# Multiscale modelling and decision support applied to breast cancer management

## Overview of DESIREE european H2020 project

**Dr. Iván Macía**
Project Coordinator
Vicomtech -K4
imacia@vicomtech.org

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# Decision Support and Information System for Breast Cancer

- *Call*: H2020-PHC-2015-single-stage

- *Topic*: PHC-30 (Personalizing Health and Care) - Digital Representation of Health Data to Improve Disease Diagnosis and Treatment

- *Budget*:  3.340.720€
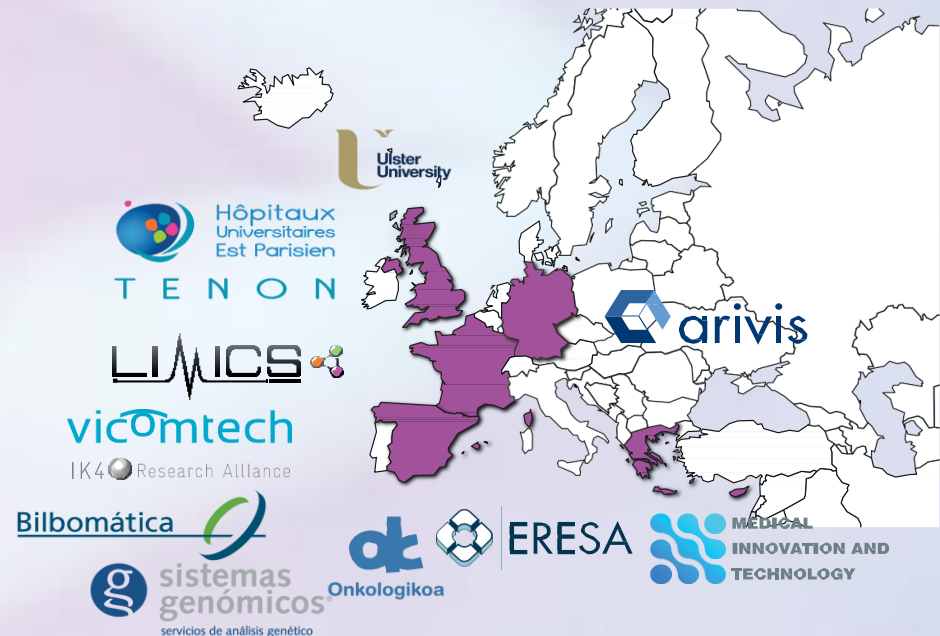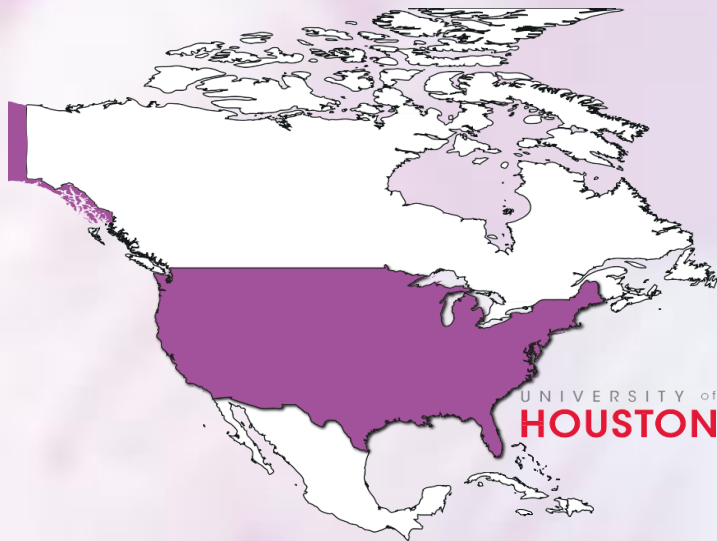
# Why Breast cancer?

- High incidence and mortality **(PBC)**

- **Complex** clinical situation

- Great amount of heterogeneous data

- Experience of the consortium in:
  - Models on effects of radiotherapy and adjuvant therapy
  -  Models on breast conservative therapy + healing
  - I**nformation / DSS systems for breast cancer** to be used **by breast units**
  - **DSS technology** and how to **model experience**
  - **Image analysis** and visualization and **genomic** data analysis

**Patient-specific Data**
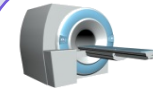
- Imaging
- Genetics
- Personal & Clinical
- RT Plans
- Biology
- Diagnostic Tests
- Therapeutic
- Environmental & Risk Factors

**External Data**

- Therapeutic Admin. Data
- Clinical Guidelines
- Trials & Studies
- Public DBs

# Main Idea

**DESIREE** is

- a **web**-based **software** ecosystem (i.e. a group of related tools)
- for personalized, collaborative and multidisciplinary case management and **decision support** of clinicians in **breast units** (**BUs**)
- mainly for **primary breast cancer** (PBC)

**Decision Support System**

- Provides **timely information and evidence** for case management and decision
- Information for decision and advice may come in different forms:
    - Integrated intuitive view of the patient data
    - Decisional rules from experience and evidence / alarms
    - Visual exploratory interfaces
    - Comparison with previous cases
    - Computational predictive modeling
    - Exploitation of unstructured digital information sources (diagnostic, prognostic)

# Objectives

- **Improve the coordination and multidisciplinary management** of breast cancer cases in Bus
  - BU professionals have a limited amount of time to review cases based on a large amount of heterogeneous information
  - Supported by a novel Digital Breast Cancer Patient model

- Exploit **novel sources** of information (genetic, lifestyle) and the rich information contained in routine **imaging examinations**
  - Develop and assess the value of prognostic imaging biomarkers and other digital information sources available

- Develop tools for the **visual assessment** of the possible **aesthetic outcome of Breast Conservative Therapy**
  - Driving computational multiscale predictive modeling tools into clinical practice for informed decision support

- Provide **decision support** for the diversity of therapeutic options available in PBC
  - Overcome the limitations of DSS based only on guidelines
  - Provide the ability to explore and learn from previous experience
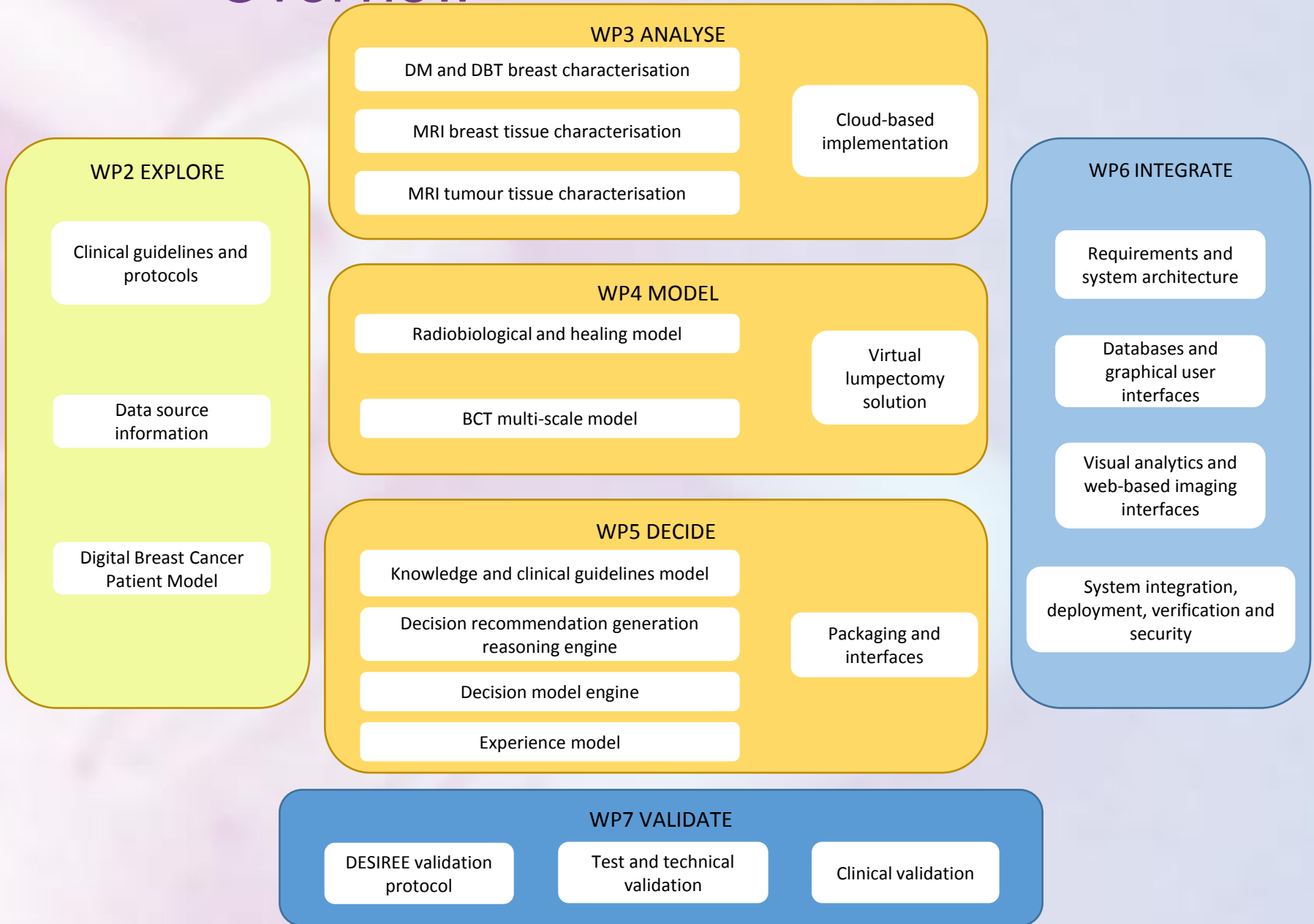
# Core components

**Decision Support System for BUs**

- Based on a **digital breast cancer patient** (**DBCP**)
- Capable of modelling **experience**
- On the basis of a set of **evolving rules** based on outcomes
- Providing **visual** exploratory **interfaces**

**Exploitation of Novel Digital Information Sources**

- Assess the **prognostic value** of certain modalities such as mammo, DBT or MRI
- Develop prognostic imaging biomarkers of **tumor appearance** (MRI) and **breast density** (mammo, DBT)
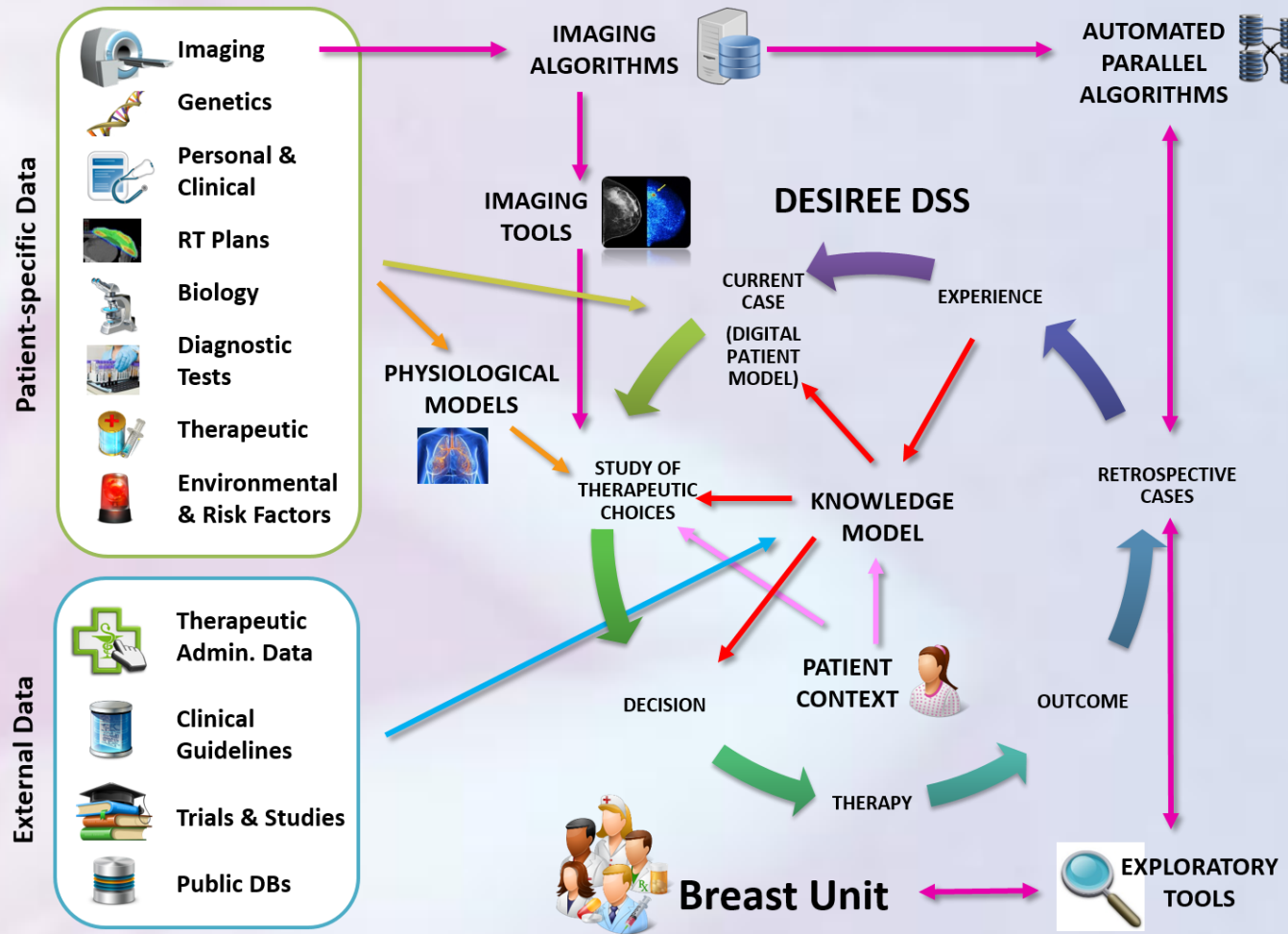- Exploiting **genetic** information (*Genesystems*)

**Physiological Predictive Modelling**

- Based on a **physiological multi-scale model** of **breast conservative therapy**
- With predictive capacity of **aesthetic outcome**
- Incorporating effects at the cellular level of external stimuli (healing, radiotherapy, chemotherapy)

# Work Package Overview

## WP3 ANALYSE

- DM and DBT breast characterisation
- MRI breast tissue characterisation
- MRI tumour tissue characterisation
- Cloud-based implementation

## WP2 EXPLORE

- Clinical guidelines and protocols
- Data source information
- Digital Breast Cancer Patient Model

## WP4 MODEL

- Radiobiological and healing model
- BCT multi-scale model
- Virtual lumpectomy solution

## WP6 INTEGRATE

- Requirements and system architecture
- Databases and graphical user interfaces
- Visual analytics and web-based imaging interfaces
- System integration, deployment, verification and security

## WP5 DECIDE

- Knowledge and clinical guidelines model
- Decision recommendation generation reasoning engine
- Decision model engine
- Experience model
- Packaging and interfaces

## WP7 VALIDATE

- DESIREE validation protocol
- Test and technical validation
- Clinical validation

# Impact Seek

- In terms of technology
  - Push forward technologies into clinical practice (increase TRLs)
  - Fully functional, web-based DSS, imaging and modelling tools
- In terms of clinical practice
  - **New insight** that may end up in new research, studies or trials
  - Technologies applied into clinical practice at the end of the project:
    - **Predictive modelling of BCT:** this might be the hardest as it has the lowest TRL. Demonstrate that is a valuable tool and to which extent
    - **Prognostic imaging biomarkers:** demonstrate utility and provide tools to measure them
    - **DSS for Breat Unit:** having the DSS working in the Breast Unit is of paramount importance

# Thank you for your attention

*imacia@vicomtech.org*
*desiree-contact@vicomtech.org*