 'Value Chain Definition and Stakeholders Identification' with specific additions pertaining to tool-specific requirements by T1.2 Usage Scenarios, User, Functional & Technical Requirements, was used in order to identify user expectations and user group specific interactions with the tool to be produced in the context of BOUNCE project. The interview was conducted based on open-ended questions allowing interviewees to include more information, such as feelings, attitudes and understanding of the subject and thus enabling the researchers to receive more useful, contextual feedback.

From the user scenarios and requirements perspective, the aim of this survey was twofold: first, to identify what is needed from a new decision-support tool, enabling healthcare personnel to assess the resilience levels of the patient and the potential need for psychosocial interventions by monitoring the patients adaptation to illness (e.g., treatment adherence, physical functioning, quality of life, emotional well-being); second, to explore the potential use of a specific version of this tool by the patients. The structure of the questionnaires was the following with each subsection representing a major topic. The questionnaires can be found in D1.1 entitled 'BOUNCE Value Chain'.

Table 2: Content of the survey

Sections	Subsections representing a major topic	Goal	Patients & Families	Healthcare professionals
Background Questions	-		✓	✓
During the treatment/illness	-		✓	✗
Questions related to the research project	*Resilience*	- To better define the concept of resilience - To identify potential gaps in resilience assessment -To identify how good/poor resilince is expressed	✓	✓
	Interventions	- To identify potentially useful interventions	✓	✗
	Use cases	**- To explore the potential role of the patient as an end-user of the tool** **- To extract the user requirements of the tool**	✓	✓
	Benefits	- To explore the value and to clarify the aims of the tool to be produced.	✓	✓
	Activities	- Same as above - To explore the patients'willingness to answer questionnaires during the treatments	✓	✓
	Information flow	**- To extract the user requirements of the tool**	✓	✓
	Costs	**- To identify and thus avoid the challenges in predicting resilience and developing such a tool**	✓	✓
	Partnership	- To identify the stakeholders involved	✓	✓
	Closing	- To bring to light potential topics evading the questionnaire	✓	✓

NHG and the clinical partners outside Finland conducted the interviews. More specifically, a total of twelve (12) interviews were conducted in Finland and Italy from various representatives of the end user categories. More specifically five (5) of the participants were patients or their family members, while seven (7) of them were current or former healthcare professionals (oncologists, psychologists and nurses). An overview of the interviewees is presented in Table 3.

Table 3: Overview of the interview participants considered in the present analysis

Country	End user category	End user	Gender	Age	Occupation	Institution/ Organization
Finland (8)	Health and social service providers	Oncologist	Female	-	Specialist in oncology	HUS Cancer Centre
	Health and social service providers	BC nurse	Female	-	BC nurse	HUS Cancer Centre
	Health and social service providers	Nurse	Female	-	Nurse	HUS Cancer Centre
	Health and social service providers	Nurse	Female	-	Development manager	Western Cancer Centre, TYKS
	Patient	Patient	Female	59	Expert/Specialist	-
	Patient	Patient	Female	58	Import assistant	-
	Family	Husband	Male	59	Management consultant	-
	Family	Sister	Female	57	-	-
Italy (4)	Health and social service providers	Oncologist	Female	-	Medical doctor in oncology, Researcher	IEO
	Health and social service providers	Nurse	Female	-	Research nurse	IEO
	Health and social service providers	Psychologist	Male	-	Clinical psychologist	IEO
	Patient	Patient	Female	49	Immigration consultant	-

5.2. Survey data results

5.2.1. Patients & Families

This subsection is structured as follows. Sections 5.2.1 and 5.2.2 provide in the form of tables a summary of the answers of patients/families and healthcare professionals in the questions that are more relevant to the foundation of the BOUNCE platform. The content of the tables has been based on the content of replies of the questionnaires with the minimum possible intervention, so as not to affect the originality of the content of replies. Section 5.2.3 summarizes in the form of text the conclusions that can be derived after analysis of the original content.

Table 4: Summary of interviewees' answers on selected questions

Property	ICT familiarity (1)	Current assessment method (2)	Current assessment time point (3)	Support received(4)	Interventions adopted (5)	Identified needs for resilience predictions (6)	Willing to answer questionnaires (7)	Desired features of a resilience prediction tool (8)	Identified challenges (9)	Information needed during use (10)
Patients	Good. Pretty good.	Resilience was not assessed with a questionnaire but via personal communication/discussion by healthcare team. Only few paper questionnaires about quality of life and pain. Not assessed. Psychological help received only after patient request.	Equally answered: All the time. Not systematically. Not at any point.	From healthcare professional. Mainly supported by family, patient organization, facebook/chat groups.	Physical exercise. Mindfulness exercise. Nutrition changes. Art, hobbies Peer support. Visits to psychologist/sexual therapist. Cancer clinic info day. For some patients the interventions, mainly psychological, were not	Need to understand individual's risk factors for poor resilience better. Identify need for support early enough. Enhance patient resilience. Not sure.	Yes, every 6 months. Yes, as often as needed.	Collects information about heart and mind. Measures emotions and physiological information. Use background information e.g. family, education, work and so on. Depends on the person what background information is useful. Take into consideration and/or evaluate impact of patients' networks e.g. economic, social, family and work life.	Predictions might increase fear, but concrete knowledge is important to patients. How do people self-evaluate (blindness towards self, over or under judging). Truthfulness of patient answers and courage to talk. Patients may be afraid of who will see their answers. Will the tool be able to Identify factors	Information about how it works, what it measures, and if it has been tested and how. Information about who has access to the data used by the tool or to the knowledge produced by the tool. Where the information ends up afterwards.

					enough or came too late.			Relevant factors to be included in the tool could be brought up after discussion with a specialist.	that help/cause problems? Possible false predictions by the tool. The tool should be dynamically updated with most recent patient's info. Increase treatments costs.	
Families (husband, partner, relatives)	Very good. Pretty good.	Not assessed. Psychological help received only after patient request.	Not at any point.	Patient mainly supported by family, patient organization, facebook/chat groups. Patient support from healthcare team minimum or not continuous as responsible doctor may change. Lack of guidance for family members.	Psychotherapy	The predictions are accompanied by proper justification/explanations. Help patient to prepare better for the future life with cancer. A clear place where to call in case of poor predictions.	Yes, as often as needed. Best face to face, but online survey ok.	Measures resilience through coping in everyday life. Support clear communication of forecasts to patients in order to understand and to be able to follow actions to improve future. Based on artificial intelligence trained on massive amounts of data from existing patients. The data need to cover before and after sickness period as well as the outcomes of specific actions. Predictions are accompanied by proper justification.	No challenges identified. A lot of patient data need to be collected to ensure quality. How to present bad outcomes to patients. Lack of intervention suggestions. Forecast won't help if actions are not changed.	Clear instruction on the tool goals and how to use. Predictions should be accompanied by proper justification/reasoning.

(1) Degree of experience with ICT tools and solutions
(2) How was resilience assessed during and after the treatments
(3) At which stage of care was resilience assessed
(4) Type of support received during treatments
(5) Interventions adopted in daily life to improve well-being
(6) Would like to have access to a prediction tool that calculates potential risk of poor resilience
(7) Would have been able/willing to answer any questionnaires during treatments
(8) How do they envision this kind of resilience prediction tool
(9) What kind of challenges they foresee in predicting resilience
(10) What information would you need to receive about the tool, if it had been in use during treatments.

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5.2.2. Healthcare professionals

Table 5: Summary of interviewees' answers on selected questions

Property	Experience (1)	IT familiarity (2)	Current assessment method (3)	Current assessment time (4)	Resilience profile (5)	Current support (6)	Identified needs for resilience predictions (7)	Desired features of a resilience prediction tool (8)	Output of tool (9)	Frequency of use (10)	Access by patient (11)	Identified challenges (12)	Information needed during use (13)
Clinical psychologists	1 year	None	Distress thermometer (scale 1-10). Evaluation based on clinical interview.	At every meeting with the patient.	Strong dependence on social support; Resilience always changes over time. Bad resilience: Perfectionism. Do not accept themselves. Lack of energy, strength. Sadness. Avoid family/friends Good resilience: See illness as an experience to learn from. It manifests from the beginning.	Patient can ask to refer to a psychologist	Help to understand how the patient responds to stress and reacts to different treatments	Strategic game in which the patient chooses how they would react to something.	Risk categories	Early At each stage	Yes, as long as the patient want	Substitute relationship with patient. Time spent on using the tool for patients and doctors.	Technical/ scientific information. Easy way to see the results. Provide information on changes in behaviour of the patient over time.
Nurses	10-20 years	Good	Do not know. Random. No guidelines. No diagnoses or measures.	At yearly clinical visits. The latest at the first-year follow-up. At visits requested by patient.	Bad resilience: - Demanding, suspicious, -Sense of being sacrificed, bitter, fearful - Poor capacity to cooperate - Other concurrent life stressors (e.g. divorce, caregiving, other illnesses, small children)	Direct patients to cancer organisations or to mental health services on a primary level. By social nurse and referral to psychosocial unit.	More efficient time management and work organisation. Allocate resources at right times to the right patients. Need for personalized approaches.	Easy to manage and easy to use. Provide recommendations about patients. Data could automati-	Colour coding of risks. Risk categories.	Early Constant feedback/ recommendations	Yes. Some patients would benefit.	Readiness level of nurses and physicians to accept and manage such a tool. Familiarizing the personnel with the tool.	Cannot say. User guidance features. Purpose. What is being measured and what are the criteria.

			Based on frequency and purpose of patient – medical team communication. Based on subjective rating of patient demeanor.	When the patient returns to work. When needed throughout the treatment, but not in structured way.	-Depression background -Lack of control in life. -Bad relationship Good resilience: -Independent, take responsibility of their own care, seek reliable information - Cooperative and confident - Knowledge and feeling in balance -Peaceful, have different expectations on the life quality.	Hospital priest Talking, going to courses, financial support. Nothing systematic.	Better support for patients who do not easily ask help. Help them learn more info about the patient Supporting self-care and help patients from the beginning. Patient can be in really bad condition when the actual referral is made. Unify treatment practices.	cally transfer to patient records Predict problems during treatment. Not too short or too long to measure. Reliable indicator.				Time spent and workload on using the tool. Patient may lack digital skills. Lack of patient commitment to fill questionnaires.	How the collected data is used (implications) How it is integrated to other systems Who has developed the tool. Previous experiences of use.
Oncologists/ Specialist doctors	15-21 years	None Good	Based on discussion and personal feeling. Not in a systematic way.	First meeting and continuously. When problems with ability to work exist and at yearly clinical visits. End of the cytostatic treatment	Depends on: Life management. Bad resilience: Tendency to become depressed/ anguished because of stress. Long sick leaves. Constantly worried and over-interpret their symptoms. Loss of self-confidence. Good resilience: Looking for survival methods by their own actions. Working partly even during the treatments.	Refer to a psychologist or other support services. Peer support groups.	Reduce time to understand patients' problems and reason of bad resilience (financial, social, mental etc). Better identify patients who need support.	Desktop application. Smartphone application. Direct patients to right kind of support. Easy and quick to use.	Colour coding of risks	At the beginning. After treatment and at yearly controls check	Yes Cannot say	Time spent on using the tool. Probability to under- or over-diagnose. False predictions can be identified only after a considerable time has passed. Privacy protection.	User guidance features. Information on where to direct the patient based on risk prediction. No need to know the algorithms

(1) How long they are involved in the care of BC patients
(2) Degree of familiarity with clinical information technology
(3) How do they currently assess resilience / how is resilience currently being assessed in breast cancer
(4) At which stage of care is resilience assessed
(5) From experience describe the profile of patients that are more prone to bad/good resilience
(6) How are the patients in need of support currently supported
(7) What kind of need is there for predicting resilience / a resilience prediction tool in your work
(8) How do they envision this kind of resilience prediction tool
(9) How do they prefer to receive information about the patient's risk level
(10) At which stage they prefer to receive the information about the patient's risk level
(11) Should the patient's risk level be shared with the patient? Should the resilience prediction module be accessible by the patient?
(12) Challenges anticipated to emerge from the use of the tool? Inconveniences and cost associated with tool installation and use.
(13) What information would you need in the installation phase of the tool? What information would you need to receive before you use the tool.

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5.3. Survey Conclusions

5.3.1. Patients & Families

The persons comprising the convenience sample for the interviews were largely familiar with ICT tools and solutions. The need for a tool assessing resilience and guiding more timely and effective intervention strategies was clearly identified. In several cases, patients and their families expressed similar/common experiences and views. The following needs, requirements and perceived challenges have been identified based on survey analysis:

Identified interactions

- Patients expressed willingness to fill in background information and respond to questionnaires pertaining to their physical, functional and psychosocial status over the course of BC treatment.
- Patient families expressed willingness to respond to inquiries about the patient and provide information regarding the status of the patient and the family.
- In general, patients and their families were positive to the availability and use of a tool predicting resilience.

Identified user needs

The patients identified the need for a tool that would:

- Enable health professionals and their families to identify need for support.
- Enable health professionals and their families to recommend useful interventions.
- Help them get a better understanding of their own resilience level and potential factors currently impacting this level.
- Enable them to monitor their own resilience level.
- Enable them to communicate directly with healthcare professionals or access peer support.
- Enable them to make wiser decisions regarding work and family life based on likely outcomes.

The patient families identified the need for tool that would:

- Help them get a better understanding of patient´s resilience level.
- Help them get a better understanding and guidance on how to support the patient.
- Help patients get guidance on how to better arrange their every-day life.
- Optimize family involvement in patient care.

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Potential pitfalls

- Possible inaccurate predictions produced by the tool.
- Concerns about the way that a potential unfavourable prediction should be communicated to the patient.
- Lack of intervention suggestions (a prediction outcome alone is not enough to change the patient's resilience).
- Risk of subjective self-assessment on behalf of the patient.
- Potential cost of the tool.

Tool-specific expectations

- The tool should provide reliable assessment of current resilience status as well as resilience level prediction and communicate to the user the confidence level of its prediction.
- The tool should be simple to use, with customized and user-friendly interface.
- It should be characterized by high quality of information (clarity, discriminability, conciseness, consistency etc.).
- Additional information such as clear instructions on how to use it or general knowledge on resilience should also be presented.
- The results should be intuitive and easily interpretable (assuming patient has access to the results).
- Time and effort put in filling in forms and answering questionnaires should be minimized.
- Dynamically-updated assessment/prediction of patient resilience based on more current information.

5.3.2. Healthcare professionals

It is worth mentioning that the majority of healthcare professionals who participated in the interviews have many years of experience on the field. The gap in resilience assessment was clearly identified along with the need for a tool assessing and predicting resilience in their work. In several cases, healthcare professionals expressed similar/common experiences and views. The following needs, requirements and challenges have been identified based on the survey analysis:

Identified interactions

- Monitoring the time-course of resilience level of a patient.
- Receiving notifications of potentially significant changes in resilience level over time.
- Filling in subjective, clinical rating of patient resilience by the physician.

Identified user needs

- Decision support toward the need to refer patients for personalized psychosocial interventions based on resilience assessment and prediction, in order to optimize resource allocation. Specifically, grouping of patients by risk level seems to be the preferred way to receive feedback from the tool.
- Help to measure, evaluate and predict patient resilience level before the treatment, after the treatment, and during the regular visits.
- Support healthcare professionals in communicating resilience and associated factors to the patient (and family).
- Allow patient follow-up, e.g. assess effect of suggested intervention.

Potential pitfalls

The main challenges that must be tackled are:

- Over- or under-estimation of resilience level.
- Excessive time consumption in its use.
- Privacy issues.
- Cost of installation. Needs to be cheap, especially for the patients.

Tool- and Model- specific expectations and requirements

- Easy to manage and easy to use, local language.
- Easily interpretable results via clearly stated risk categories and colour coding.
- Tool can be used in mobile phone or computer.
- The tool should be quick to use. Ideally, it should be used during regular clinical visits.
- Additional information such as clear instructions on how to use it should also be presented.
- Life style, adopted interventions, support received, specific behaviours, workload, prolonged sick leaves, concurrent stressors could be indicators of poor or good resilience.
- The tool should be able to gather different kinds of patient-specific information.
- The tool should be able to collect patient-reported outcomes.
- The tool should provide trajectory of resilience level and associated risk for adverse patient outcomes.

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6. Clinical Scenarios of Use

6.1. User scenario definition

Each end user has a goal; the system should help the end user to reach that goal. Each scenario contains a sequence of basic steps showing how the actions and interactions unfold. A scenario is a description of a system interaction from the user's perspective [7]. Unlike use cases, scenarios can be understood by people who do not have any technical background. To write a scenario, you need a basic understanding of the tasks to be supported by the system. You also need to have an understanding of the users and the context of use. The scenarios describe in simple language the interaction that needs to take place, avoiding references to technology, except where the technology represents a design constraint that must be acknowledged [7]. They are presented as simple statements describing the triggers and specific situations that prompt a user to interact with a system [8]. They can also include simple lists of the steps in a task.

The following definition apply to our view (adapted from [9]):

- **User Scenario**: a sequence of interactions that take place to achieve each end user's goal(s), and the intended goal-specific outcomes. The interactions start from the triggering action and continue until the goal is delivered, and the system completes whatever responsibilities it has with respect to the interaction. It is a real-world narrative of a user's accomplishing an action or goal expressed in simple statements and including only information that is highly relevant to the user's experience with the system.

6.2. User Scenario value

Usage scenarios contribute a value in guiding the conversation during the design process, giving it context and scope. They indicate what to include, exclude, how wide, how deep to go and when to stop and they provide variations to test the design. The distinct advantage of using scenarios resides on their capacity to provide a context and boundaries to ensure that future discussion and utilization steps remain within the area of interest.

User scenarios can be used during many stages of a system development, being associated with different objectives. Used at the analysis stage, they can prevent costly error corrections at later stages of the development. At the current stage, user scenarios will serve as a guiding tool to identify, preview and analyse the functionalities of the BOUNCE system, as well as to determine the technical requirements, both functional and non-functional, of the system being developed.

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6.3. Description of User Scenarios

Project experts (healthcare professionals, technologists) have jointly drafted the BOUNCE User Scenarios, which have been reviewed and approved by the clinical sites representatives and the project consortium.

The following BOUNCE User Scenarios have been identified per end users of the BOUNCE system (oncologist, nurse, social-worker, psychologist, patient):

1. **Oncologist/nurse/social worker:** Assesses the need for referral to the psychological Team/Unit.
2. **Oncologist/nurse/psychologist/social worker:** Assesses patient progress on psychological functioning/well-being and resilience levels.
3. **Oncologist/social worker:** Assesses likely impact of patient biomedical and psychological characteristics and resilience levels on overall adaptation to illness.
4. **Psychologist/social worker:** Assesses patient resilience levels and/or psychological well-being in order to inform the patient and the medical team.
5. **Psychologist:** Assesses patient need for psychological/counselling intervention.
6. **Psychologist:** Design optimal intervention strategies, tailored to patient needs and current .health status, and/or evaluate the progress of an ongoing psychological intervention.
7. **Patient:** Provide necessary information at first login and at predefined time intervals.

The interaction steps of BOUNCE end users with BOUNCE system throughout the breast cancer treatment continuum, e.g. the collection of different types of data and the resilience assessment after diagnosis and at regular visits, are summarized in Figure 2.

Each User Scenario is presented below giving an answer to the following questions:

- *Who* is the end-user of the decision support system?
- *What* does the user want to accomplish with the decision support system?
- *How* is the user going to achieve his/her goals?
- Are there any additional functionalities or interactions associated with the specific scenario?

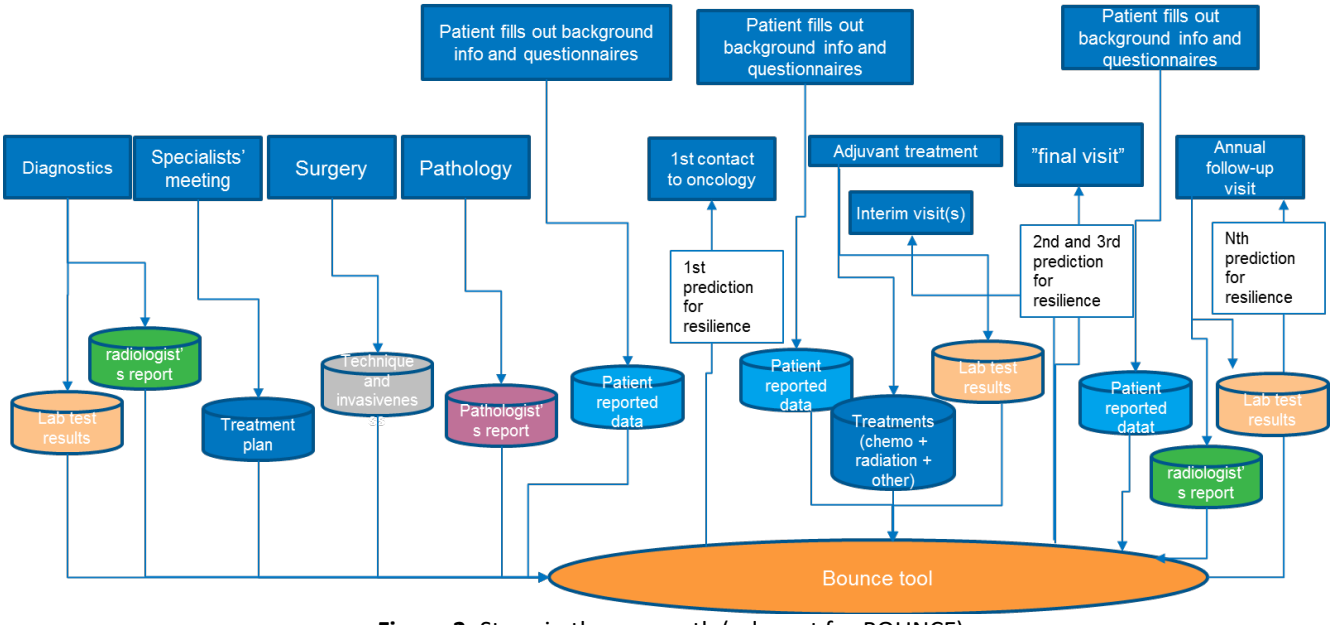

Figure 2: Steps in the care path (relevant for BOUNCE)

6.3.1. User scenario 1

***Who** is the end-user of the decision support system?* **The oncologist/nurse/social worker**
***What** does the user want to accomplish with the decision support system?* Assess the need for referral to the psychological/psychosocial Team/Unit.
***How** is the user going to achieve his/her goals?* 1. The oncologist/nurse/social worker asks the patient to use the BOUNCE online system and fill in the psychological scales included in the system. OR, Uses the relevant info already available for this patient in the system. 2. The online system examines the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables (coming from the current and/or possible previous assessments) and produces (a) an overall "resilience predictor" score, and (b) scores for specific psychological variables that are important for resilience and adaptation to cancer. 3. The BOUNCE program notifies the oncologist/nurse/social worker that the result is ready. 4. The oncologist/nurse/social worker enters the online system and receives the above described outcomes. 5. The oncologist/nurse/social worker briefly discusses the outcomes with the patient and suggests referral.
Additional functionalities or interactions ○ The patient enters her answer to each question on a Likert-type scale (e.g., 1-5). ○ If needed (e.g., when not already available through the laboratory information system or when additional information is necessary), the medical professionals (oncologist, nurse) enters info regarding the biomedical variables for each patient (e.g., test results; all numeric data). ○ The system produces a short "report" including (a) a summary of the results on crucial biomedical variables, (b) an overall resilience score and, (c) scores (raw and scaled) on specific psychological variables (e.g., anxiety and depression levels). ○ The system report is available only to the clinician or other professionals, members of the treatment/clinical team; not the patient.

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6.3.2. User scenario 2

***Who** is the end-user of the decision support system?*

The oncologist/nurse/psychologist/social worker

***What** does the user want to accomplish with the decision support system?*

Assess patient progress on psychological functioning/well-being, family support and resilience levels.

***How** is the user going to achieve his/her goals?*

1. The oncologist/nurse/psychologist/social worker asks the patient to use the BOUNCE online system and fill in the scales in the online system, based on their current state and feelings. OR, Uses the relevant most recent info already available for this patient in the system.
2. The online system examines the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables, compares them with the scores from previous assessments, computes possible differences and produces an estimation of the patient's future psychological state (based on certain particular indices; e.g., anxiety and depression levels, post-traumatic growth) and resilience level trajectory over time.
3. The BOUNCE program notifies the oncologist/nurse/psychologist/ social worker that the result is ready.
4. The oncologist/nurse/psychologist/ social worker enters the online system and receives the above described outcomes.
5. The oncologist/nurse/psychologist/ social worker discusses the outcomes with the patient and makes informed relevant decisions (e.g., reinforces patient's efforts; suggests the patient to visit the psychological team/unit; the oncologist/nurse discusses the outcomes with a psychologist; additional interventions are proposed, such as exercise, nutritional guidance, peer support).

Additional functionalities or interactions

- The patient enters her answer to each question on a Likert-type scale (e.g., 1-5).
- If needed (e.g., when not already available through the laboratory information system or when additional information is necessary), medical professionals (oncologist, nurse) enters info regarding the biomedical variables for each patient (e.g., test results; all numeric data).
- The system produces a short "report" including (a) the current and previous resilience overall scores, (b) current and previous scores (raw and scaled) on specific psychological variables, (c) a summary of the current and previous results on crucial biomedical variables, (d) a calculation of differences between current and previous assessments and, (e) a broad schematic estimation of the patient's psychological state and resilience levels trajectory over time.
- The system report is available only to health professionals, members of the treatment/clinical team; not the patient.
- The members of the treatment/clinical team can occasionally add more info (e.g., regarding biomedical factors; the illness progress) into the system.
- The patient can enter the system and provide additional info or complete the questionnaires included in the system only at specific time intervals (e.g., once a month).

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6.3.3. User scenario 3

***Who** is the end-user of the decision support system?*

The oncologist/social worker

***What** does the user want to accomplish with the decision support system?*

Assess the overall likelihood of patient psychological characteristics and resilience levels to impact adaptation to illness (e.g., treatment adherence, physical functioning, quality of life, emotional well-being).

***How** is the user going to achieve his/her goals?*

1. The oncologist/ social worker asks the patient to use the BOUNCE online system and fill in the psychological scales included in the online system. OR, Uses the relevant info already available for this patient in the system.
2. The online system examines the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables (coming from the current and/or possible previous assessments), and produces an estimation of the potential impact of resilience levels and other significant biomedical and psychosocial variables scores on current and future adaptation and well-being (e.g., treatment adherence, physical functioning, quality of life, emotional well-being).
3. The BOUNCE program notifies the oncologist that the result is ready.
4. The oncologist/ social worker enters the online system and receives the above described outcomes.
5. The oncologist/ social worker discusses the outcomes with the patient and makes informed medical decisions (e.g., regarding treatment) relevant to patient's psychological state and resilience level.

Additional functionalities or interactions

- The patient enters her answer to each question on a Likert-type scale (e.g., 1-5).
- If needed (e.g., when not already available through the laboratory information system or when additional information is necessary), the medical professionals (oncologist, nurse) enters info on the biomedical variables for each patient (e.g., test results; all numeric data).
- The system produces a short "report" including (a) the overall resilience score and scores (raw and scaled) on specific psychological variables (e.g., anxiety and depression levels), (b) a summary of the results on crucial biomedical variables and, (c) an estimation (a regression score) of the impact of (a) and (b) on current and future (probably short-term) adaptation and well-being (e.g., treatment adherence, physical functioning, quality of life, emotional well-being).
- The system report is available only to the clinician or other professionals, members of the treatment/clinical team; not the patient.
- The members of the treatment/clinical team can occasionally add more info (e.g., regarding biomedical factors; the illness progress) into the system.
- The patient can enter the system and provide additional info or complete the questionnaires included in the system only at specific time intervals (e.g., once a month).

6.3.4. User scenario 4

***Who** is the end-user of the decision support system?*

The psychologist/social worker

***What** does the user want to accomplish with the decision support system?*

Assess patient resilience levels and/or psychological well-being in order to inform the patient or the medical team.

***How** is the user going to achieve his/her goals?*

1. The psychologist/ social worker asks the patient to use the BOUNCE online system and fill in the psychological scales included in the system. OR, Uses the relevant info already available for this patient in the system.
2. The online system examines the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables (coming from the current and/or possible previous assessments), and produces (a) an overall resilience score, and (b) scores for the psychological variables that reflect psychological well-being (e.g., symptoms of anxiety and depression, post-traumatic growth).
3. The BOUNCE program notifies the psychologist that the result is ready.
4. The psychologist/ social worker enters the online system and receives the above described outcomes.
5. The psychologist/ social worker discusses the outcomes with the patient and/or incorporates them into their work with the patient.
6. The psychologist/ social worker informs and discusses outcomes with the medical team.

Additional functionalities or interactions

- The patient enters her answer to each question on a Likert-type scale (e.g., 1-5).
- If needed (e.g., when not already available through the laboratory information system or when additional information is necessary), the medical professionals (oncologist, nurse) enters info on the biomedical variables for each patient (e.g., test results; all numeric data).
- The system produces a short “report” including (a) an overall resilience score and, (c) scores (raw and scaled) on specific psychological variables (e.g., anxiety and depression levels).
- The system report is available only to the psychologist or other professionals, members of the treatment/clinical team; not the patient.

6.3.5. User scenario 5

***Who** is the end-user of the decision support system?*

The psychologist

***What** does the user want to accomplish with the decision support system?*

Assess patient's need for a psychological/counselling intervention.

***How** is the user going to achieve his/her goals?*

1. The psychologist asks the patient to use the BOUNCE online system and fill in the psychological scales included in the system. OR, Uses the relevant info already available for this patient in the system.
2. The online system examines the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables (coming from the current and/or possible previous assessments), and produces (a) an overall resilience score, (b) scores for specific biomedical and psychological variables that are important for resilience, psychological well-being and adaptation to cancer (e.g., quality of life, physical functioning) and, (c) produces an estimation of the potential impact of resilience levels and other significant biomedical and psychosocial variables scores on current and future (probably, short-term) well-being, as well as on future resilience levels.
3. The BOUNCE program notifies the psychologist that the result is ready.
4. The psychologist enters the online system and receives the above described outcomes.
5. The psychologist discusses the outcomes in detail with the patient and suggests the patient to participate in a psychological support/counselling program.

Additional functionalities or interactions

- The patient enters her answer to each question on a Likert-type scale (e.g., 1-5).
- If needed (e.g., when not already available through the laboratory information system or when additional information is necessary), the medical professionals (oncologist, nurse) enters info on the biomedical variables for each patient (e.g., test results; all numeric data).
- The system produces a short "report" including (a) an overall resilience score, (b) scores (raw and scaled) on specific biomedical and psychological variables (e.g., anxiety and depression levels) and, (c) an estimation (a regression score) of the impact of (a) and (b) on current and future (short-term) well-being levels.
- The system report is available only to the psychologist or other professionals, members of the treatment/clinical team; not the patient.

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6.3.6. User scenario 6

***Who** is the end-user of the decision support system?*

The psychologist

***What** does the user want to accomplish with the decision support system?*

Design optimal intervention strategies, tailored to patient needs and current condition, AND/OR evaluate the progress of an ongoing psychological intervention.

***How** is the user going to achieve his/her goals?*

1. The psychologist asks the patient to use the BOUNCE online system and fill in the psychological scales included in the system. OR, Uses the relevant and recent info already available for this patient in the system.
2. The online system examines the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables (coming from the current and/or possible previous/recent assessments), and produces (a) an overall resilience score, (b) scores for specific biomedical and psychological variables that are important for resilience, psychological well-being and adaptation to cancer (e.g., quality of life, physical functioning), and, (c) produces an estimation of the potential impact of resilience levels and other significant psychosocial and biomedical variables scores on current and future well-being, as well as on future resilience levels.
3. The BOUNCE program notifies the psychologist that the result is ready.
4. The psychologist enters the online system and receives the above described outcomes.
5. The psychologist takes into consideration the outcomes and, in collaboration with the patient, designs specific, tailored to patient's needs, intervention strategies or modifies the current ones.
6. The psychologist informs the patient and the other health professionals about the progress of the intervention as far as the BOUNCE online system outcomes is concerned.

Additional functionalities or interactions

- The patient enters her answer to each question on a Likert-type scale (e.g., 1-5).
- If needed (e.g., when not already available through the laboratory information system or when additional information is necessary), the medical professionals (oncologist, nurse) enters info on the biomedical variables for each patient (e.g., test results; all numeric data).
- The system produces a short "report" including (a) the current and previous resilience overall scores, (b) current and previous scores (raw and scaled) on specific psychological variables, (c) a summary of the current and previous results on crucial biomedical variables, (d) a calculation of differences between current and previous assessments and, (e) a broad schematic estimation of the patient's well-being and resilience levels trajectory.
- The system report is available only to the psychologist or other professionals, members of the treatment/clinical team; not the patient.

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6.3.7. User scenario 7

***Who** is the end-user of the decision support system?* **The patient**
***What** does the user want to accomplish with the decision support system?* Provide information necessary for the implementation of Scenarios 1 to 6 using the BOUNCE online system[1] at first login and at predetermined time intervals during cancer treatment
***How** is the user going to achieve his/her goals?* 1. The patient uses the BOUNCE health platform for the first time and fills in demographic and clinical data. 2. The patient uses the BOUNCE online system to fill-out self-report psychological scales 3. The cloud-based system stores patient's data. 4. The BOUNCE program notifies the health professional/member of the treatment team that the patient has used the online system.
Additional functionalities or interactions ○ The patient creates an account (first login). ○ The patient enters the demographic data (first login). ○ The patient enters the clinical data (first login). ○ The patient enters her answer to each question on a Likert-type scale at regular time intervals (e.g., every approximately three months). ○ The patient can enter the system and provide additional info or complete the questionnaires included in the system only at specific time intervals. ○ The BOUNCE system notifies the patient to fill in the online questionnaires at specific time points.

[1] an online platform integrating demographic, clinical, lifestyle, health and psychosocial information, which extends the Noona health platform.

7. System requirements

The definition of system requirements serves (a) as a guide for architectural design, and (b) as a checklist for evaluation of the actual (implemented) system. They describe what the BOUNCE system must do, or must not do, how it should look like, and express a number of constrains and expectations, which may be taken into consideration in the subsequent full-scale, technical system evaluation.

The first step to derive system requirements is to analyse user scenarios. The user scenarios describe the system actors, in other words the various groups of potential system users who are likely to be affected by or have an impact on it, and the system behaviour and expected results. The technical partners of the consortium have also analysed the usage scenarios and the implementation plan of the BOUNCE Description of Action and have derived a number of services/tools that are required for the proper operation of the BOUNCE platform. Whilst the user scenarios express what is wanted, the system requirements specify how it will be achieved.

At the second step, the requirements that the aforementioned services/tools impose on the system as well as their limitations need to be identified. These requirements need to be taken into account during the integration of the various components into the BOUNCE platform, towards the creation of a working system.

It becomes obvious that we can divide the system requirements into two main categories:

- (semi-)formal statements about the functionalities of the system as a whole and per component wherever necessary; we will refer to them as functional requirements.
- the constrains that the various services/tools impose on the system from technical perspectives (i.e. requirements imposed on the hardware infrastructure, etc.), as well as the limitations of the various modalities; we will refer to them as non- functional requirements.

In the present document both categories of system requirements have been addressed in cooperation with the relevant WPs. As introduced before, the system requirements have been collected and organised per identified service/tool that composes the BOUNCE platform. The identified services/tools can be summarized to the following, while will be revisited during the architecture specification (Deliverable D5.1 BOUNCE Conceptual & Reference Architecture at M09):

1. Temporary Research Supporting Tool
2. Final Decision Support System
3. Personal Health System - Noona
4. Data Aggregator
5. Data Cleanser
6. Security Service
7. Model Repository
8. In Silico Trial and Prediction Repository

In order to collect the technical requirements of BOUNCE system the template in ANNEX A has been used. Consequently, according to the list of systems, services and tools presented above, the BOUNCE technical requirements can be described as follows. For each requirement, we use the identifier “type – x.y - tool”, where:

- type is “FR” OR “NFR” depending on whether the requirement is a functional or non-functional requirement,
- the number “x” is increasing per each requirement of the same type and tool, while the number “y” increases when the requirement can be divided to further requirements.
- while the tool is an abbreviation of the specific service tool we refer to.

7.1. Temporary Research Supporting Tool

Service/Tool Name:	**Temporary Research Supporting Tool**
Functional requirements	
Functional description:	• The short-term internal project tool to facilitate data exploration and model training/application.
Generic functional requirements:	• **FR-1-TRST:** The tool should be able to retrieve patient data and data about the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables (coming from the current and/or possible previous assessments) • **FR-2-TRST:** The tool should be able to execute models through the model repository • **FR-3-TRST:** The tool should store the results in a corresponding repository enabling also the exploration of the results • **FR-4-TRST:** The tool should have an authentication/authorization mechanism • **FR-5-TRST:** The tool should dispose Graphical User Interface (GUI) • **FR-6-TRST:** The tool should have a notification system for the notification of the researcher when the result is ready • **FR-7-TRST:** A reporting component should be available for generating the various reports needed by oncologists/psychologists/nurses/researchers.
User interface (FR-5-TRST):	A responsive graphical user interface should be available with the following components. • **FR-5.1-TRST:** A GUI should exist for the representation of the patient scores • **FR-5.2-TRST:** A GUI should exist for entering info by the medical professional (e.g., test results; all numeric data). • **FR-5.3-TRST:** A GUI should exist for executing models and a GUI for visualizing the results
Access/Control (FR-4-TRST):	• **FR-4.1-TRST:** Researchers, clinicians (and other professionals, members of the treatment /clinical team) should have access to the stored data while formulating the final model. This access should be implemented through the appropriate authentication/authorization mechanism. • **FR-4.2-TRST:** The GUI for the medical expert should be secured by a user authentication mechanism
Other processes supported:	• **FR-8-TRST:** The system should include the operation that will examine the scores and the combination of scores and the results should be available in the GUI. • **FR-9-TRST:** The online system should be responsive for user-friendly access from different devices.
Data Storage/Format (FR-3-TRST):	• **FR-3.1-TRST:** Internal data and results will be stored using the relational model.
Input:	Data available to the internal database of the tool and data available through the BOUNCE data repository. Models available through the model repository

	Results from model repository stored in the in Silico Trial and Prediction Repository	
Output:	Visual analysis of the data, execution of the models and a visual analysis of the results.	
Non-functional requirements		
Software requirements	**Code language**	Can be developed in any web programming language
	Runtime environment needed	Not specific runtime environment needed
	Operating systems and architecture (x86 or x64)	No specific OS is needed
	External libraries dependencies	No specific libraries are needed
	Other?	-
Hardware requirements	**Processor**	**NFR-1-TRST:** Should be able to run at least in a pc with four processors
	Disk memory	**NFR-2-TRST:** Should be able to run at least in a pc with 100GB of disk space
	RAM memory	**NFR-3-TRST:** Should be able to run at least in a pc with 8GB of memory
	Other?	-
Communication requirements:	Internet connection • **NFR-4-TRST:** A data repository where patient data should be available communicating through appropriate APIs • **NFR-5-TRST:** The model repository and the in Silico Trial and Prediction Repository should provide the necessary APIs	
Software interfaces:	**NFR-6-TRST:** Web based interfaces should be supported	
Hardware interfaces:	**NFR-7-TRST:** Hardware interfaces should comprise personal computer, mobile and tablet	
Security and Privacy:	1. N**FR-8-TRST:** Physical security should be ensured. ● User authentication ● User authorization 2. N**FR-9-TRST:** Access by user role or types should be ensured. ● User has access to his data only ● Medical Expert has access to his patient's data only.	
Capacity:	**NFR-10-TRST:** Should be able to be used in parallel by at least 20 users	
Performance:	**NFR-11-TRST:** Should have a response time less than 1 sec.	
Reliability:	**NFR-12-TRST:** Should be 100% reliable	
Other Requirements:	-	
Comments:	-	

7.2. Decision Support System

Service/Tool Name:	**Decision Support System**
Functional requirements	
Functional description:	The final online decision support system produces (a) an overall "resilience predictor" score, and (b) scores for specific psychological variables that are important for resilience and adaptation to cancer.

Generic functional requirements:	• **FR-1-DSS:** The tool should be able to retrieve data about the individual scores on each scale and the combination of scores in different biomedical and psychosocial variables (coming from the current and/or possible previous assessments) • **FR-2-DSS:** The tool should be able to produce (a) an overall "resilience predictor" score, and (b) scores for specific psychological variables that are important for resilience and adaptation to cancer • **FR-3-DSS:** The tool should have an authentication/authorization mechanism • **FR-4-DSS:** The tool should dispose Graphical User Interface (GUI) • **FR-5-DSS:** The tool should have a notification system for the notification of the oncologist/nurse when the result is ready • **FR-6-DSS:** A reporting component should be available for generating the various reports needed by oncologists/psychologists/nurses.	
User interface (FR-4-DSS):	A responsive graphical user interface should be available with the following components. • **FR-4.1-DSS:** A GUI should exist for the representation of the patient scores • **FR-4.2-DSS:** A GUI should exist for entering info by the medical professional (e.g., test results; all numeric data) • **FR-4.3-DSS:** A GUI for visualizing the results for the resilience predictor	
Access/Control (FR-3-DSS):	• **FR-3.1-DSS:** The clinician (or other professionals, members of the treatment /clinical team) should be the only ones with access to stored data and not the patient. This access should be implemented through the appropriate authentication/authorization mechanism. • **FR-3.2-DSS:** The GUI for the medical expert should be secured by a user authentication mechanism	
Other processes supported:	• **FR-7-DSS:** The system should include the operation that will examine the scores and the combination of scores and the results should be available in the GUI. • **FR-8-DSS:** The online system should be responsive for user-friendly access from different devices.	
Data Storage/Format:	• **FR-9-DSS:** Internal data and results will be stored using the relational model	
Input:	Data available to the internal database of the tool and data available through the BOUNCE data repository.	
Output:	An overall "resilience predictor" score, and scores for specific psychological variables that are important for resilience and adaptation to cancer.	
Non-functional requirements		
Software requirements	**Code language**	Can be developed in any web programming language
	Runtime environment needed	Not specific runtime environment needed
	Operating systems and architecture (x86 or x64)	No specific OS is needed
	External libraries dependencies	No specific libraries are needed
	Other?	-
Hardware requirements	**Processor**	**NFR-1-DSS:** Should be able to run at least in a pc with four processors
	Disk memory	**NFR-2-DSS:** Should be able to run at least in a pc with 100GB of disk space
	RAM memory	**NFR-3-DSS:** Should be able to run at least in a pc with 8GB of memory
	Other?	-

Communication requirements:	• **NFR-4-DSS:** A data repository with the available data should provide the necessary Application Programming Interface (API) to store and retrieve the data
Software interfaces:	**NFR-5-DSS:** Web based interfaces should be supported
Hardware interfaces:	**NFR-6-DSS:** Hardware interfaces should comprise personal computer, mobile and tablet
Security and Privacy:	1. N**FR-7-DSS:** Physical security should be ensured. ● User authentication ● User authorization 2. N**FR-8-DSS:** Access by user role or types should be ensured. ● User has access to his data only ● Medical Expert has access to his patient's data only.
Capacity:	**NFR-9-DSS:** Should be able to be used in parallel by at least 20 users
Performance:	**NFR-10-DSS:** Should have a response time less than 1 sec.
Reliability:	**NFR-11-DSS:** Should be 100% reliable
Other Requirements:	-
Comments:	-

7.3. Personal Health System (Noona)

Functional requirements	
Service/Tool Name:	**Personal Health System (Noona)**
Functional description:	The main goal for this tool is to provide the psychological scales and other relevant eCRF forms to be filled in by the patients.
Generic functional requirements:	• **FR-1-PHS:** The Personal Health system should provide questionnaires with Likert-type scale questions in order to be completed by the patients for collecting psychological, quality of life and symptom information. • **FR-2-PHS:** An alerting mechanism should be available for setting the alerts by doctors/nurses and for notifying the patient to complete a questionnaire. • **FR-3-PHS:** The same alert mechanism should be able to notify doctors/nurses about the schedule of a questionnaire. • **FR-4-PHS:** The tool should have an authentication/authorization mechanism • **FR-5-PHS:** The tool should dispose Graphical User Interface (GUI) for the patient to enter questionnaires. • **FR-6-PHS:** The tool should have a database where all data should be stored. • **FR-7-PHS:** An Application Programming Interface (API) should exist to store and retrieve the data. • **FR-8-PHS:** Data export functionality should exist.
User interface (FR-5-PHS):	**FR-5.1-PHS:** A personal health system GUI should be available, able to be responsively adapted to the device used.
Access/Control (FR-4-PHS):	• **FR-4.1-PHS:** The proper authentication and authorization mechanism should be available for the users to sign-up and login. • **FR-4.2-PHS:** The data collected from personal health system belong to the patient. As the necessary consents will have been signed all data should also be accessible to the partners that have signed the data sharing agreement.

	• **FR-4.3-PHS:** The patient should be able to withdraw his/her consent at any time and delete all data. • **FR-4.4-PHS:** The Personal health system should be fully compliant with the GDPR.	
Other processes supported:	-	
Data Storage/Format (FR-6-PHS):	**FR-6.1-PHS:** The data should be stored using a relational schema	
Input:	Data for psychological, quality of life and symptom information.	
Output:	Visualization of the available data and summaries.	
Non-functional requirements		
Software requirements	**Code language**	**NFR-1-PHS:** Should comprise Angular, Kotlin, Java
	Runtime environment needed	**NFR-2-PHS:** Should be hosted in a cloud
	Operating systems and architecture (x86 or x64)	**NFR-3-PHS:** Should support Linux
	External libraries dependencies	**NFR-4-PHS:** Should comprise several Java and Javascript
	Other?	-
Hardware requirements	**Processor**	**NFR-5-PHS:** Should be Amazon AWS EC2 instances
	Disk memory	**NFR-6-PHS:** Should be Amazon AWS EC2 instances
	RAM memory	**NFR-7-PHS:** Should be Amazon AWS EC2 instances
	Other?	-
Communication requirements:	**NFR-8-PHS:** Internet connection and availability should be provided	
Software interfaces:	**NFR-9-PHS:** Web based GUI should be provided	
Hardware interfaces:	**NFR-10-PHS:** Personal computer, mobile and tablet should be supported	
Security and Privacy:	**NFR-11-PHS:** The platform should be compatible with GDPR respecting all ethical and security guidelines. N**FR-12-PHS:** Physical security should be ensured. ● User authentication ● User authorization N**FR-13-PHS:** Access by user role or types should be ensured. ● User has access to his data only ● Medical Expert has access to his patient's data only.	
Capacity:	**NFR-14-PHS:** Should be able to be used in parallel by at least 20 users	
Performance:	**NFR-15-PHS:** Should have a response time less than 1 sec.	
Reliability:	**NFR-16-PHS:** Should be 100% reliable	
Other Requirements:	-	
Comments:	• Noona is utilized in the pilot stage for collecting quality of life and phycological information from patients through a set of selected questionnaires. Noona can also be utilized in collecting patients' symptom information during their cancer treatments. • The collected data is exported from Noona as CSV-files to a research partner to be stored and utilized for data modelling. • In the future Noona plans to integrate to the Bounce system to be able to display resilience data to care personnel as part of clinical work.	

7.4. Data Aggregator

Functional requirements		
Service/Tool Name:	**Data Aggregator**	
Functional description:	The main goal of the Data Aggregator, as its name implies, is to aggregate the available information, both prospective and collected during the pilots	
Generic functional requirements:	• **FR-1-DA:** The tool should aggregate information from databases, "download" files offline from URLs, support push and pull functions for information retrieved / received from web services • **FR-2-DA:** The tool should configure communication parameters for connection to the data sources • **FR-3-DA:** The tool should expose API for integration with other (web) services	
User interface:	**FR-4-DA:** A basic UI should be offered for customising and setting the appropriate communication parameters and for monitoring the logged actions.	
Access/Control:	**FR-5-DA:** Proper security mechanisms (e.g. JWT) should be made available for regulating access to the service and to the underlying available information.	
Other processes supported:	**FR-6-DA:** The tool should connect to Semantic Mapping / Enrichment Service **FR-7-DA:** The tool should connect to Data Cleanser	
Data Storage/Format:	**FR-8-DA:** The service should comply with the data formats already defined by the data providers and with the data storage solution adopted.	
Input:	All prospective and retrospective raw data made available	
Output:	Aggregated raw data	
Non-functional requirements		
Software requirements	**Code language**	**NFR-1-DA:** Should support Java
	Runtime environment needed	Not specific runtime environment needed
	Operating systems and architecture (x86 or x64)	No specific OS is needed
	External libraries dependencies	To be specified.
	Other?	-
Hardware requirements	**Processor**	**NFR-2-DA:** Should be able to run at least in a pc with four processors
	Disk memory	**NFR-3-DA:** Should be able to run at least in a pc with 100GB of disk space
	RAM memory	**NFR-4-DA:** Should be able to run at least in a pc with 8GB of memory
	Other?	-
Communication requirements:	**NFR-5-DA:** Internet connection and availability should be provided	
Software interfaces:	API for integration with other (web) services	
Hardware interfaces:	**NFR-6-DA:** Personal computer should be supported	
Security and Privacy:	N**FR-7-DA:** Physical security should be ensured. • User authentication • User authorization N**FR-8-DA:** Access by user role or types should be ensured.	
Capacity:	N**FR-9-DA:** The system should be scalable effectively processing big amounts of data.	

Performance:	N**FR-10-DA:** Should have a response time less than 1 sec.
Reliability:	N**FR-11-DA:** Should be 100% reliable
Other Requirements:	-
Comments:	-

7.5. Data Cleanser

Functional requirements		
Service/Tool Name:	**Data Cleanser**	
Functional description:	The main goal of the Data Cleanser, as its name implies, is to clean the aggregated information, both prospective and collected during the pilots	
Generic functional requirements:	• **FR-1-DC:** The tool should validate aggregated information against specified file types • **FR-2-DC:** The tool should handle missing values and outliers • **FR-3-DC:** The tool should handle inconsistencies according to medical rules defined • **FR-4-DC:** The tool should log all cleaning actions • **FR-5-DC:** The tool should expose API for integration with other (web) services	
User interface:	**FR-6-DC:** A basic UI should be offered for customising and setting the appropriate cleaning rules and for monitoring the logged actions.	
Access/Control:	**FR-7-DC:** Proper security mechanisms (e.g. JWT) should be made available for regulating access to the service and to the underlying available information.	
Other processes supported:	-	
Data Storage/Format:	**FR-8-DC:** The service should comply with the data formats already defined by the data providers and with the data storage solution adopted.	
Input:	All prospective and retrospective data made available	
Output:	“Cleaned” data	
Non-functional requirements		
Software requirements	**Code language**	**NFR-1-DC:** Should support Python, Weka
	Runtime environment needed	Not specific runtime environment needed
	Operating systems and architecture (x86 or x64)	No specific OS is needed
	External libraries dependencies	To be specified.
	Other?	-
Hardware requirements	**Processor**	**NFR-2-DC:** Should be able to run at least in a pc with four processors
	Disk memory	**NFR-3-DC:** Should be able to run at least in a pc with 100GB of disk space
	RAM memory	**NFR-4-DC:** Should be able to run at least in a pc with 8GB of memory
	Other?	-

Communication requirements:	**NFR-5-DC:** Internet connection and availability should be provided
Software interfaces:	API for integration with other (web) services
Hardware interfaces:	**NFR-6-DC:** Personal computer should be supported
Security and Privacy:	N**FR-7-DC:** Physical security should be ensured. ● User authentication ● User authorization N**FR-8-DC:** Access by user role or types should be ensured.
Capacity:	N**FR-9-DC:** The system should be scalable effectively processing big amounts of data.
Performance:	N**FR-10-DC:** Should have a response time less than 1 sec.
Reliability:	N**FR-11-DC:** Should be 100% reliable
Other Requirements:	-
Comments:	-

7.6. Security Service

Functional requirements		
Service/Tool Name:	**Security Service**	
Functional description:	The main goal of the Security Service, as its name implies, is to introduce the appropriate privacy and security measures	
Generic functional requirements:	• **FR-1-SS:** The tool should secure data throughout their lifecycle (including data at rest, data in transfer and data in use) • **FR-2-SS:** The tool should ensure proper access control	
User interface:	**FR-3-SS:** A UI should be provided to the administrator to define the user roles and the access rights per role and per platform entity	
Access/Control:	-	
Other processes supported:	**FR-4-SS:** The set of security mechanisms made available should be applied across the platform so as to safeguard security and privacy across the platform and throughout all supported processes	
Data Storage/Format:	N/A	
Input:	User Roles, Platform Processes and Information Entities	
Output:	N/A	
Non-functional requirements		
Software requirements	**Code language**	**NFR-1-SS:** Should support Java
	Runtime environment needed	Not specific runtime environment needed
	Operating systems and architecture (x86 or x64)	No specific OS is needed
	External libraries dependencies	To be specified.
	Other?	-
Hardware requirements	**Processor**	**NFR-2-SS:** Should be able to run at least in a pc with four processors

	Disk memory	**NFR-3-SS:** Should be able to run at least in a pc with 100GB of disk space
	RAM memory	**NFR-4-SS:** Should be able to run at least in a pc with 8GB of memory
	Other?	-
Communication requirements:	**NFR-5-SS:** Internet connection and availability should be provided	
Software interfaces:	**NFR-6-SS:** API for integration with other (web) services should be provided	
Hardware interfaces:	**NFR-7-SS:** Personal computer, tablet, mobile should be supported	
Security and Privacy:	• Data integrity and privacy safeguards throughout the data lifecycle (including data at rest, data in transfer and data in use) • Proper access control	
Capacity:	N**FR-8-SS:** The system should be scalable effectively processing big amounts of data.	
Performance:	N**FR-9-SS:** Should have a response time less than 1 sec.	
Reliability:	N**FR-10-SS:** Should be 100% reliable	
Other Requirements:	-	
Comments:	-	

7.7. Model Repository

Functional requirements	
Service/Tool Name:	**Model repository (MR)**
Functional description:	This is the web-based component that will permanently host the models that will be developed in the context of the BOUNCE project.
Generic functional requirements:	**FR-1-MR:** For each model the BOUNCE Model Repository should contain all the related information. • **FR-1.1-MR:** Descriptive information for each model (abstract and detailed description, references, etc.) should be included • **FR-12-MR:** Information related to the model input parameters needed for the execution of the model (data type, units, description etc.) should be included • **FR-1.3-MR:** Information related to the output data of the model (description, type, etc.) should be included. • **FR-1.4-MR:** Several versions of binaries should be included User Interface: • **FR-2-MR:** The interface should be simple. • **FR-3-MR:** The user interface should make use of common user interface elements. • **FR-4-MR:** The page should be structured based on user experience (UX) importance. • **FR-5-MR:** Coloring theme and form elements should be strategically used. Web Services: • **FR-6-MR:** Their calling URLs and lists of arguments should be concise. • **FR-7-MR:** Their responses should be verbose enough to notify the 3rd party application (and its users) of method execution success or failure.

	Database: • **FR-8-MR:** SQL queries to the database should consume a minimum amount of time for their execution.	
User interface:	**FR-9-MR:** The user interface may include the following screens: • *Initial Screen*: Greet user and prompt them to go to login screen to enter their credentials • *Login Screen*: User is required to login to the system using their credentials • *Incorrect login Screen*: User is notified that their login attempt was unsuccessful and prompted to retry • *Main Screen*: User is presented with the necessary choices for CRUD procedures on the model components • *Creation Screens*: For each model component (files, parameters, etc.) and/or administrative data (users, roles, etc.) the user is required to complete a list of fields in a corresponding screen and submit the form • *Content list screen(s)*: User is presented with a set of screens containing the MR contents. By clicking on specific buttons in each row the user can edit (and update) or delete the row • *Edit Screens*: For each model component (files, parameters, etc.) and/or administrative data (users, roles, etc.) the user is required to correct a list of fields in a corresponding screen and submit the form	
Access/Control:	• **FR-10-MR:** Regular users should have full access over their own personal data and the content they created themselves • **FR-11-MR:** Regular users should have read-only access to non-personal data that they have not created themselves • **FR-12-MR:** Administrators should have access over any and all data in the MR • **FR-13-MR:** Equivalent limitations should apply for all 3rd party applications, none of which can assume the role of an administrator.	
Other processes supported:	*N/A*	
Data Storage/Format:	**FR-14-MR:** The tool should support the following types/format: • Database engine: Inno DB • Database Content Data Types: String, Integer, Double, BLOB (where applicable), Date, Boolean • File Data formats: Executables (for various OS), .doc, .dat, .xml, .pdf, etc. • API data exchange format: JSON	
Input:	• Textual data (in the creation screens) • Files (various formats) • JSON objects	
Output:	• Messages (to users) • JSON objects (containing responses to API calls)	
Non-functional requirements		
Software requirements	**Code language**	**NFR-1-MR:** Python, SQL, Javascript should be supported
	Runtime environment needed	**NFR-2-MR:** Should be supported: Python 3.X Ubuntu Linux 14.XX or above or Windows 10 MySQL 5.7 or higher

	Operating systems and architecture (x86 or x64)	**NFR-3-MR:** x64 should be supported
	External libraries dependencies	**NFR-4-MR:** Django 2.0, Connector for Django with MySQL should be supported
	Other?	TBD during MR development and refinement
Hardware requirements	**Processor**	**NFR-5-MR:** 4-core processor or higher should be supported
	Disk memory	**NFR-6-MR:** 128 GB SSD or higher should be supported
	RAM memory	**NFR-7-MR:** 16GB should be supported
	Other?	TBD during MR development and refinement
Communication requirements:	**NFR-8-MR:** Internet connection supporting at least https protocol for communication via API should be provided	
Software interfaces:	**NFR-9-MR:** Other BOUNCE applications to be developed should be able to be connected to the MR as needed.	
Hardware interfaces:	**NFR-10-MR:** P/C should be supported	
Security and Privacy:	**NFR-11-MR:** MR should be located in a server within a closed properly conditioned and secured area (server room) **NFR-12-MR:** Two Basic User roles (user, Administrator) should be initially created. Additional roles, should be created as needed throughout the project. **NFR-13-MR:** User role should have read only rights over the MR contents and full access rights to the content they have created. Administrator role should have full access rights over all the contents of MR. Roles and rights should be able to be extended/altered as needed. **NFR-14-MR:** Tables containing the registered MR user data should be available with full access rights only to the Administrator user role. **NFR-15-MR:** For communicating via API, https connection with SSL certificates should be provided.	
Capacity:	**NFR-16-MR:** ~10 users should be supported to simultaneously use the system and conduct transactions concurrently **NFR-17-MR:** System should be able to scale to further growing number of users without the increase in response times	
Performance:	**NFR-18-MR:** ~100ms for SQL queries alone, ~1sec for a full transaction through the GUI/API should be ensured **NFR-19-MR:** 50-150 transactions per day should be ensured.	
Reliability:	**NFR-20-MR:** System fails less than 12 hours per year should be ensured. **NFR-21-MR:** System should be restored within 12 hours in case of failure.	
Other Requirements:	*N/A*	
Comments:	*N/A*	

7.8. In Silico Trial and Prediction Repository

Functional requirements

Service/Tool Name:	***In Silico* Trial and Prediction Repository (ISTPR)**
Functional description:	The *In Silico* Trial and Prediction Repository is a web-based application, capable of persistently storing the predictions of the models developed within the BOUNCE project.
Generic functional requirements:	**FR-1-ISTPR:** The input data of each simulation (biological status, medical information sets, clinical information sets, contextual and psychosocial information sets, etc.), the model used in the simulation, and the output data should be stored persistently after the completion of the simulation scenario. Since the three trajectories **FR-2-ISTPR:** (psychosocial/behavioral, functional and biological/medical) interact with each other through particular parameters, the values of those parameters in each simulation should be stored in the ISTPR along with the corresponding input data. **FR-3-ISTPR:** Information related to the input (biological markers, medical imaging, lifestyle, psychological status, etc.) and the output (predicted psychological status, biological status or level of resilience of women with breast cancer) of all the simulations conducted using the *in silico* resilience trajectory predictor (RTP) should be readily available through the ISTPR for evaluation, comparison and validation. User Interface: • **FR-4-ISTPR:** The interface should be simple. • **FR-5-ISTPR:** The user interface should make use of common user interface elements. • **FR-6-ISTPR:** The page should be structured based on user experience (UX) importance. • **FR-7-ISTPR:** Coloring theme and form elements should be strategically used. Web Services: • **FR-8-ISTPR:** Their calling URLs and lists of arguments should be concise. • **FR-9-ISTPR:** Their responses should be verbose enough to notify the 3rd party application (and its users) of method execution success or failure. Database: • **FR-10-ISTPR:** SQL queries to the database should consume a minimum amount of time for their execution.
User interface:	**FR-11-ISTPR:** The user interface may include the following screens: • *Initial Screen*: Greet user and prompt them to go to login screen to enter their credentials • *Login Screen*: User is required to login to the system using their credentials • *Incorrect login Screen*: User is notified that their login attempt was unsuccessful and prompted to retry • *Main Screen*: User is presented with the necessary choices for CRUD procedures on the trial / subject / experiment components • *Creation Screens*: For each trial / subject / experiment component (models, parameters, etc.) and/or administrative data (users, roles, etc.) the user is required to complete a list of fields in a corresponding screen and submit the form • *Content list screen(s)*: User is presented with a set of screens containing the ISTPR contents. By clicking on specific buttons in each row the user can edit (and update) or delete the row • *Edit Screens*: For each trial / subject / experiment component (models, parameters, etc.) and/or administrative data (users, roles, etc.) the user is required to correct a list of fields in a corresponding screen and submit the form
Access/Control:	• **FR-12-ISTPR:** Regular users should have full access over their own personal data and the content they created themselves

	• **FR-13-ISTPR:** Regular users should have read-only access to non-personal data that they have not created themselves • **FR-14-ISTPR:** Administrators should have access over any and all data in the ISTPR • **FR-15-ISTPR:** Equivalent limitations should apply for all 3rd party applications, none of which can assume the role of an administrator.	
Other processes supported:	*N/A*	
Data Storage/Format:	**FR-16-ISTPR:** The tool should support the following types/format: • Database engine: Inno DB • Database Content Data Types: String, Integer, Double, BLOB (where applicable), Date, Boolean • File Data formats: Executables (for various OS), .doc, .dat, .xml, .pdf, etc. • API data exchange format: JSON	
Input:	• Textual data (in the creation screens) • Files (various formats) • JSON objects	
Output:	• Messages (to users) • JSON objects (containing responses to API calls)	
Non-functional requirements		
Software requirements	**Code language**	**NFR-1-ISTPR:** Python, SQL, Javascript should be supported
	Runtime environment needed	**NFR-2-ISTPR:** Should be supported: Python 3.X Ubuntu Linux 14.XX or above or Windows 10 MySQL 5.7 or higher
	Operating systems and architecture (x86 or x64)	**NFR-3-ISTPR:** x64 should be supported
	External libraries dependencies	**NFR-4-ISTPR:** Django 2.0, Connector for Django with MySQL should be supported
	Other?	TBD during ISTPR development and refinement
Hardware requirements	**Processor**	**NFR-5-ISTPR:** 4-core processor or higher should be supported
	Disk memory	**NFR-6-ISTPR:** 128 GB SSD or higher should be supported
	RAM memory	**NFR-7-ISTPR:** 16GB should be supported
	Other?	TBD during ISTPR development and refinement
Communication requirements:	**NFR-8-ISTPR:** Internet connection supporting at least https protocol for communication via API should be provided	
Software interfaces:	**NFR-9-ISTPR:** Other BOUNCE applications to be developed should be able to be connected to the ISTPR as needed.	
Hardware interfaces:	**NFR-10-ISTPR:** P/C should be supported	
Security and Privacy:	**NFR-11-ISTPR:** ISTPR should be located in a server within a closed properly conditioned and secured area (server room) **NFR-12-ISTPR:** Two Basic User roles (user, Administrator) should be initially created. Additional roles, should be created as needed throughout the project.	

	NFR-13-ISTPR: User role should have read only rights over the ISTPR contents and full access rights to the content they have created. Administrator role should have full access rights over all the contents of ISTPR. Roles and rights should be able to be extended/altered as needed. **NFR-14-ISTPR:** Tables containing the registered ISTPR user data should be available with full access rights only to the Administrator user role. **NFR-15-ISTPR:** For communicating via API, https connection with SSL certificates should be provided.
Capacity:	**NFR-16-ISTPR:** ~10 users should be supported to simultaneously use the system and conduct transactions concurrently **NFR-17-ISTPR:** System should be able to scale to further growing number of users without the increase in response times
Performance:	**NFR-18-ISTPR:** ~100ms for SQL queries alone, ~1sec for a full transaction through the GUI/API should be ensured **NFR-19-ISTPR:** 50-150 transactions per day should be ensured.
Reliability:	**NFR-20-ISTPR:** System fails less than 12 hours per year should be ensured. **NFR-21-ISTPR:** System should be restored within 12 hours in case of failure.
Other Requirements:	*N/A*
Comments:	*N/A*

8. Conclusions

This Deliverable defines in a systematic and holistic way the basis for the development of BOUNCE system and tools, based upon:

- End user needs and acceptance survey
- User Scenarios from the clinical standpoint
- Characteristics of the various BOUNCE actors
- Systemic technical requirements fairly split over two main categories (functional and non-functional) (Figure 3). Each technical requirement has one unique identifier associated to it to allow for traceability of the requirements from the design phase to the final validation one.

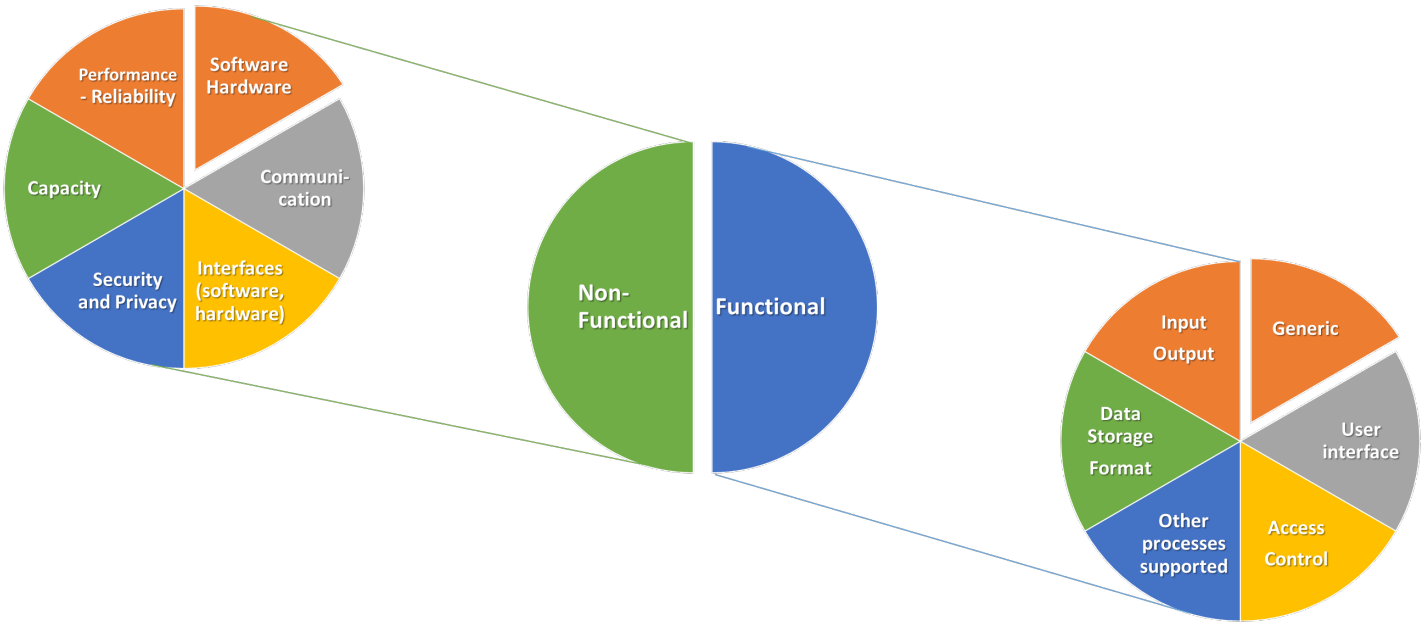

Figure 3: BOUNCE technical requirements repartition over categories.

Thus, this document provides the required and sufficient guidelines upon which the BOUNCE system architecture and development may be based.

Last but not least, table 6 highlights factors most likely associated with the acceptance and common barriers of clinical decision support systems. These factors are also likely to determine the degree of adoption of the BOUNCE framework and system by potential end-users. BOUNCE recognizes that such factors and barriers should be taken into consideration early during tool development to maximize exploitation and project impact in BC health care.

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Table 6: List of most recognized barriers or facilitators for CDSS adoption based on [10]

	Barriers	Facilitators
Effort Expectancy	• Lack of knowledge of system or content • Physician/ user attitude towards the system • Too many unwanted alerts • Complexity • Less user friendly • Poor system design • Lack of flexibility	• Fast information retrieval/ transfer • Flexibility of system • Good information presentation • User friendly • Ease of finding information in CDSS • Usability testing • Good System Design • Reducing complexity
Facilitating Conditions	• Economic constraints/ finance and resources • Prior bad experience • Poor computer skills • Provider discontinuity/support • Lack of motivation/ incentives • Lack of awareness existence • Poor customer support • Lack of training	• Economic incentives to user or provider • Good training • Computer literacy of younger generation/good computer skills • Enhancing user/provider knowledge • Professional body collaboration/endorsement • Good prior experience using CDSS
Performance Expectancy	• Lack of time/ time constraints • Obscure work flow issues • Less authenticity/ reliability of info • Lack of agreements with the system • Difficulty of competing clinical demands • Interoperability/standards • Loss of productivity	• Providing or collecting relevant information for user/patient • Potential to improve quality of care • Improve productivity • Proper documentation of procedures • Integration of the CDSS into the workflow • Chance of decreasing error • Reliability of data/information • Integration of the CDSS into existing systems • Applicability
Social Influence	• Reluctance to use system in front of patients • Social barriers/lack of social acceptance • Cultural concerns	• Positive user attitude • Discrete accessibility of resource

9. References

[1] Breast Cancer Research Foundation: https://www.bcrfcure.org/breast-cancer-statistics

[2] WHO: http://www.who.int/cancer/detection/breastcancer/en/

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10. ANNEX A

Functional requirements *<Functional requirements provide a clear statement of the functions required and the specific intended behavior of the BOUNCE service/tool being developed and associated with the previously described use case. They define things such as service/tool calculations, data manipulation and processing, user interface and interaction with the application, and other specific functionality that show how user requirements are satisfied >*		
Service/Tool Name:		
Functional description:	*<Provide an introductory description of the service/tool and its context of use>*	
Generic functional requirements:	*<Provide generic functional requirements of the service/tool taking into account all major classes/categories of users>*	
User interface:	*<Describe the operations performed by each screen (e.g. administrative functions etc.) taking into account all major classes/categories of users and the data (attributes) input to and output from the operations>*	
Access/Control:	*<Describe access to stored data and control processes over stored data>*	
Other processes supported:	*<Describe any additional operations/processes that the service/tool must do >*	
Data Storage/Format:	*<Describe requirements related to data storage and required data format. Different forms of data also include: system documentation, audit records, database records, access records etc.>*	
Input:	*<Describe data to be entered into the service/tool>*	
Output:	*<Describe service/tool reports or other outputs>*	
Non-functional requirements *<Non-functional requirements (or quality requirements): impose constraints on the design or implementation (such as performance requirements, security, reliability etc.)>*		
Software requirements ***<**Provide a description of the software platform needed to support the service/tool**>***	**Code language**	
	Runtime environment needed	<Specify Runtime environment needed along with its version (java runtime environment, matlab runtime environment, etc.)>
	Operating systems and architecture (x86 or x64)	
	External libraries dependencies	
	Other?	
Hardware requirements ***<**Provide a description of the hardware platform needed to support the service/tool**>***	**Processor**	
	Disk memory	
	RAM memory	
	Other?	

Communication requirements: (Network Connections, interfaces)	*<Describe communications interfaces to other systems or devices, such as local area networks>*
Software interfaces:	*<Name the applications with which the subject application must interface. State the following for each such application: name of application, external owner of application, interface details>*
Hardware interfaces:	*<Define any hardware interfaces supported by the service/tool>*
Security and Privacy:	*<State the type(s) of security required. Include the need for the following as appropriate:* *1. Physical security.* *2. Access by user role or types.* *3. State access control requirements by data attribute. For example, one group of users has permission to view an attribute but not update it while another group of users has permissions to update or view it.* *4. State access requirements based on service/tool function. For example, if there is a need to grant access to certain service/tool functions to one group of users, but not to another. For example, "The system shall make Function X available to the System Administrator only".* *5. State if there is a need for certification and accreditation of the security measures adopted for this application>*
Capacity:	*< List the required capacities and expected volumes of data in business terms. Do not state capacities in terms of system memory requirements or disk space >*
Performance:	*< Describe the requirements for the following:* *A. Response time for queries and updates* *B. Throughput* *C. Expected rate of user activity (for example, number of transactions per hour, day, or month, or cyclical periods)* *Specific performance requirements, related to a specific functional requirement, should be listed with that functional requirement.>*
Reliability:	*<State required reliability:* *1. Mean-Time-Between-Failure is the number of time units the service/tool is operable before the first failure occurs.* *2. Mean-Time-To-Failure is the number of time units before the service/tool is operable divided by the number of failures during the time period.* *3. Mean-Time-To-Repair is the number of time units required to perform system repair divided by the number of repairs during the time period>*
Other Requirements:	*<Detail any other requirement associated with the specific service/tool>*
Comments:	