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CO	Confidential, only for members of the consortium (including the Commission Services)	X



COVER AND CONTROL PAGE OF DOCUMENT	
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ABSTRACT:

In the CHIC project, the outreach activities played a key role in the promotion of the awareness as well as strong cooperation and exchange with research communities inside and outside of the EU. Thus, the main target of dissemination was to inform all relevant target groups about the project results and the positive impacts that these results might have for clinical, industrial and societal users as well as for the research community.

Those dissemination activities are complemented with the definition of the exploitation plans for the CHIC outputs. In particular, the expected exploitable projects outputs (clinical outputs, technological and software outputs, modelling outputs) have been finalised. For each output (both technological and modelling ones), the resources needed to sustain its operation after the end of the project have been identified by the consortium, which include identification of target users and expected time-to-market.

For the CHIC platform as a whole, the consortium has agreed on the need before clinical exploitation takes place of complete prospective clinical validation. The steps to reach this clinical relevance have been identified together with the commitment by the partners to self-sustain the system to allow the completion of the first validation phase by the end of 2018. In that period, also research and educational exploitation will take place.

This document summarises the dissemination and exploitation CHIC outcomes for the fourth year of the project.

KEYWORD LIST:

Dissemination, exploitation plans, sustainability, maintenance, IPR, communication

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Executive Summary

During the CHIC project, dissemination activities had an important role to foster the widespread awareness as well as strong cooperation and exchange with research communities inside and outside of the EU.

The extensive dissemination activities embraced informing all relevant target groups about the project results and the implications that these results might have for clinical, industrial and societal users as well as for the research communities.

With the support of those dissemination activities, the definition of the plans for future exploitation of the CHIC outputs was one of the consortium focus in the last year of the project. In particular, considering the IPR management strategy (IPR ownership issues, software licensing strategy analysed in WP4), the exploitable projects outputs (technological and software outputs, and modelling outputs) have been completely defined.

For each output, the resources needed for its sustainability after the end of the project have been identified together with specific plans for exploitation, which include identification of the technology readiness level, the target users and the expected time-to-market.

The CHIC consortium has also defined an approach for long-term exploitation for the CHIC platform as a whole. The exploitation has been divided into research, educational, and clinical ones. Research and educational exploitation will continue immediately after the end of the project sustained by the project consortium itself. On the other side, the clinical exploitation cannot be completely achieved until the clinical relevance is demonstrated via an extensive clinical prospective validation. This type of validation is outside the aim of the CHIC project, and will take many years to be completed. The consortium has defined how this will be achieved and sustained after the end of the project in the short term. For the medium-term validation (i.e. clinical trials), specific funding opportunities will be pursued. As soon as the clinical relevance of the CHIC paradigm will be confirmed, the natural clinical exploitation of the CHIC paradigm will be as a clinical decision support system to be commercialised by medical technology companies (like Philips).

1 Introduction

1.1 Purpose of this document

This document is part of the WP12 activities whose objectives are:

- to coordinate the dissemination and exploitation of the CHIC outputs to target groups,
- to establish relationships and seek synergies with other projects or initiatives, and
- to coordinate training activities.

The previous WP12 deliverables (D12.1, D12.3, and D12.4) formed the basis for the activities that have been performed in the last year by the consortium.

The purpose of this final document is to provide the description of the latest CHIC dissemination results together with an overview of the CHIC exploitable outputs and their individual exploitation plans. This deliverable also illustrates the sustainability and exploitation path chosen for the CHIC platform after the end of the project.

The present deliverable, as output of Tasks 12.1 (Dissemination activities) and 12.2 (Exploitation and IPR issues), aims at:

- providing an update on the carried-out dissemination activities;
- reporting on the identified project outputs in terms of software components, and models (both hypo- and hyper-models);
- reporting on the sustainability plans and exploitation activities, both at individual and at consortium level.

1.2 Structure of the Deliverable

The document is organised as follows:

- Section 2 provides an update on the CHIC dissemination results achieved in the fourth year of the project;
- Section 3 provides the description of the exploitable project outputs: technological and software outputs, and modelling outputs together with their specific sustainability and exploitation plans;
- Section 4 reports on the exploitation plans for the CHIC platform as a whole;
- Section 5 provides the individual exploitation plans of the CHIC partners.

2 Dissemination

2.1 Dissemination plan

Different *target* groups for dissemination activities were identified in the very early stages of the project, and they include stakeholders in research, scientific, clinical or industrial fields, who have been continuously informed about the intermediate and final results of the project. The identification of the target groups was based on the type and level of the involvement in the project (internal, connected, or external). For each of the groups, an analytical description is provided together with the stakeholders identified as part of each group (see Table 1 for updated details).

Target group	Description	Stakeholders
Internal	It includes all institutions or associations, which are part of the CHIC project effort. Even if each of them has access to specific information and material, it is important to make sure that all the results and the activities of the project are well known. Awareness is important for cross-fertilization among WPs and partners' activities, increase synergies and capitalise on each other results. The specificity of the target and of the content (i.e. information with access restricted to the consortium) will require the use of specific channels (i.e. private mailing lists).	<ul style="list-style-type: none"> CHIC consortium Institutional observers (departments involved) CHIC external advisory board: <ul style="list-style-type: none"> David Ingram, Professor of Health Informatics and Director of the Centre for health Informatics and Multiprofessional Education, University College London Metin Akay, Professor of Biomedical Engineering, University of Houston, Texas, USA and IEEE Press Series Editor for the IEEE Press Series in Biomedical Engineering, Francoise Meunier, Director General of the European Organization for Research and Treatment of Cancer (EORTC) Trachette Jackson, Professor of Mathematics at the University of Michigan, USA. Senior Editor of Cancer Research Yuri Nikolsky, Chief Executive Officer GeneGo (a Thomson Reuters Company) Roger Dale, Professor for Cancer Radiobiology, Department of Surgery and Cancer, Faculty of Medicine, Imperial College, London Piotr Czauderna, Professor, Head of Surgery and Urology for Children and Adolescents, Medical University of Gdansk, Poland
Connected	It includes all stakeholders that might already have some connections with the CHIC activities but not actively be part of them. This group needs to access public information from CHIC but they can be provided with more technical and scientific details than the general public.	<ul style="list-style-type: none"> EC community and related services Media/journalist Specialised media Political stakeholders Potential users Related projects from the VPH: <ul style="list-style-type: none"> p-medicine VPH-Share EUDAT2020 dr Therapat iManageCancer MyHealthAvatar VPH-PRISM Go-Smart Avicenna
External	This group is composed by stakeholders, who are completely external to the project activities. Some of these groups most probably have not heard of CHIC before or might not have any technical or domain specific background. They should receive general information on the project, written in an easily understandable way with more	<ul style="list-style-type: none"> Individual researchers Research institution or universities Scientific communities or associations <ul style="list-style-type: none"> National Cancer Institute, Division of Cancer Biology European Clinical Research Infrastructures Network (ECRIN) The European Platform for Patients Organisations Science & Industry (EPPOSI) The Meg Jones Crain Cancer charity (braintrust)

	emphasis on the impact and the vision of the project than on its technical aspects.	<ul style="list-style-type: none"> ○ International Confederation of Childhood Cancer Patient Organisation ○ IEEE ○ VPH-Institute • Clinicians/Patients • Industries <ul style="list-style-type: none"> ○ Pharmaceuticals ○ Healthcare service providers ○ Others • Public at large
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Table 1: CHIC target groups

The *channels* used to convey the message to the target groups were different according not only to the target group but also to the type of information to be disseminated. A range of different dissemination channels and tools have been used to ensure the highest visibility of the project progress and its results. In general,

- Scientific and technical results disseminated via peer-reviewed papers or specialised scientific conferences.
- For software developments, apart from technological and scientific results above, demonstrations were organised both for specific groups of stakeholders in conjunction to bigger events (such as conferences) and the organisation of instructional courses on the developed infrastructure within major worldwide events.
- General tools: well-established set of dissemination processes, which includes web presence, media material preparation, and periodic newsletters.
- Web presence: a strong and highly visible web presence set up from the very beginning of the project, which includes the project website and the social media (Facebook, Twitter, and YouTube).

The dissemination tools can be grouped according to the type of dissemination activities they are used for, as it is shown in the following table (Table 2).

Type of content	Channel	Examples	Target group
Motivation, Results, Vision, Exploitation	Oral	Presentation at scientific conferences/workshops, project conference, summer schools/meetings, face-to-face communication	Connected, External
Results, Exploitation	Demo	e-based consultancies, online videos	Internal, Connected
Results, Vision, Exploitation	Print	Reports, scientific article on peer-reviewed journals, promotional materials (fact sheet, flyer, posters)	Internal, Connected, External
Motivation, Results, Vision	Web content	Project website, presence in other websites, e-newsletter, mailing list, e-form of a set of promotional materials, information database	Internal, Connected, External
Motivation, Vision	Media (generalist and specialised)	Press-release, interviews, panel discussion	Connected, External

Table 2: Overview of CHIC dissemination tools and activities Type of activity

2.2 Dissemination process update

As described above, the project stakeholders have been classified into three main target groups (internal, connected and external). For each of those groups, a special set of appropriate dissemination methods/tools and benefits from the dissemination activities have been defined.

As the channels and target groups of the CHIC project are many, it has been decided for some of the partners to be responsible for guiding the specific dissemination (as reported in Table 3). This does not mean, however, that the other partners were excluded or not contributing to the dissemination project activities.

Target group	Stakeholders	Channel	Partner in charge
External	Political	Web content (website, newsletters) Paper (promo material)	USAAR, KULeuven, ICCS
External	General public	Web content (website, newsletters) Paper (promo material)	USAAR, KULeuven, ICCS
Connected	European Commission	Web content (website, newsletter) Paper (promo material)	Project Management team (Eurice, ICCS)
Connected	Institutional observers	Web content Paper Oral	All partners
Connected	Users	Oral (conferences and summer schools) Web content Paper	USAAR, KULeuven, BED, ICCS
External	VPH community	Oral Web content Paper	USFD, UCL, ICCS, FORTH, UOXF, CINECA, BED
External	Healthcare ICT	Oral Web content Paper	Philips, FORTH, UCL, BED, USFD, CUSTODIX, CINECA, BED, ICCS
External	Mathematical modelling	Oral Web content Paper	ICCS, UPENN, BED

Table 3: Main partners' responsibilities in the dissemination process

2.3 Dissemination results (year 4)

In this section, we report the lists of the events and contributions from the different partners during the fourth year of the project to three categories of channels (peer-reviewed publications, workshops and conferences, and press/web activities).

Title	First author	Type of publication	Involved partners	Status	Date	DOI or publication information
A hybrid discrete-continuous model of in vitro spheroid tumor growth and drug response	Tzedakis, G.	Paper in Proceedings of a Conference/Workshop	FORTH	Published	17.08.2016	38th IEEE-EMBS, Engineering in Medicine and Biology Society (EMBC 2016), DOI: 10.1109/EMBC.2016.7592130
Addressing Intravoxel Incoherent Motion Challenges Through an Optimized Fitting Framework for Quantification of Perfusion	Manikis, GC	Paper in Proceedings of a Conference/Workshop	FORTH	Published	05.10.2016	International Conference on Imaging Systems and Techniques (IST 2016), DOI: 10.1109/IST.2016.7738275
Diffusion Modelling Tool (DMT) for the analysis of Diffusion Weighted Imaging (DWI) Magnetic Resonance Imaging (MRI) data	Manikis, GC	Paper in Proceedings of a Conference/Workshop	FORTH	Published	29.06.2016	Proceedings of Computer Graphics International (CGI), the 33th Annual Conference, Pages 97-100
Imaging pathophysiologic parameters of primary Glioblastoma spheroids with light sheet microscopy towards theranostic heuristics	Oraipoulou, ME	Paper in Proceedings of a Conference/Workshop	FORTH	Published	12.10.2016	1th annual event of the European Technology Platform on Nanomedicine, DOI: 10.13140/RG.2.2.32399.38568
Visualizing tumor environment with perfusion and diffusion MRI: Computational challenges	Marias, K	Paper in Proceedings of a Conference/Workshop	FORTH	Published	28.07.2016	Proceedings Computer Graphics International (CGI), the 33rd Annual Conference, Pages 113-116
Computational Horizons on Cancer: A computational infrastructure for the retrieval, alignment, and orchestration of cancer specific computational models	Tsiknakis, M.	Peer-reviewed publication	TEI-C, Custodix, ICCS, USFD, FORTH, CINECA, USAAR, BED	In preparation	2017	IEEE Journal of Biomedical and Health Informatics
A Modular Repository-based Infrastructure for Simulation Model Storage and Execution Support in the Context of In Silico Oncology and In Silico Medicine	Christodoulou, N	Peer-reviewed publication	ICCS	Published	04.09.2016	Cancer Informatics 15, 219-235, 10.4137/Cln.s40189
A Numerical Handling of the Boundary Conditions Imposed by the Skull on an Inhomogeneous Diffusion Reaction Model of Glioblastoma Invasion Into the Brain: Clinical Validation Aspects	Stamatakis, G	Peer-reviewed publication	ICCS	Published	03.02.2017	Cancer Informatics, pp. 1-16, Feb. 2017, DOI: 10.1177/1176935116684824

In Silico Oncology: Evaluating the Predictability of Acute Lymphoblastic Leukemia Patients' Response to Treatment Utilizing a Multiscale Oncosimulator Model in Conjunction with Machine Learning Methods	Ouzounoglou, E	Paper in Proceedings of a Conference/ Workshop	ICCS	Published	26.09.2016	in A.G. Hoekstra (Editor), VPH2016, book of abstracts, University of Amsterdam, (Amsterdam), ISBN 978-90-826254-0-0, pp. 166-169, DOI: 10.13140/RG.2.2.32940.05760
In Silico Simulation of Glioblastoma Growth and Invasion into the Human Brain Including an Explicit Modelling of the Adiabatic Boundary Condition Imposed by the Skull	Giatali, S	Paper in Proceedings of a Conference/ Workshop	ICCS	In press	14.10.2016	JAE- Journal of Applied Electromagnetism, in press (to appear in July 2017)
Numerical simulation of vascular tumor growth under antiangiogenic treatment: addressing the paradigm of single-agent bevacizumab therapy with the use of experimental data	Argyri, K	Peer-reviewed publication	ICCS	Published	22.03.2016	Biology Direct 11(1), December 2016 DOI: 10.1186/s13062-016-0114-9
The Oncosimulator - Combining Clinically Driven and Clinically Oriented Multiscale Cancer Modeling with Information Technology in the In Silico Oncology Context	Stamatakis, G	Paper in Proceedings of a Conference/ Workshop	ICCS	Published	11.08.2016	International Conference and Exhibition on Pediatric Oncology and Clinical Paediatrics August 11-13, 2016 Toronto, Canada, Pediat Therapeut 2016, 6:3(Suppl), http://dx.doi.org/10.4172/2161-0665.C1.023 http://www.omicsonline.org/ArchivePediatrics/pediatric-oncology-2016-proceedings-keynote.php
Use Case II: Imaging Biomarkers and New Trends for Integrated Glioblastoma Management	Garcia, EF	Book chapter	ICCS	Published	2016	In book: Imaging Biomarkers, Springer, 2016, pp.181-194, DOI: 10.1007/978-3-319-43504-6_16
In Silico Oncology: Quantification of the In Vivo Antitumor Efficacy of Cisplatin-Based Doublet Therapy in Non-Small Cell Lung Cancer (NSCLC) through a Multiscale Mechanistic Model	Kolokotroni, E	Peer-reviewed publication	ICCS, USAAR	Published	22.09.2016	PLOS Computational Biology 12(9), doi: 10.1371/journal.pcbi.1005093
Oncosimulator Models as Components of a Personal Health Record Platform can Enable and Enhance the Provision of Personalized Medical Treatment	Georgiadi, E	Paper in Proceedings of a Conference/ Workshop	ICCS, USAAR, BED	Published	26.09.2016	in A.G. Hoekstra (Editor), VPH2016, book of abstracts, University of Amsterdam, (Amsterdam), ISBN 978-90-826254-0-0, pp. 297-300
Workflow-driven clinical decision support for personalized oncology	Bucur, A	Peer-reviewed publication	ICCS, USAAR, FORTH, PHILIPS	Published	21.07.2016	BMC Medical Informatics and Decision Making 16(Suppl 2):87, doi: 10.1186/s12911-016-0314-3

Computational Horizons in Cancer (CHIC)	Stamatakis, G	Paper in Proceedings of a Conference/ Workshop	ICCS, USAAR, KU Leuven, BED, USFD, FORTH, LUH, UPENN, UOXF, UNITO, UBERN, CUSTODIX, PHILIPS, UCL, CINECA, TEI-C	Published	24.06.2017	Abstract to be published in the Proceedings of the 13th Congress of the European Association for Clinical Pharmacology and Therapeutics (EACPT) to take place in Prague, 24-27 June 2017 (Major CHIC dissemination event)
Computational Horizons In Cancer (CHIC): Developing Meta- and Hyper-Multiscale Models and Repositories for In Silico Oncology – Strategies, Systems and Results	Stamatakis, G	Paper in Proceedings of a Conference/ Workshop	ICCS, USAAR, KU Leuven, BED, USFD, FORTH, LUH, UPENN, UOXF, UNITO, UBERN, CUSTODIX, PHILIPS, UCL, CINECA, TEI-C	Published	11.08.2016	International Conference and Exhibition on Pediatric Oncology and Clinical Pediatrics, August 11-13, 2016 Toronto, Ontario, Canada. Pediat Therapeut 2016, 6:3(Suppl), http://dx.doi.org/10.4172/2161-0665.C1.024 https://www.omicsonline.org/proceedings/computational-horizons-in-cancer-chic-developing-meta-and-hypermultiscale-models-and-repositories-for-in-silico-oncology--50701.html
Important Aspects of the Large Scale Integrating EU-US Project CHIC on Advancing In Silico Oncology	Stamatakis, G	Paper in Proceedings of a Conference/ Workshop	ICCS, USAAR, KU Leuven, UBERN, CINECA	Published	26.09.2016	in A.G. Hoekstra (Editor), VPH2016, book of abstracts, University of Amsterdam, (Amsterdam), ISBN 978-90-826254-0-0, pp. 319-322
VPH-HF: a software framework for the execution of complex subject-specific modelling workflow	Viceconti, M	Peer-reviewed publication	ICCS, USFD, FORTH, CINECA	In preparation	2017	Journal of Computational Science
Cancer Models as medical support tools	Lishchuk, I	Paper in Proceedings of a Conference/ Workshop	LUH	Published	17.09.2016	Herbstakademie 2016, Smart World - Smart Law? Weltweite Netze mit regionaler Regulierung, 14 – 17 September 2016, Hamburg, OIWR, pp.885-900.
Cancer Research and Ownership in Medical Data	Schütze, B	Peer-reviewed publication	LUH	In preparation	2017	The European Journal of Health Law
From personal rights to Intellectual Property Rights	Lishchuk, I	Paper in Proceedings of a Conference/ Workshop	LUH	Published	01.01.2017	Tagung „Junge Wissenschaft – Kolloquium zum Gewerblichen Rechtsschutz, Urheber- und Medienrecht“, 17-18 June 2016, Köln, Germany.
Licensing Implications of the Use of Open Source Software in Research Projects	Lishchuk, I	Paper in Proceedings of a Conference/ Workshop	LUH	Published	22.05.2016	The Sixth International Conference on Advanced Communications and Computation, INFOCOMP 2016, ISSN: 2308-3484, ISBN: 978-1-61208-478-7

Multiscale Cancer Modelling in Terms of Copyright	Lishchuk, I	Peer-reviewed publication	LUH	Published	30.06.2016	International Journal On Advances in Life Sciences, vol 8, 1 and 2, 2016, ISSN: 1942-2660. open access: http://www.thinkmind.org/index.php?view=article&articleid=lifsci_v8_n12_2016_6
Open Source Software and Some Licensing Implications to Consider	Lishchuk, I	Peer-reviewed publication	LUH	Published	31.12.2016	International Journal On Advances in Systems and Measurements, v 9 n 3&4 2016, issn: 1942-261x
Options for Protecting Medical Data by IP Rights	Lishchuk, I	Paper in Proceedings of a Conference/ Workshop	LUH	Published	13.10.2016	The Fifth International Conference on Global Health Challenges, GLOBAL HEALTH 2016, October 9 - 13, 2016 - Venice, Italy, ISBN: 978-1-61208-511-1
Patentability Aspects of Computational Cancer Models	Lishchuk I	Paper in Proceedings of a Conference/ Workshop	LUH	Submitted	2017	ICNAAM 2016 Proceedings
Protecting Data generated in Medical Research: Aspects of Data Protection and Intellectual Property Rights	Lishchuk, I	Peer-reviewed publication	LUH	Submitted	30.06.2017	The International Journal On Advances in Security, v 10 n 1&2 2017, issn: 1942-2636
Automatic estimation of extent of resection and residual tumor volume of patients with glioblastoma	Meier, R	Peer-reviewed publication	UBERN	Published	2017	Journal of Neurosurgery, 1--9, 2017.
CHIC-CDR -- a repository for managing multi-modality clinical data and its application to in-silico oncology	Abler, D	Paper in Proceedings of a Conference/ Workshop	UBERN	Published	11.08.2016	International Conference and Exhibition on Pediatric Oncology DOI: 10.4172/2161-0665.C1.024
Clinical Evaluation of a Fully-automatic Segmentation Method for Longitudinal Brain Tumor Volumetry	Meier, R	Peer-reviewed publication	UBERN	Published	2016	Nature Scientific Reports, 6, 2016 http://dx.doi.org/10.1038/srep23376
Evaluation of a mechanically-coupled reaction-diffusion model for macroscopic brain tumour growth	Abler, D	Paper in Proceedings of a Conference/ Workshop	UBERN	Published	20.09.2016	CMBBE 2016
Fully Automated Enhanced Tumor Compartmentalization: Man vs. Machine Reloaded	Porz, N	Peer-reviewed publication	UBERN	Published	2016	PLoS ONE, 11, 1-16, 2016. http://dx.doi.org/10.1371/journal.pone.0165302
Mechanically coupled Reaction-Diffusion Model of Macroscopic Brain Tumour Growth	Abler, D	Paper in Proceedings of a Conference/ Workshop	UBERN	Published	10.07.2016	Proceedings of a Conference/Workshop, ESB 2016, 10-13 July 2016
A new predictive tool for the post-surgical risk of recurrence of prostate cancer potentially unveiling hidden residual disease	Stura, I	Peer-reviewed publication	UNITO	Submitted	2017	

A simple PSA-based computational approach predicts the timing of cancer relapse in prostatectomized patients	Stura, I	Peer-reviewed publication	UNITO	Published	2016	Cancer Res. 2016, Sep 1;76(17):4941-7. doi: 10.1158/0008-5472.CAN-16-0460
A two-clones tumor model: Spontaneous growth and response to treatment	Stura, I	Peer-reviewed publication	UNITO	Published	2016	10.1016/j.mbs.2015.10.014
Is there still a role for computed tomography and bone scintigraphy in prostate cancer staging? An analysis from the EUREKA-1 database	Gabriele, D	Peer-reviewed publication	UNITO	Published	2016	10.1007/s00345-015-1669-2
RBF kernel method and its applications to clinical data, Dolomites Research Notes on Approximation	Perracchione, E	Paper in Proceedings of a Conference/Workshop	UNITO	Published	2016	10.14658/pupj-drna-2016-Special_Issue-3
Results from the studies EUREKA1 and EUREKA2	Gabriele, D	Paper in Proceedings of a Conference/Workshop	UNITO	Published	2017	Minerva Medica, Vol 108, Suppl 2 No 1, pag 7
Simulating prostate cancer dynamics via a stochastic RBF-based numerical tool	Stura, I	Peer-reviewed publication	UNITO	Submitted	2016	
Smart(phone) follow-app dopo prostatectomia: validazione di una nuova modalità di supporto alla decisione clinica e di relazione terapeutica	Stura, I.	Paper in Proceedings of a Conference/Workshop	UNITO	Published	2017	Minerva Medica, Vol 108, Suppl 2 No 1, pag 20
The Candiolo Nomogram	Gabriele, D	Paper in Proceedings of a Conference/Workshop	UNITO	Published	2017	Minerva Medica, Vol 108, Suppl 2 No 1, pag 15
Bayesian calibration, validation and uncertainty quantification for predictive modelling of tumour growth: a tutorial	Collis, J	Peer-reviewed publication	UOXF	Published	13.03.17	Bull Math Biol (2017) 79: 939. doi:10.1007/s11538-017-0258-5
Mathematical Modelling of the Corneal Micropocket Angiogenesis Assay	Grogan, JA	Peer-reviewed publication	UOXF	In preparation	31.03.17	Target: Bulletin of Mathematical Biology
Microvessel Chaste: An open library for spatial modelling of vascularized tissues	Grogan, JA	Peer-reviewed publication	UOXF	In press	2017	Biophysical Journal
Predicting the influence of microvascular structure on tumour response to radiotherapy	Grogan, JA	Peer-reviewed publication	UOXF	Published	03.03.2017	IEEE Transactions on Biomedical Engineering, Volume: 64, Issue: 3, March 2017

Biophysically inspired model for nanocarrier adhesion to live cells: roles of mechanical factors and protein expression	Ramakrishnan, N	Peer-reviewed publication	UPENN	Published	29.06.2016	Royal Society Open Science, 2016, 3, 160260. DOI: 10.1098/rsos.160260; supplementary information DOI: doi:10.5061/dryad.4h76d
Computational methods related to molecular structure and reaction chemistry of biomaterials	Farokhirad, S	Book chapter	UPENN	In Press	01.02.2017	Comprehensive Biomaterials II, eds. P. Ducheyne, K.E. Healy, D.W. Hutmacher, D.W. Grainger, C.J. Kirkpatrick, Elsevier London, in press.
Curvature-undulation coupling as a basis for curvature sensing and generation in bilayer membranes	Bradley, RP	Paper in Proceedings of a Conference/Workshop	UPENN	Published	2016	Proceedings of the National Academy of Sciences Plus, 2016, 113, 35, E5117–E5124. DOI: 10.1073/pnas.1605259113
Deletion mutations keep kinase inhibitors in the loop	Freed, DM	Peer-reviewed publication	UPENN	Published	01.09.2016	Cancer Cell, 2016, 29(4):423-425. DOI: 10.1016/j.ccell.2016.03.017
Lipid membrane shape evolution and the actin cytoskeleton	Slochow, DR	Peer-reviewed publication	UPENN	Submitted	01.10.2016	Handbook of lipid membranes, molecular and materials aspects
Molecular and subcellular models in insilico oncology-computational horizons in cancer systems biology and multiscale cancer modelling	Ghosh, A	Paper in Proceedings of a Conference/Workshop	UPENN	Published	11.08.2016	Proceedings of the International Workshop on Pediatric Oncology, Toronto, Canada
Subcellular membrane mechanotyping using local estimates of cell membrane excess area	Ramakrishnan, N	Peer-reviewed publication	UPENN	Submitted	2017	Biophysical Journal
The spatial heterogeneity of acute lung injury selectively shunts different drug classes either towards or away from flooded alveoli	Brenner, J	Peer-reviewed publication	UPENN	In press	01.02.2017	Nanomedicine: Nanotechnology, Biology, and Medicine, 2017, in press. DOI: 10.1016/j.nano.2016.12.019
Thermodynamic free energy methods to investigate shape transitions in bilayer membranes	Ramakrishnan, N	Peer-reviewed publication	UPENN	Published	06.06.2016	International Journal of Advances in Engineering Sciences and Applied Mathematics, 8(2), 88-100 DOI: 10.1007/s12572-015-0159-5 (http://link.springer.com/article/10.1007/s12572-015-0159-5)
A Multi-modal Benchmark for Wilms' Tumor Segmentation.	Müller, S	Paper in Proceedings of a Conference/Workshop	USAAR	Submitted		
Automatic brain tumor segmentation with a fast Mumford-Shah algorithm.	Müller, S	Paper in Proceedings of a Conference/Workshop	USAAR	Published	2016	In M. A. Styner, E. D. Angelini (Eds.): Medical Imaging 2016: Image Processing (San Diego, CA, February 2016), SPIE Vol. 9784, 97842S, 2016.
Robust interactive multi-label segmentation with an advanced edge detector.	Müller, S	Paper in Proceedings of a Conference/Workshop	USAAR	Published	2016	In B. Andres, B. Rosenhahn (Eds.): Pattern Recognition. Lecture Notes in Computer Science, Vol. 9796, 117-128, Springer, Cham, 2016.

A multiscale hypermodel to predict the nephroblastoma response to preoperative chemotherapy	Graf, N	Paper in Proceedings of a Conference/ Workshop	USAAR, ICCS	Published	02.04.2016	9th International Renal Tumour Biology Conference, Toronto, Ontario, Canada April 2-3, 2016. http://www.cvent.com/events/9th-international-conference-on-pediatric-renal-tumour-biol-gy/event-summary-448a7f212a9a44488984d5239667e75a.aspx .
Big Data, Big Knowledge: Big Data for Personalized Healthcare	Viceconti, M	Peer-reviewed publication	USFD	Published	2015	IEEE J Biomed Health Inform 19(4), 1209-15; doi: 10.1109/JBHI.2015.2406883
Biomechanics-based in silico medicine: The manifesto of a new science	Viceconti, M	peer-reviewed publication	USFD	published	2015	Journal of Biomechanics, Volume 48, Issue 2, 21 January 2015, Pages 193-194, ISSN 0021-9290, http://doi.org/10.1016/j.jbiomech.2014.11.022 .
Biomechanics-based in silico medicine: The manifesto of a new science.	Viceconti, M	Peer-reviewed publication	USFD	Published	2015	J Biomech Jan 21;48(2), 193-194
Computational biomedicine	Coveney, P	Edited book	USFD	Published	2014	Oxford University Press
In silico assessment of biomedical products: the conundrum of rare but not so rare events in two case studies.	Viceconti, M	Peer-reviewed publication	USFD	In press	2017	Proceedings of the Institution of Mechanical Engineers. Part H: Journal of Engineering in Medicine. ISSN 0954-4119 (In Press)
In silico clinical trials: how computer simulation will transform the biomedical industry	Viceconti, M	Peer-reviewed publication	USFD	Published	2016	International Journal of Clinical Trials 3 (2), 37-46
In SilicoMedicine: The Practitioners' Points of View	Viceconti M	Peer-reviewed publication	USFD	Published	2016	HUMANA MENTE-JOURNAL OF PHILOSOPHICAL STUDIES, 175-187
Multiscale modeling methods in biomechanics	Bhattacharya, P	Peer-reviewed publication	USFD	Published	2017	Wiley Interdiscip Rev Syst Biol Med.
Multiscale modelling in biomechanics	Viceconti, M	Peer-reviewed publication	USFD	Published	2015	Interface focus 5 (2), 20150003
The Virtual Physiological Human: Ten Years After.	Viceconti, M	Peer-reviewed publication	USFD	Published	2016	Annu Rev Biomed Eng 18, 103-23; doi: 10.1146/annurev-bioeng-110915-114742
Addressing challenges in fitting bi-exponential DW-MRI data	Georgios Manikis	Paper in Proceedings of a Conference/ Workshop	FORTH	Published	2017	Proceedings of the ECR 2017–27th European Congress of Radiology, March 1-5, 2017, Vienna, Austria
A versatile platform for the longitudinal analysis of the DW-MRI data	Georgios Manikis	Paper in Proceedings of a Conference/ Workshop	FORTH	Published	2017	Proceedings of the ECR 2017–27th European Congress of Radiology, March 1-5, 2017, Vienna, Austria
A DCE-MRI analysis workflow	Kontopodis Eleftherios	Paper in Proceedings of a Conference/ Workshop	FORTH	Published	2016	Proceedings of Computer Graphics International (CGI), the 33rd Annual Conference, June 28-July 01, 2016

A model-free approach for imaging tumor hypoxia from DCE-MRI data	Venianaki Maria	Paper in Proceedings of a Conference/ Workshop	FORTH	Published	2016	Proceedings of Computer Graphics International (CGI), the 33rd Annual Conference, June 28-July 01, 2016
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Table 4: List of the CHIC publications during the fourth year

Title	Type	Main leader	Reference	Date
3rd Annual CHIC Newsletter	Press releases	EURICE	http://chic-vph.eu/fileadmin/chic/downloads/CHIC_3rd_Annual_Newsletter.pdf	05.04.2016
4th Annual CHIC Newsletter	Press releases	EURICE	http://chic-vph.eu/fileadmin/chic/downloads/CHIC_4th_Annual_Newsletter.pdf	
Microvessel Chaste Website	Web sites/ Applications	UOXF	https://jmsgrogan.github.io/MicrovesselChaste/	03.11.2016
VPH-HF	Web sites/ Applications	CINECA, USFD	https://github.com/INSIGNEO/VPH-HF	
CRAF Video	Web sites/ Applications	FORTH	https://www.youtube.com/watch?v=YarV8cPgPVM&t=2s	22.02.2017
Hypermodelling Editor Video	Web sites/ Applications	FORTH	https://www.youtube.com/watch?v=nqKhSATvZfA&t=138s	14.03.2017
Dr Eye video	Web sites/ Applications	FORTH	https://www.youtube.com/watch?v=P6PehkoEO-0&t=5s	24.03.2017
CDR video	Web sites/ Applications	UBERN	https://www.youtube.com/watch?v=KFsz7dQKI8A	13.04.2017
Bi-monthly newsletter issue	Press releases	CINECA	http://eepurl.com/bTsR7P	20.05.2016
Bi-monthly newsletter issue	Press releases	CINECA	http://eepurl.com/cm5ixb	03.11.2016
Bi-monthly newsletter issue	Press releases	CINECA	http://eepurl.com/cD6cYT	28.02.2017
Announcements on the Facebook page	Social media	CINECA	https://www.facebook.com/CHIC-project-333884726816111/	
Announcements on the Twitter page	Social media	CINECA	https://twitter.com/CHIC_project	
Updates to the CHIC website	Web sites/ Applications	EURICE	http://www.chic-vph.eu	
Data Repository	Web sites/ Applications	UBERN	https://www.smir.ch/	
Data Repository Video	Web sites/ Applications	UBERN	https://www.youtube.com/watch?v=KFsz7dQKI8A	12.04.2017
Ypsomed Innovation Award - Automated Brain Lesion Analysis using Human-Machine Intelligence	Press releases	UBERN	http://www.ypsomed.ch/medien-investoren/medienmitteilungen/news-details/items/ypsomed-verleiht-den-8-innovationspreis.html	10.01.2017
MediX Press release on BraTumIA	Press releases	UBERN	http://www.medmix.at/berner-biotech-auf-internationalem-siegeszug/	31.10.2016
Penn Researchers Improve Computer Modeling for Designing Drug-delivery Nanocarriers	Press releases	UPENN	https://news.upenn.edu/news/penn-researchers-improve-computer-modeling-designing-drug-delivery-nanocarriers	02.08.2016

Interview of Ilaria Stura (UNITO) published online about the results explained in a paper on Cancer Research	Press releases	UNITO	http://medicalresearch.com/author-interviews/math-algorithm-helps-predict-recurrence-of-prostate-cancer/27524/#more-27524	04.09.2016
Interview of Ilaria Stura (UNITO) about CHIC published online	Press releases	UNITO	http://www.unitonews.it/index.php/en/news_detail/i-progetti-di-ricerca-europei-di-unito-da-alice-rap-myhealthavatar	05.10.2016

Table 5: List of the CHIC press activities and other media

Title	Type	Main participants	Event	Venue	Date
Segmentation of Nephroblastoma in 3D MRI using Graph Algorithm	Oral presentation to a scientific event	BED	Presentation at meeting of CARRE project, consisting of introduction to CHIC and description of nephroblastoma segmentation.	Alexandroupoli, Greece	01.11.2016
Big Data – Status & Technical Insights	Oral presentation to a scientific event	FORTH		Chania, Crete	14.07.2016
Big Data and Computational Cancer Modelling	Invited talk	TEI-C	Presentation at a scientific workshop on big data analytics in healthcare and biomedicine	Heraklion, Crete	22.09.2016
Multiscale Modelling of Tumour Initiation, Growth and Progression	Oral presentation to a scientific event	FORTH		Bielefeld, Germany	13.09.2016
Computational Cancer Modelling	Invited talk	FORTH & TEI-C	National eHealth 2016 Conference	Athens, Greece	25.10.2016 to 26.10.2016
Big Data Analytics: Promise and Potential for eHealth and Biomedicine	Oral presentation to a scientific event	TEI-C	Presentation at the national eHealth 2016 Conference	Athens, Greece	25.10.2016
An overview of the CHIC project	Poster presentation	ICCS	7 th CHIC progress meeting	Saarbrücken, Germany	31.08.2016 to 02.09.2016
The Overarching Topology and the Basic Science Architecture of the CHIC Multimodeller Hypermodels	Poster presentation	ICCS	7 th CHIC progress meeting	Saarbrücken, Germany	31.08.2016 to 02.09.2016
The ICCS Oncosimulator	Poster presentation	ICCS	7 th CHIC progress meeting	Saarbrücken, Germany	31.08.2016 to 02.09.2016
In Silico Trial and Model Repositories	Poster presentation	ICCS	7 th CHIC progress meeting	Saarbrücken, Germany	31.08.2016 to 02.09.2016
Using a modular tool/model repository infrastructure for hypermodel creation in the context of In Silico Oncology	Oral presentation to a scientific event	ICCS	15th International Summer School on Biocomplexity, Bidesign and Bioinnova: from Gene to System	Seferihisar - Izmir, Turkey	24.06.2016 to 30.06.2016
Longitudinal immune monitoring in Glioblastoma patients: preliminary results of the Glioma Translat Study	Oral presentation to a scientific event	KU Leuven	Presented on 'Annual scientific meeting of the Belgian Society of Neurosurgery' by Dr. Joost Dejaegher.	Brussels, Belgium	18.03.2017
Cancer Models as medical support tools	Oral presentation to a scientific event	LUH	Herbstakademie 2016 Smart World - Smart Law? Weltweite Netze mit regionaler Regulierung	Hamburg, Germany	15.09.2016

Gene Patents: From personal rights to Intellectual Property Rights	Oral presentation to a scientific event	LUH	Tagung „Junge Wissenschaft – Kolloquium zum Gewerblichen Rechtsschutz, Urheber- und Medienrecht“	Cologne, Germany	18.06.2016
Licensing Implications of the Use of Open Source Software in Research Projects	Oral presentation to a scientific event	LUH	The Sixth International Conference on Advanced Communications and Computation, INFOCOMP 2016	Valencia, Spain	26.05.2016
Patentability Aspects of Computational Cancer Models	Oral presentation to a scientific event	LUH	ICNAAM 2016, the sixth symposium on advanced computation and information in natural and applied sciences	Rhodes, Greece	19.09.2016
Patient Role in Mobile Adaptable Healthcare: Awareness and Accessibility, Privacy Aspects	Oral presentation to a scientific event	LUH	Panel eTELEMED/DIGITAL HEALTHY LIVING/ MATH, The Eighth International Conference on eHealth, Telemedicine, and Social Medicine eTELEMED 2016, Archived in the free access ThinkMindTM Digital Library: http://www.thinkmind.org/	Venice, Italy	24.04.2016 to 28.04.2016
CHIC – A Multiscale Modelling Platform for in-silico Oncology	Oral presentation to a scientific event	UBERN	International Conference on Translational Research in Radio-Oncology Physics for Health in Europe (ICTR-PHE) 2016	Geneva, Switzerland	02.2016
CHIC (Computational Horizons in Cancer) - Perspective from the clinical side	Oral presentation to a scientific event	USAAR	International Conference and Exhibition on pediatric Oncology	Toronto, Canada	11.08.2016
A multiscale hypermodel to predict the nephroblastoma response to preoperative chemotherapy	Oral presentation to a scientific event	USAAR	9th International Pediatric Renal Tumour Biology Conference	Toronto, Canada	02.04.2016
Computational Horizons in Cancer (CHIC): Developing meta- and hyper-multiscale models and repositories for in-silico oncology – Strategies, systems and results	Oral presentation to a scientific event	ICCS	International Conference and Exhibition on pediatric Oncology	Toronto, Canada	11.08.2016
The law and in-silico health technology: Help or hindrance?	Oral presentation to a scientific event	LUH	International Conference and Exhibition on pediatric Oncology	Toronto, Canada	11.08.2016
In silico oncology- Computational horizons in cancer systems biology and multi-scale cancer modeling	Oral presentation to a scientific event	UPEEN	International Conference and Exhibition on pediatric Oncology	Toronto, Canada	11.08.2016
Integrating CHIC technologies into a clinical research application framework (“CRAF”) for cancer modeling	Oral presentation to a scientific event	FORTH	International Conference and Exhibition on pediatric Oncology	Toronto, Canada	11.08.2016
CHIC-CDR -- a repository for managing multi-modality clinical data and its application to in-silico oncology	Oral presentation to a scientific event	UBERN	International Conference and Exhibition on pediatric Oncology	Toronto, Canada	11.08.2016
Component Model for Macroscopic Tumour Biomechanics	Poster to a scientific event	UBERN	Latsis Symposium on Personalised Medicine	Zürich, Switzerland	06.2016

Longitudinal Brain Tumor Image Segmentation	Oral presentation to a scientific event	UBERN	Medical Image Computing and Computer Assisted Interventions- MICCAI Conference 2017	Athens, Greece	16.10.2016
Evaluation of a mechanically-coupled reaction-diffusion model for macroscopic brain tumour growth	Oral presentation to a scientific event	UBERN	14th International Symposium Computer Methods in Biomechanics and Biomedical Engineering (CMBBE)	Tel Aviv, Israel	20.09.2016
Mechanically coupled reaction-diffusion model of macroscopic brain tumour growth	Oral presentation to a scientific event	UBERN	Congress of the European Society of Biomechanics (ESB) 2016	Lyon, France	10.07.2016
Hybrid Multi-scale Modelling and Validation	Invited talk	UBERN	Mathematical Biosciences Institute: Workshop on „Hybrid Multi-Scale Modelling and Validation“	Columbus, Ohio, USA	27.03. - 31.03.2017
Visione multidisciplinare del carcinoma della prostata	Oral presentation to a scientific event	UNITO	Visione multidisciplinare del carcinoma della prostata	Candiolo, Italy	24.02.2017
Prostate Follow-App: a model based tool for patients and clinicians	Poster presentation to a scientific event	UNITO, BED	VPH2016, Virtual Physiological Human Conference	Amsterdam, Netherlands	26.09.2016
	Poster presentation to a scientific event	UNITO, BED	D-Day 2016, http://dott-scivisa.campusnet.unito.it/avvisi/att/ctq3.allegato.pdf	Turin, Italy	15.09.2016
A computational framework for multi-scale vascular tumour growth models	Oral presentation to a scientific event	UOXF	Computational Life Sciences Workshop	Aachen, Germany	13.06.2016
Combining Computer Simulations and Imaging in Cancer Research	Poster presentation to a scientific event	UOXF	Quantitative Biology in Oxford (QBIOX) Meeting	Oxford, UK	03.03.17
Combining Computer Simulations and Imaging in Cancer Research	Poster presentation to a scientific event	UOXF	STEM For Britain Competition for Early Career Researchers	Houses of Parliament, UK	13.03.17
Integrated intravital imaging and mathematical modelling of vascular networks in tumours	Oral presentation to a scientific event	UOXF	Quantitative Biology in Oxford (QBIOX) Springboard Meeting	Oxford, UK	16.05.2016
Integrated Intravital Imaging and Mathematical Modelling of Vascular Networks in Tumours	Poster presentation to a scientific event	UOXF	Hybrid Multi-scale Modelling and Validation Emphasis Workshop	Ohio State University, USA	27.03.17
Integrating multiphoton imaging, microfluidics channels and mathematical modelling to study vascular networks in tumours	Oral presentation to a scientific event	UOXF	Cancer Research UK (CRUK) Oxford Annual Symposium	Oxford, UK	06.06.2016
Modeling Cells and remodeling biological tissues	Oral presentation to a scientific event	UOXF	Invited seminar at the School of Mathematical Sciences	Adelaide, Australia	01.08.2016
Modelling blood flow and solute transport in solid tumors	Oral presentation to a scientific event	UOXF	VPH2016, Virtual Physiological Human Conference	Amsterdam, Netherlands	26.09.2016
Modelling micro-vascular transport in tumours using intra-vital imaging data	Oral presentation to a scientific event	UOXF	European Society for Mathematical and Theoretical Biology (ECMTB) Conference	Nottingham, UK	11.07.2016

The sub cellular and cellular consequences of WNT signaling in the intestinal crypt	Oral presentation to a scientific event	UOXF	European Society for Mathematical and Theoretical Biology (ECMTB) Conference	Nottingham, UK	11.07.2016
Unravelling heterogeneity in solid tumour growth	Invited talk	UOXF	DFG Interzartener Kreis fur Krebsforschung (from Molecular Mechanisms to Cancer Therapy)	Cadenabbia, Italy	23.03.17 to 26.03.17
Unravelling the impact of heterogeneity on tumour response to radiotherapy	Invited talk	UOXF	Mathematical Modelling of Radiation in Cancer Therapy	Belfast, UK	11.01.17 to 12.01.17
Unravelling the impact of heterogeneity on tumour response to radiotherapy	Invited Talk	UOXF	Workshop on Mathematical Medicine	Swansea University, UK	02.02.17 to 03.02.17
Unravelling the impact of heterogeneity on tumour response to radiotherapy	Invited talk	UOXF	First Tumour Heterogeneity Environment Workshop	Paris, France	28.02.17
Biophysically inspired model for functionalized nanocarrier targeting to live cells	Oral Presentation to a scientific event	UPENN	ACS Fall Meeting	Philadelphia, USA	22.08.2016
Can soft Signals Turn Oncogenic? Membrane Mechanotransduction and Rewiring of Trafficking Pathways in Cancer.	Poster presentation to a scientific event	UPENN	Cancer Forces, Structures, and Mathematical Predictions, Gordon Research Conference on Physical Sciences of Cancer, 2017	Galveston, USA	5.2.2017-10.2.2017
Cellular adhesion: evaluating the effect of receptor-ligand chemistries, distribution of receptors, and spread versus spherical geometry	Oral Presentation to a scientific event	UPENN	Biophysical Society Meeting	Los Angeles, USA	2016
Computational models for nanoscale biofluid dynamics and colloid transport inspired by non-equilibrium thermodynamic	Oral Presentation to a scientific event	UPENN	ACS Fall Meeting	Philadelphia, USA	22.08.2016
Curvature-undulation coupling as a basis for curvature sensing and generation in bilayer membranes at molecular and colloidal scales	Oral Presentation to a scientific event	UPENN	ACS Fall Meeting	Philadelphia, USA	22.08.2016
In silico profiling of activating mutations in cancer	Oral presentation to a scientific event	UPENN	ACS Fall Meeting	Philadelphia, USA	22.08.2016
Integrated Modeling Framework For Signaling Of ErbB Family Of Receptors And Their Clinical Significance.	Poster presentation to a scientific event	UPENN	Cancer Forces, Structures, and Mathematical Predictions, Gordon Research Conference on Physical Sciences of Cancer, 2017	Galveston, USA	5.2.2017-10.2.2017
Modularity of Membrane Trafficking Conferred by a Rab GEF and GAP Regulatory Loop.	Poster presentation to a scientific event	UPENN	Cancer Forces, Structures, and Mathematical Predictions, Gordon Research Conference on Physical Sciences of Cancer, 2017	Galveston, USA	5.2.2017-10.2.2017
Multiscale Modelling of Receptor Activation and Trafficking in Cancer	Oral Presentation	UPENN	Vanderbilt University	Nashville, USA	13.03.2017
Predictive Multiscale Models in Oncology	Oral presentation to a scientific event	UPENN	Bioengineering Symposium, Princeton University	Princeton, USA	07.10.2016

Predictive Multiscale Models in Oncology	Oral presentation to a scientific event	UPENN	Cancer Biology Institute Pharmacology, Yale University	Yale, USA	02.06.2016
We can predict the effects of kinase domain mutations using molecular dynamics and machine learning	Oral Presentation to a scientific event	UPENN	Biophysical Society Meeting, 2017	New Orleans, USA	2.2.2017
A multiscale hypermodel to predict the nephroblastoma response to pre-operative chemotherapy	Oral Presentation to a scientific event	USAAR	48th Congress of the International Society of Paediatric Oncology (SIOP)	Dublin, Ireland	19.10.2016 - 22.10.2016
Of Mice and Human: a journey in the Virtual Physiological Mouse	Oral presentation to a scientific event	USFD	VPH2016, Virtual Physiological Human Conference	Amsterdam, Netherlands	26.09.2016
The potential of the Virtual Physiological Human	Oral presentation to a wider public	USFD	European Commission Scientific Conference "Non-Animal Approaches - The Way Forward"	Brussels, Belgium	06.12.2016

Table 6: List of workshops and conferences attended by the CHIC partner for project related presentations

3 Exploitable CHIC outputs

The CHIC partners have been asked to revise the list of exploitable outputs reported in D12.4 according to the most recent technical and scientific achievements of the project. At the end of this analysis, 27 exploitable outputs have been defined of which:

- 14 technological/software components,
- 12 models (including both hypo and hyper-models (modelling outputs have increased with respect to the previous report due to additional work performed by the WP6 partners), and
- The CHIC platform as a whole.

In the next sub-sections, for each of the exploitable outputs it is provided: a short description, innovation and impact, foreground owners and type, target users, expected time to market, TRL evolution over the project lifespan, needs in terms of sustainability, licence issues, sustainability and exploitation paths.

3.1 Technological/software components

3.1.1 Private cloud infrastructure

Name	Private cloud infrastructure
Description	In the context of the CHIC project, a private cloud infrastructure has been deployed to provide computational resources for the implementation of the CHIC technological platform. The infrastructure is already fully operational for the CHIC partners who use it to deploy services and running hyper-models. For more details, please see D5.3.
Innovativeness of result as compared to already existing Products/Services	The CHIC Private Cloud infrastructure does not have any technological innovation compared to existing Cloud infrastructure services. It is based on open source software (Openstack), thus it is aligned with the techniques and practices of many other vendors.
Impact	The impact of the cloud infrastructure has already been acknowledged due to the functionality that it offers. FORTH expects that the Private Cloud Infrastructure will be mainly utilized for the research and technology objectives of FORTH and not on providing commercial services. It will enhance the productivity of the organization, it will provide better utilization of the computational resources, and it will provide ground for collaboration with other groups in future research projects.
Unique Selling Point / value proposition (competitive advantages)	The competitive advantages of the Private Cloud Infrastructure are <ul style="list-style-type: none"> • the data protection, security and privacy guarantees that it offers, as a service originating from an acknowledged research institution (FORTH) compared to commercial/public cloud infrastructures • the economical service lifecycle due to the utilization of already available computational resources and staff expertise instead of creating (capital) outflows on service outsourcing • the management and administration flexibility due to the in-house deployment
Expected stage of development of result at the end of the project	<u>M48: TRL 9</u> The private cloud infrastructure is already operational and providing in a reliable, dependable and trustworthy level that the whole CHIC partners.
Exploitation plan summary	The private cloud infrastructure can be exploited in various ways, due to the diverse functionalities that it offers. It provides the basis for transforming FORTH's own data centre facilities. It can be utilized in future research projects, since there is a trend in moving applications and services in the cloud

	(Software as a Service). It provides utilization of its computational and storage capabilities in big data computing in the biomedical domain.
Market specification	The private cloud infrastructure targets mainly on the niche market of research projects and technology transfer.
Prospects/Customers	The prospective end users of the private cloud are Technical partners, either individual users or whole institutions, in need of computational resources in the academic context.
Product/Service Market Size	N/A
Market Trends/Public Acceptance	The market shows a trend of adopting the cloud technology by all big players both on the commercial and the academic context. In addition, the security and data protection concerns of the end users in this market signify and highlight the value proposition and acceptance of our service that has already been noted above.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	A certification of the private cloud infrastructure by appropriate authorities or institutions regarding its compliance to standards and security policies and mechanisms would be needed for the cloud as a final service/product, both as a legal and ethical requirement as well as a market requirement.
Competitors	The private cloud infrastructure competes with the commercial vendors offering public cloud infrastructure services. However, we feel that the Unique Selling Point of the private cloud, being the in-house deployment and thus security and privacy benefit, differentiates it from publicly available commercial services.
Expected cost of commercialisation	As mentioned above, the private cloud infrastructure targets mainly the in-house utilization and exploitation and does not currently have neither a business plan nor an estimate of the expected cost of commercialisation.
Time to market	In terms of technological readiness, the infrastructure is near-market ready, as it is already operational. However, in order to be commercially exploited, the infrastructure lacks a business plan, in billing, usage policies, user support and marketing planning. We could estimate roughly 1 year as time to market.
Foreseen Product/Service Price	An estimate of the foreseen service price needs a market analysis (detailed market specification, prospective customer number), an analysis of the competitive services and their price, a viability and sustainability analysis of the cost for our infrastructure (computational resources, labour, maintenance, support services). As mentioned earlier we have not produced such a detailed business plan so we do not have an estimation of the service price. However, besides the security and privacy concerns that initially led us to create a private cloud infrastructure, our cost analysis has shown also the economic benefits of having an in-house cloud infrastructure than relying to public/commercial services.
Availability of exploitation potential and interest in the consortium	The utilization of the cloud for the purposes of the CHIC project as well as utilization of the cloud internally to FORTH has shown an interest in the consortium, a ground of exploitation potential and significant prospects in research and technology projects.
External Experts/Partners to be involved	No external partners are foreseen to be involved.
Status of IPR: Background (type and partner owner)	The cloud infrastructure is based on open source software.
Status of IPR: Foreground (type and partner owner)	FORTH
Status of IPR: Exploitation Forms (type and partner owner)	Direct use, license agreement, publications.

Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	FORTH: Data centre resources, computational resources, administrative personnel, technical knowledge and expertise, maintenance and support costs, legal support.														
Partner/s involved expectations	<ul style="list-style-type: none">• Add a new service to our portfolio• Add knowledge to our research organization• Achieve an economy of scale on computational resources, data storage and analysis facilities and administration labour• Compete in the research and technology domain with a state of the art infrastructure														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td><ul style="list-style-type: none">• High-end servers (at least 4)• Network switch (at least 1Gigabit, preferably 10Gbit)</td><td>Ubuntu Linux, Openstack</td><td>1 FTE (Maintenance, Upgrades, Security, User support, etc.)</td><td>N/A</td><td>N/A</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	<ul style="list-style-type: none">• High-end servers (at least 4)• Network switch (at least 1Gigabit, preferably 10Gbit)	Ubuntu Linux, Openstack	1 FTE (Maintenance, Upgrades, Security, User support, etc.)	N/A	N/A
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
<ul style="list-style-type: none">• High-end servers (at least 4)• Network switch (at least 1Gigabit, preferably 10Gbit)	Ubuntu Linux, Openstack	1 FTE (Maintenance, Upgrades, Security, User support, etc.)	N/A	N/A											
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The private cloud infrastructure has been built by utilizing, in a great extent, already available resources and is expected also to be financed after the end of the CHIC project from our own resources. On this ground, the cloud infrastructure is expected not only to not create outflows but also to provide a return on investment since it will lower operational costs that were already present in our organisation.														
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes, the private cloud infrastructure will be supported after the end of the project. We commit to provide computational resources and support for a period of 18 months after the end of the project (until end of 2018), provided that this is in line with the provisions and limitations of the legal and ethical context of EU and the CHIC legal agreements. After this period, we will be providing resources and keep supporting the infrastructure based on the ongoing exploitation plans, the future prospects of the CHIC consortium and the commitment of other CHIC partners to support and maintain their own tools and services.														

3.1.2 Obtima

Name	ObTiMA
Description	product, service
Innovativeness of result as compared to already existing Products/Services	Ontology-based (trial) data management
Impact	Unknown
Unique Selling Point / value proposition (competitive advantages)	Ontology-based (trial) data management.
Expected stage of development of result at the end of the project	Actual system completed and qualified through test and demonstration <u>M48: TRL 6</u>
Exploitation plan summary	Plan not yet fully established
Market specification	Niche market
Prospects/Customers	Final users in the area of clinical trials and research.

Product/Service Market	Estimation not yet performed.														
Market Trends/Public Acceptance	Market adaption hampered by several similar established open-source and commercial competing systems.														
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Fulfilment of all good clinical practice criteria and legal requirements and compliance to CDISC ODM standard.														
Competitors	MACRO, Capture Systems, eResearch Network, CleanWeb, eClinical, secuTria, OpenClinica, Marvin, Rave, TrialMaster, Medidata, PhaseForward, etc.														
Expected cost of commercialisation	Unknown														
Time to market	Immediately														
Foreseen Product/Service Price	Unknown														
Availability of exploitation potential and interest in the consortium	Unknown														
External Experts/Partners to be involved	USAAR														
Status of IPR: Background (type and partner owner)	Shared technological background														
Status of IPR: Foreground (type and partner owner)	USAAR, Fraunhofer IBMT														
Status of IPR: Exploitation Forms (type and partner owner)	Industrial use, technology transfer, license agreement, publications, copyrights														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	Joint development work on all system components														
Partner/s involved expectations	Fulfilment of the respective project requirements														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>common (virtual) server with modest memory requirements</td><td>Java, Apache Tomcat, Postgres</td><td>one</td><td>none</td><td>none</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	common (virtual) server with modest memory requirements	Java, Apache Tomcat, Postgres	one	none	none
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
common (virtual) server with modest memory requirements	Java, Apache Tomcat, Postgres	one	none	none											
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Other grants.														
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Full commitment until the end of 2018 as discussed at the last general meeting that took place in Eindhoven in March 2017. After 2018, full commitment in case appropriate financial sources are provided														

3.1.3 Model/tool repository

Name	Model/tool repository
Description	The model/tool repository can store models, including hypomodels, hypermodels and tools, being developed or to be developed by the CHIC modelling partners as well as the broader cancer modelling community. For more details please see D8.1, D8.2, D8.3, D8.4 and the 3 rd annual CHIC Newsletter.
Innovativeness of result as compared to already existing Products/Services	<p>In comparison with the already available Repositories, the CHIC Model and Tool Repository has the following characteristics:</p> <ul style="list-style-type: none"> It not only hosts multiscale cancer models, but also linkers and data transformation tools necessary for the construction of hypermodels. It is not just an isolated database, but a web application fully integrated with the CHIC platform. The developed web services fully support the retrieval, the update and the creation of models through the other CHIC components (VPH-HF, Hypermodelling Editor, CRAF, etc.) Apart from the descriptive information of the models, the Model Repository also contains the input and output parameters of the models, the executables and information related to the categorization of the models depending on the perspective from which they are viewed in the basic science context. The CHIC Model Repository conforms to the legal and ethical framework developed within CHIC.
Impact	<p>A high impact on the physiological, pathological and medical research software infrastructure is expected due to both the complexity of the problems addressed and the advanced multipurpose functionalities of the components and systems being developed.</p> <p>Technologies being developed and/or integrated within the framework of the CHIC project are expected to boost the European biomedical software industry and contribute to its leading role in the emergent in silico oncology and in silico medicine domain.</p>
Unique Selling Point / value proposition (competitive advantages)	The CHIC Model Repository is a unique system, since it is a web application which effectively stores multiscale cancer models, tools and data transformation tools, by using cutting edge software technologies. Moreover, the web services developed for the Model Repository provide the needed flexibility and facilitate its integration with new potential software components. Furthermore, the Model Repository holds all the necessary information needed for the execution of the linking of the hypomodels and the execution of the hypermodels (input and output parameters, information related to the categorization of the models, etc.)
Expected stage of development of result at the end of the project	MO, TRL 1 <u>M48, TRL 6</u>
Exploitation plan summary	<p>The exploitation plan for model repository is to be used as a free software service. In particular, it can be exploited as</p> <ul style="list-style-type: none"> a source of various software components for the development of Clinical Decision Support (CDS) systems. a trustable and convenient storage and model handling environment for additional cancer models. Additionally, the repositories could be extended in order to accommodate other disease or physiological models.
Market specification	Niche market and multi-sided
Prospects/Customers	Basic scientists, modellers, clinicians
Product/Service Market Size	Not yet known

Market Trends/Public Acceptance	Constantly increasing public, clinicians’ and patients’ acceptance.														
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Appropriate authentication and authorization mechanisms need always to be in place in order to ensure that only authorized persons have access to the content of the Repository. For instance, the source code of a model may not always be accessible to other users, apart from its owner.														
Competitors	Although the multiscale and extensively multimodeller nature and the special clinically driven and clinically oriented character of the CHIC Model Repository substantially differ from existing biomodel repositories, the closest existing Model Repositories are the following: <ul style="list-style-type: none">• Swiss Institute of Bioinformatics (SWISS-MODEL Repository)• Drug Disease Model Resources (DDMoRe) consortium (DDMoRe Model Repository)• International initiative BioModels.net (Biomodels Database)• International Physiome Project (CellML repository)														
Expected cost of commercialisation	Not yet known														
Time to market	In approximately 2 years from the end of the project.														
Foreseen Product/Service Price	Not yet know														
Availability of exploitation potential and interest in the consortium	The Model Repository has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.														
External Experts/Partners to be involved	ICCS														
Status of IPR: Background (type and partner owner)	Proprietary, ICCS														
Status of IPR: Foreground (type and partner owner)	Individual, ICCS														
Status of IPR: Exploitation Forms (type and partner owner)	Direct industrial use, patenting, technology transfer, license agreement, publications, standards, trademark applications, copyrights.														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS is the only contributor.														
Partner/s involved expectations	To provide the users with a collaborative environment for exchanging knowledge and sharing technical work in an effective and standardized way. Researchers involved in developing, enhancing and improving multi-scale models will be equipped with the necessary tools and working environments to retrieve other researcher’s models and model-related information, compare models, test them and eventually reuse them, either alone or combined with other models. This collaborative procedure will ultimately lead, following an extensive population of the model repository, to the desired goal of more elaborate and reusable multi-scale models.														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>1 VM (x64), 16GB RAM</td><td>ubuntu, python 2.7, MySQL</td><td>~ 0,5 FTE</td><td>N/A</td><td>Apache HTTP server, Django Rest Framework, djangosaml2,</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	1 VM (x64), 16GB RAM	ubuntu, python 2.7, MySQL	~ 0,5 FTE	N/A	Apache HTTP server, Django Rest Framework, djangosaml2,
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
1 VM (x64), 16GB RAM	ubuntu, python 2.7, MySQL	~ 0,5 FTE	N/A	Apache HTTP server, Django Rest Framework, djangosaml2,											

	community edition, Django framework			dm.xmlsec.binding, XML security library, jQuery library, Bootstrap framework
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding.			
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes			

3.1.4 In silico trial repository

Name	<i>In silico</i> Trial Repository
Description	The in-silico trial repository is used for the persistent storage of the simulation scenarios and the in-silico predictions. Reference document: D8.1, D8.2, D8.3, D8.4 and the 3 rd annual CHIC Newsletter.
Innovativeness of result as compared to already existing Products/Services	To the best of our knowledge, there are no Repositories publicly available for the persistent storage of cancer multiscale simulation scenarios. In order to fill this gap, the CHIC <i>In Silico</i> Trial Repository is used in order for the user to store the <i>in silico</i> predictions of the cancer multiscale models. More specifically the <i>In Silico</i> Trial Repository stores: <ul style="list-style-type: none"> • Data related to the original state of the patient, • The simulation scenario (the <i>in silico</i> treatment), • The output data (the state of the patient after the <i>in silico</i> treatment).
Impact	A high impact on the physiological, pathological and medical research software infrastructure is expected due to both the complexity of the problems addressed and the advanced multipurpose functionalities of the components and systems being developed. Technologies being developed and/or integrated within the framework of the CHIC project are expected to boost the European biomedical software industry and contribute to its leading role in the emergent in silico oncology and in silico medicine domain. Furthermore, since the simulation results will be readily available for evaluation, comparison and validation without the need for executing the same simulation again, less computational resources are going to be needed in the future.
Unique Selling Point / value proposition (competitive advantages)	The CHIC <i>In Silico</i> Trial Repository is a unique system, since it is a web application which effectively stores the simulation scenarios and the <i>in silico</i> predictions of multiscale cancer models by using cutting edge software technologies. Moreover, the web services developed for the <i>In Silico</i> Trial Repository provide the needed flexibility and facilitate its integration with new potential software components.
Expected stage of development of result at the end of the project	MO, TRL 1 <u>M48, TRL 6</u>
Exploitation plan summary	The exploitation plan for <i>in silico</i> trial repository is to be used as a free software service. Because of the sensitivity of the data (processing of clinical data), the content of the in silico trial repository cannot be exposed to everyone before or after the end of the project. ICCS will ensure that storage of new simulations, experiments and trials (input - output files and metadata

	of the experiments) and browsing of the content of the in silico trial repository will be allowed only to limited people, based on the protection of patient confidentiality and the legal constraints. Taking into account the aforementioned restrictions, ICCS will ensure that in silico trial repository will be a free service used by the clinicians and the modellers to inspect the outcome of the simulations in order to evaluate and validate the models.				
Market specification	Niche market and multi-sided				
Prospects/Customers	Clinicians, basic scientists, modellers				
Product/Service Market Size	Not yet known				
Market Trends/Public Acceptance	Constantly increasing public, clinicians' and patients' acceptance				
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Appropriate authentication and authorization mechanisms need always to be in place in order to ensure that only authorized persons have access to the simulation results.				
Competitors	No competitors				
Expected cost of commercialisation	Not yet known				
Time to market	In approximately 2 Years from the end of the project.				
Foreseen Product/Service Price	Not yet known				
Availability of exploitation potential and interest in the consortium	The <i>In Silico</i> Trial Repository has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.				
External Experts/Partners to be involved	ICCS				
Status of IPR: Background (type and partner owner)	Proprietary, ICCS				
Status of IPR: Foreground (type and partner owner)	Individual, ICCS				
Status of IPR: Exploitation Forms (type and partner owner)	Direct industrial use, patenting, technology transfer, license agreement, publications, standards, trademark applications, copyrights				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS is the only contributor				
Partner/s involved expectations	Since the simulation results will be readily available for evaluation, comparison and validation without the need for executing the same simulation again, less computational resources are going to be needed in the future. Consequently, the <i>In Silico</i> Trial Repository will increase the productivity of the partners.				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	1 VM (x64), 16GB RAM	ubuntu, python 2.7, MySQL community edition, Django framework,	~ 0,5 FTE	N/A	Apache HTTP server, Django Rest Framework,.djangosaml2, dm.xmlsec.binding, XML security library,

					jQuery library, Bootstrap framework
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes				

3.1.5 Clinical data repository

Name	Clinical data repository (CDR)
Description	The data provided by the clinical partners (healthy-related clinical data) are stored in the clinical data repository. This database system was built as a research collaboration tool where all the CHIC partners can search relevant datasets to conduct their research. The system allows storing structured information on the patients, links to relevant datasets, which enable researchers to browse, organize and share their data with their peers. Semantic search is also possible through integration with the RICORDO framework. Although developed in the CHIC context, the software framework is generic and could be used in various contexts where storage of clinical information is required. For more details, see D8.1, D8.2, D8.3, and D8.4.
Innovativeness of result as compared to already existing Products/Services	The major innovation of the system lies on its underlying concepts. Unlike most of the existing systems, the CDR aims at simultaneously storing a wide range of medical file formats/modalities (from 3D image dataset, to clinical report and genetic data) and to structure this information to make it easily queryable. Other benefits compared to competitive approach is the commitment to standard formats, ontology-based annotation/queries and ability given to the user to organize its own online workspace using folder structures (shared or not) to fits its needs.
Impact	The concepts underlying the clinical data repository aim at enabling exchange and re-usability of the data. Each dataset is stored as an object and is semantically linked with related datasets present in the systems. Semantic annotations are implemented to enable effective querying of the database, which is expected to allow efficient re-use of dataset collected and accelerate research and innovations, even in research application that differ from the primary goal of the data collections. This flexibility especially important with ever increasing need for data associated with the rapid growth of machine learning techniques in various areas of biomedical engineering.
Unique Selling Point / value proposition (competitive advantages)	System to collect medical records from 3D images to clinical questionnaires in an optimal research environment, including annotation, different interfaces (web, API) and sharing functionalities.
Expected stage of development of result at the end of the project	At the end of the project, a completed working prototype is available. The prototype has been tested in realistic environment during the CHIC project. In addition, the system has been exposed outside the CHIC environment through scientific competitions (image segmentation challenges).

Exploitation plan summary	<p>Provide services around storage and exchange of medical data in a research environment. Hosting shared benchmark data for medical image analysis as well as custom on-site deployments.</p> <p>Several exploitation options will be investigated for the clinical data repository. The first direction is to exploit the system as a collaboration tool for clinical trials performed at different locations. The benefit for clinician involved in collaborative research projects is that they have better control on what they share and with whom. Additionally, the dataset does not leave the hospital/data provider before being reviewed and anonymized.</p> <p>Another exploitation option is the development of centralized repository for medical images. Statistical shape analysis techniques are very popular in the medical imaging community and results can be transferred to companies active in implant design or imaging. A large data collection of medical images would major issue of the techniques, which is the very large number of dataset required to build a valid model. This constrain is even more critical when pathological situations are concerned. In the same direction, this platform could be used to propose open challenges such as image segmentation competition. On one hand, open challenge stimulates research by providing a common set of data to compare new developments with existing benchmarks. In addition, proposing challenges is a great way to attract researcher, process available data and promote the system.</p>
Market specification	<p>Niche market for clinical /biomechanical research where a data collection is needed to reach a critical mass or where a collaborative approach is needed to achieve results.</p> <ul style="list-style-type: none"> - Clinical trials and research - Pharma trials and research - Scientific competitions - Implant manufacturers (population-based implant design) - Scientific institutions will to outsource their data management
Prospects/Customers	Final users such as clinicians, biomedical engineers and computer scientists.
Product/Service Market Size	<p>The size of the market is difficult to evaluate and should be part of the future business analysis. However, the rough initial estimation indicates that the pharma industry is heavily investing in imaging. Same is true for the medical sector, where the need for multi-centric registries is ever more important. Similarly, the need of the medtech industry for medical data is strongly increasing.</p>
Market Trends/Public Acceptance	<p>Market of personalized health care data expected to raise. Subsequently acceptance of digital health as well. Legal requirements for patient data for collaboration and research should become clearer and better accepted. The major risk for the development of this business model resides in the restrictive European data protection laws.</p>
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	<p>With the current exploitation strategy, the platform will not be considered as a medical product. Therefore, the normative requirements are limited. The major requirement concerns the legal of the data protection law for the sharing aspect of the system. This problem will be addressed with ethic-legal experts. However, this restriction doesn't concern the data hosting part of the exploitation and (in general) processed dataset can be shared more easily (typically image segmentation or statistical models based on the collected data).</p>
Competitors	<p>Several competitive systems are available such as Midas (Kitware), Zenodo (Cern), or XNAT. However, none of them provides equivalent functionalities towards sharing clinical multimodal datasets.</p>
Expected cost of commercialisation	<p>The current version of the system can already be deployed and is currently in used to share data for scientific competitions and to host the research data of local researchers. However, larger scale commercialization requires a deeper analysis of the market opportunities and to adapt the software tool</p>

	accordingly. It is expected that this work will require about 2-year timeframe and an additional investment of 500k euros.				
Time to market	About 24 months (see previous section).				
Foreseen Product/Service Price	Different business models are envisioned according to the type of service provided around data storage. The current plan is not the sell the database system itself, but services such as providing customer with the relevant datasets or to provide hosting/sharing facilities. Price will be determined based on the volume of the data, their quality and required pre-processing/curation. A business plan still needs to be developed.				
Availability of exploitation potential and interest in the consortium	The data collected during the CHIC project are very valuable and would be a great benefit from an exploitation point of view. However, legal questions remain to be solved before being able to exploit this outcome.				
External Experts/Partners to be involved	The exploitation is not planned to be conducted by UBERN directly, but by a non-profit organization. This foundation – named Swiss Institute for Computer Aided Surgery – has been established in Delémont (Switzerland) and receives support from the local politic authorities. The foundation has a strong interest to expand and strengthen its activities in medical data collaboration.				
Status of IPR: Background (type and partner owner)	Agreement between SICAS and UBERN to ensure royalty free exploitation of the system by SICAS (non-profit organization).				
Status of IPR: Foreground (type and partner owner)	Individual, UBERN (see previous point)				
Status of IPR: Exploitation Forms (type and partner owner)	Same as before.				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	The CDR has been developed by UBERN with the support of SiCAS.				
Partner/s involved expectations	The exploitation plan is defined around services provided by the SiCAS foundation.				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	1 server or 1 VM and storage space for the data	ASP.NET MVC / Web API / Razor Entity Framework SimpleITK ReCaptcha Fuseki dotNetRDF Newtonsoft JSON VDS.Common jQuery Bootstrap Statismo HDF5DotNet ClearCanvas (exchangable)	0.5 FTE (Maintenance) 0.5 FTE (Bug Fixes)	N/A	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Foundation of a platform to provide/sell know-how and services in biomedical engineering. From an organisational perspective, the development and maintenance of this database system will be supported in the future by a non-profit foundation. The foundation name Si-CAS is based in Delémont (Switzerland) aims at becoming a support platform providing know-how and services in biomedical engineering. One of the core competences is linked to medical image analysis and modelling, including statistical shape modelling as well as data sharing infrastructure.				

Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Support has been approved the support the exploitation of the CDR by SiCAS and UBERN until end 2017. The funding available covers 2 full time employees (1 developed and a responsible post-doc.). Further support will be evaluated by the end of next year. In the plenary meeting that took place in Eindhoven in March 2017, a tentative agreement was made to extend the support of the entire CHIC platform until the end of 2018, however the discussion is still ongoing in order to reach an optimal agreement on the data management.
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3.1.6 Data upload tool

Name	Data upload tool
Description	The Data Upload Tool, with embedded CATS engine described below, can be used by a source/hospital to pseudonymise a data file (first round) and upload it through CATS (responsible for the second round) into the CHIC clinical data repository. Currently CSV and DICOM are supported, but other file formats can be added as needed. The big advantage of the Data Upload Tool compared to the CATS Upload Client is the graphical user interface through which data files can be reviewed before uploading them. This allows the data source to verify whether a file is pseudonymised correctly. For more details, please see D2.5.
Innovativeness of result as compared to already existing Products/Services	The main features of the Data Upload Tool are to pseudonymise and securely upload the data sets to be used in the CHIC platform, through a user-friendly interface.
Impact	Despite its narrow set of objectives (pseudonymizing and uploading data sets) this tool aims to be valuable for the CHIC partners and end users. Outside of the CHIC project its impact will likely be limited, depending on its purpose as a general upload tool in other research infrastructures.
Unique Selling Point / value proposition (competitive advantages)	This is a component tightly integrated and solely used by the services of the CHIC project. There is no competitor product in the market.
Expected stage of development of result at the end of the project	M0, TRL 1 <u>M48, TRL 6</u>
Exploitation plan summary	Due to the dependencies on the security framework and the rest of the CHIC architectural components this tool cannot be exploited as it is in isolation. Nevertheless, the majority of the end user visible functionalities and its usability features can be re-packaged and distributed separately, following an open source software development model.
Market specification	There is no market for the Data Upload Tool (due its limited range of use) as a stand-alone tool. Potential applications/services, which would like to be compatible with and/or extend the CHIC infrastructure, could use the tool to add data in the platform in a secure and compatible manner. The result of the above, is that the Data Upload Tool is bundled together with the rest services and tools of the CHIC platform, and therefore it is addressed to the same market as the platform as whole.
Prospects/Customers	Clinicians, Clinical Trial Managers, Data Curators.
Product/Service Market Size	As a stand-alone application, there is no market for the Data Upload Tool. The tool is a part of the CHIC platform as a whole package, and therefore it is addressed to the same market.
Market Trends/Public Acceptance	See above. Practically the tool inherits the market trends and public acceptance of the CHIC tools when bundled with them.
Legal or normative or ethical requirements (need	As the Data Upload Tool handles patient data, it is a requirement to comply with the legal framework and the European data protection laws.

for authorisations, certification, compliance to standards, norms, etc.)					
Competitors	There is no competition.				
Expected cost of commercialisation	This needs to be analysed in the context of a specific business plan.				
Time to market	1 year				
Foreseen Product/Service Price	The price of the final product is not known at this point in time. Most certainly, revenue will be based on the offering of the installed services of the platform.				
Availability of exploitation potential and interest in the consortium	The exploitation potential of the tool is consistent with the exploitation potential of the CHIC tools that need and use the Data Upload Tool as a part of their workflow. Another factor to be taken into account is that the potential for exploitation depends on the availability and commitment of multiple technical partners due to its “internal dependencies”.				
External Experts/Partners to be involved	The exploitation is conducted by the Center for eHealth Applications and Services (CEHA) of FORTH. CEHA develops and deploys IT software for the healthcare sector providing integrated and qualitative tools and solutions. Although CEHA is not an external expert/partner, it is still a different division of our laboratory devoted to the commercial exploitation of the tools.				
Status of IPR: Background (type and partner owner)	Individual, FORTH				
Status of IPR: Foreground (type and partner owner)	Individual, FORTH				
Status of IPR: Exploitation Forms (type and partner owner)	Direct industrial use, technology transfer, license agreement, publications, standards, trademark applications, copyrights				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	Data Upload Tool has been developed by FORTH (only contributor)				
Partner/s involved expectations	The exploitation plan is defined around services provided by the CeHA (see above).				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	1 desktop computer	Java	0.05 FTE (Maintenance) 0.05 FTE (Bug Fixes)	CHIC Security infrastructure and data repository	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The data upload tool will be maintained after the end of the project by the adaptation and reuse in follow-up projects.				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	FORTH commits to the sustainability of the data upload infrastructure for the 18 months after the project completion. Of course, the usefulness of this component during this period (or after it) depends to a great degree on the availability and maintenance of important collaborating tools and services (e.g. pseudonymization services) by the responsible partners and the preservation of the CHIC data provided that this is in compliance with the legal and ethical context of EU and the CHIC legal agreements.				

3.1.7 Pseudonymisation tools

Name	Pseudonymisation tools
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Description	The pseudonymisation tools, CATS (Custodix Anonymisation Tool Services), is a set of tools and services responsible for the de-identification of data files. It consists of the CATS Engine, CATS Privacy Profile Store, CATS Data Upload Interfaces, CATS Upload Client and CATS Server. The CATS Engine de-identifies a data file based on a set of pre-configured transformation rules (privacy profiles). The privacy profiles that need to be executed on a data file are matched based on the data file's mime type and schema. The CATS Engine can currently process XML, CSV, DICOM, CEL, plain text, PDF and WORD documents. Other data formats can be added as needed through engine extensions. See more details in D4.3.1 and D4.3.2.
Innovativeness of result as compared to already existing Products / Services	Limited tools are currently available on the market to assist an organisation in their de-identification needs.
Impact	Data de-identification and approval is today still a difficult and time-consuming task. The pseudonymisation tools aim to make this process easier and allow, once a processing flow has been set-up and approved, batch processing of follow-up data exports.
Unique Selling Point / value proposition (competitive advantages)	The pseudonymisation tools aims to make data de-identification easier by allowing, once a processing flow has been set-up and approved, batch processing of follow-up data exports.
Expected stage of development of result at the end of the project	M0: TRL 5 M48: TRL 9, used in commercial operational environments.
Exploitation plan summary	The Custodix pseudonymisation tools are exploited as various solutions to solve privacy issues such as data de-identification to pseudonym management. CATS is a long term Custodix product. In parallel to the research versions commercial grade spin-offs of CATS are exploited and continuously maintained.
Market specification	Niche market.
Prospects/Customers	Organisations that need to collect sensitive data in a de-identified form such as hospitals, research institutions and CROs.
Product/Service Market Size	Estimation not yet performed
Market Trends/Public Acceptance	N/A
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	ISO 27001 certification
Competitors	N/A
Expected cost of commercialisation	N/A
Time to market	Currently on the market via a commercial spin-off. Improvements through European Research efforts will gradually make the commercial spin-off.
Foreseen Product/Service Price	N/A
Availability of exploitation potential and interest in the consortium	The pseudonymisation tools have great potential of being exploited in research projects to fulfil the data de-identification requirements.
External Experts/Partners to be involved	N/A
Status of IPR: Background (type and partner owner)	Individual, Custodix

Status of IPR: Foreground (type and partner owner)	Individual, Custodix				
Status of IPR: Exploitation Forms (type and partner owner)	Platform as a service or license agreement. Owned by Custodix.				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	Custodix developed the pseudonymisation tools.				
Partner/s involved expectations	N/A				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	1 server or VM	Java 8	0.5 (Maintenance & Bug Fixes) 0.5 FTE (User Support)	CHIC Security infrastructure and data repository	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The pseudonymisation tools of Custodix are supported through various commercial projects and can be reused in follow-up projects.				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Exploitation support can be provided until the end of 2017. Further support will be provided if appropriate funding is available. In the plenary meeting that took place in Eindhoven in March 2017, a tentative agreement was made to extend the support of the entire CHIC platform until the end of 2018, however the discussion is still ongoing in order to reach an optimal agreement on the data management.				

3.1.8 VPH-HF

Name	VPH-HF
Description	The software framework (VPH-HF) provides a complete Problem Solving Environment that supports collaborative development and the re-use of complex computational models for computational physiology and computational medicine. Please see for more details D7.4.
Innovativeness of result as compared to already existing Products/Services	Originally developed as part of the EU-funded VPHOP project, the VPH-HF was completely re-written during the CHIC project. The three most important characteristics of this new implementation of the VPH-HF are: <ul style="list-style-type: none"> It translates two of the best practices in software development, reusability and continuous integration, to the modelling domain. Every time a hypo-model is updated in the model repository, it is versioned and automatically deployed on a computational host. A test suite is run for verifying the correctness and the outcome is published on a continuous integration dashboard; It is designed to execute virtually any workflow pattern, to allow rapid prototyping and reusability of models; It offers two key features to improve the computational efficiency of complex workflows composed by reusable models, caching of executions and a surrogate model replacement service.
Impact	The software framework VPH-HF is delivered to support the orchestration and execution of hypermodels that process patient clinical data. It is embedding cutting edge research methodologies that aim to change the current technical standard. VPH-HF is being released under an Apache2 license with open source code to be European software for the Europeans. This philosophy guarantees from one side a stronger commitment to deliver

	high quality software engineering products that can set the standard for good practices in computational science. On the other side, European citizens and SMEs can freely access the source code of VPH-HF as a learning reference or a starting point to extend and provide more software services. In both cases the impact in European society will be substantial as translational knowledge and exploitable product. The aim is to build a substantial academic computational science community around VPH-HF such that its maintenance and extension will be the result of a self-supported collective interest and effort – this would be an interesting innovative measure of success. Furthermore, VPH-HF is developed following the best practices in computational science reproducibility and releasing it open source will provide a concrete example in this direction.
Unique Selling Point / value proposition (competitive advantages)	N/A
Expected stage of development of result at the end of the project	M0, TRL 3 <u>M48, TRL 6</u>
Exploitation plan summary	VPH-HF is becoming an open source product. It will be released following the best practices in computational science and engineering development with emphasis on reproducibility. A public online Web service (e.g. Github.com) is used to host VPH-HF source code and provides the necessary tools for concurrent versioning systems, collaborative software development, continuous integration, user communications and bug reporting. Documentation and installation packages will be provided and released to the public to enable free test of the VPH-HF. Joint owners USFD and CINECA, both plan to exploit VPH-HF in their respective institutions in other research projects and for internal use. This will guarantee the maintenance and support of the software code immediately after the end of the CHIC project until external users will start to collaborate to the open source maintenance.
Market specification	N/A
Prospects/Customers	Biomedical researchers, wider research community in general
Product/Service Market Size	N/A
Market Trends/Public Acceptance	N/A
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	N/A
Competitors	N/A
Expected cost of commercialisation	N/A
Time to market	Immediately after the end of the project
Foreseen Product/Service Price	N/A
Availability of exploitation potential and interest in the consortium	The VPH-HF release as open-source project is performed in conjunction with the CHIC hypermodelling Editor so to provide to future users a complete infrastructure from the design to the execution of hypermodels.
External Experts/Partners to be involved	N/A
Status of IPR: Background (type and partner owner)	CINECA, USFD

Status of IPR: Foreground (type and partner owner)	Joint: USFD, CINECA														
Status of IPR: Exploitation Forms (type and partner owner)	Open-source release under Apache2 license														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	CINECA, USFD (Knowledge)														
Partner/s involved expectations	Both CINECA and USFD expects to internally re-use the developed code for other research initiatives.														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>1 server or 1 VM</td><td>Unix /Linux OS preferred Django and Django REST framework Celery Taverna MUSCLE Bootstrap JQuery public IP</td><td>0.05 FTE (Maintenance) 0.05 FTE (Bug Fixes)</td><td>N/A</td><td>Taverna MUSCLE</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	1 server or 1 VM	Unix /Linux OS preferred Django and Django REST framework Celery Taverna MUSCLE Bootstrap JQuery public IP	0.05 FTE (Maintenance) 0.05 FTE (Bug Fixes)	N/A	Taverna MUSCLE
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
1 server or 1 VM	Unix /Linux OS preferred Django and Django REST framework Celery Taverna MUSCLE Bootstrap JQuery public IP	0.05 FTE (Maintenance) 0.05 FTE (Bug Fixes)	N/A	Taverna MUSCLE											
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The release of the hypermodelling framework as open source will allow the software to be maintained by the community itself: anyone with an interest in using the code will be motivated to keep it updated and solve technical issues that might arise in the future.														
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	The release as Open-source of VPH-HF would allow any partner to contribute to the maintenance and any needed future development of the code. This will also be supported by released documentation.														

3.1.9 DrEye

Name	DrEye
Description	Dr Eye is a flexible and easy-to-use DICOM viewer and editor for quick and precise identification and delineation of tumors in medical images. Its design is clinically driven and it is a result of FORTH's long involvement in European projects, initially developed in the context of Contra Cancrum, then in TUMOR, p-medicine, and now in CHIC. For more information please see D2.5 and D5.1.1.
Innovativeness of result as compared to already existing Products/Services	DrEye offers multiple tools for segmenting regions of interest, either manual or semi-automatic, which allow precise delineations of tumors and healthy tissues. The platform provides an easy mechanism to expand its capabilities, through plugins and via a dedicated api. Through the API new tools, either for segmentation or for image analysis (e.g. statistical analysis, volume measurement, filtering, etc.) can be added, providing a custom-tailored platform for any working environment.
Impact	Due to its wide field of usage and its proven extensibility, DrEye continues its successful path in the communities of radiologists and imaging medical experts. With the updates that will implement in the context of the CHIC project and the extension of its communication functionalities with the

	clinical trial system of CHIC, its profile will become even more appealing to the stakeholders.
Unique Selling Point / value proposition (competitive advantages)	Capability to create plugins based on .NET technologies which are very common in the windows platform. Segmentation tools which adopt functionality and usability from the graphic design and editing domain. The ability to accurately delineate complex areas up to voxel level precision. Tools to measure core statistical and geometrical magnitudes as well as multiple options for import export.
Expected stage of development of result at the end of the project	M0, TRL 5 <u>M48, TRL 9</u>
Exploitation plan summary	The exploitation plans for the Dr Eye application, include its possible involvement in future European projects, in the academic environment as a training tool and by health providers specialized with medical imaging. The application is already being used as a research tool in several points in Europe.
Market specification	Niche market and multi-sided <ul style="list-style-type: none"> - Clinical practitioners (Radiologists, Oncologists and others) - Health centers / Hospitals - Medical schools - Clinical trials and research
Prospects/Customers	Clinicians, bioinformaticians, mathematical modellers and computational biologists with the need to view or segment medical images. The application can be used in other research communities in need of a medical viewer as a part of their workflow.
Product/Service Market Size	As the global medical imaging equipment (GMIE) market is growing in a fast pace the need for applications to handle, analyze and administer the imaging data also rises. The forecast for the GMIE market is expected to reach a market value of USD 35.35 billion (EUR 34,12 billion) by 2019. Based on the above there is need for an extendable medical image viewer, such as DrEye.
Market Trends/Public Acceptance	There are no substantial obstacles to reach the market, on the contrary the market forecast shows that the need for medical imaging applications with advanced functionalities will rise.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Although the DrEye platform is mature enough and has a solid base for applying for a medical approval (with some minor modifications), for the time being it will not be marketed as a medical product. Therefore, the normative requirements are minimal.
Competitors	Several competitive systems are available such as OSIRIX, Slicer etc. However, the ones that are most capable are not available to the most common platforms (e.g. OSIRIX is available only in Apple systems which represent less than 10 percent of the total active PC Systems) and the others do not offer the same functionalities.
Expected cost of commercialisation	The system is already used in several research facilities as a part of sophisticated workflows, result from it is open structure and the custom-tailored configuration. So, in that context is already commercialized for small scale cases (see next section). But although it is actively used, it requires some modifications in order to be ready for a large-scale commercialization, to ensure that it is well adjusted and tested for the more generic requirements of the market. It is expected that this work will require about 2-year timeframe and an additional investment of 200k euros.
Time to market	The application is "market ready" and is already being used in several research facilities around Europe as a part of their workflow as a research tool, with a dual licensing plan. The application is offered as "Free for usage"

	by any user which downloads it (through the application website) but with no dedicated support plan, and as part of the tools (with support plan) offered by the Center for eHealth Applications and Services (CEHA) of FORTH. CEHA develops and deploys IT software for the healthcare sector providing integrated and qualitative tools and solutions.				
Foreseen Product/Service Price	The platform has a dual licensing plan. The application is offered as "Free for usage" by any user which downloads it but with no dedicated support plan, and as part of the tools (with support plan) offered by the Center for eHealth Applications and Services (CEHA) of FORTH. The pricing varies as it is a part of the package which is tailor build and configured on the needs of each client, and it is estimated based on the total support plan.				
Availability of exploitation potential and interest in the consortium	The DrEye platform has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.				
External Experts/Partners to be involved	The exploitation is conducted by the Center for eHealth Applications and Services (CEHA) of FORTH. CEHA develops and deploys IT software for the healthcare sector providing integrated and qualitative tools and solutions. Although CEHA is not an external expert/partner, it is a different division of our laboratory devoted to the commercial exploitation of the tools.				
Status of IPR: Background (type and partner owner)	Proprietary: FORTH				
Status of IPR: Foreground (type and partner owner)	Individual: FORTH				
Status of IPR: Exploitation Forms (type and partner owner)	Individual: FORTH				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	DrEye has been developed by FORTH (only contributor).				
Partner/s involved expectations	The exploitation plan is defined around services provided by the CeHA (see above).				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	1 workstation	Windows OS version 8.0+ with .net framework 4+ installed	0.05 FTE (Maintenance) 0.05 FTE (Bug Fixes)	N/A	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The sustainability plan for DrEye is based on FORTH's own resources and the participation of FORTH in relevant subsequent research projects. As Dr Eye is already in use by some health providers (in Greece, Germany, etc) FORTH provides its support to the application, maintaining its existing user base.				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Full commitment in case appropriate financial sources are provided. In the plenary meeting that took place in Eindhoven in March 2017, a tentative agreement was made to extend the support of the entire CHIC platform until the end of 2018, however the discussion is still ongoing in order to reach an optimal agreement on the data management.				

3.1.10 Hypermodelling editor

Name	Hypermodelling editor
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Description	The hypermodelling editor is the infrastructure that allows computational biologists and other domain experts to design the multiscale, multimodel hypermodels in a graphical and user friendly way. Consequently, it is a user-friendly environment for the construction of syntactically and semantically valid, multiscale hypermodels. Its target end-users, therefore, consist of mathematical modellers, computational biologists, clinicians, and other research communities and stakeholders. For more information, please see D5.1.1.
Innovativeness of result as compared to already existing Products/Services	The CHIC Hypermodelling Editor features a unique combination of qualities that rank it prominently among similar products: <ul style="list-style-type: none"> - An intuitive, web-based, and user friendly user interface, - Semantics-based validation and consistency checking of the designed hypermodels, - Tight integration with the CHIC infrastructure and its components (e.g. VPH-HF for the hypermodel execution), - Ease of use, performance, and designed using the latest web standards and technologies.
Impact	The Hypermodelling Editor is expected to have a positive impact on the computational modelling community and its activities. The Editor is expected to be of great value as a user friendly, web based graphical environment for supporting the researcher in the full cycle of experimentation/exploration, design, publication, execution and monitoring of complex integrative computational models.
Unique Selling Point / value proposition (competitive advantages)	The integration with the CHIC platform is of course a unique selling point when offered as part of the whole “CHIC product”. In addition to that, the user-friendliness and ubiquity of its web based interface and the ontology based validation of the designed hypermodels further strengthen its value.
Expected stage of development of result at the end of the project	MO, TRL 1 <u>M48, TRL 5</u>
Exploitation plan summary	The hypermodelling editor is the user-friendly environment for the construction of syntactically and semantically valid, multiscale hypermodels. Its target end-users therefore consist of mathematical modellers, computational biologists, clinicians, and other research communities and stakeholders. To engage these communities and strengthen the collaboration, the Editor will be offered as open source software together with VPH-HF, but also in a “software as a service” (SaaS) delivery model. The involvement of key end users and relevant communities is crucial in order to get feedback and guarantee the Editor’s sustainability so dissemination of its objectives and features will be pursued through publications, involvement in future research projects, and demonstrations in suitable workshops and conferences.
Market specification	Niche and multi-sided market.
Prospects/Customers	Mathematical modellers, computational biologists, clinicians, and other research communities and stakeholders.
Product/Service Market Size	Market side is difficult to estimate and should be part of the future business analysis.
Market Trends/Public Acceptance	The use of computer modelling and simulation for the development of biomedical products (e.g. in pharmaceutical industry) is expected to increase in the years to come. The Editor is well positioned in this new setting as an enabling technology for the design and execution of simulation experiments or even for educating new researchers. On the other hand, similar offerings and products result in a highly competitive market.
Legal or normative or ethical requirements (need for authorisations,	The Editor is not intended to be used as medical device so no certification process is relevant. It is aimed at the experimentation using computer based

certification, compliance to standards, norms, etc.)	mathematical models with no use of patient specific and other sensitive data. So, there are no ethic-legal or normative requirements to consider.				
Competitors	There are generic scientific workflow systems like Taverna Workbench, Galaxy, and KNIME, mainly targeted at bioinformatics, genomics, or analytics. There are a few specialized products, like the Multiscale Application Designer (MAD) from the MAPPER project, but with limited development activity and support.				
Expected cost of commercialisation	The Hypermodelling Editor is released as open source software under an Apache 2.0 license. This license permits the commercialization of the tool, although FORTH does not have such plans for the moment. At the end of the project a working prototype is available in a non-fully operational environment. Before the first public release of the product at least one year of further development, testing, and validation is needed. The cost of this process and the full commercialization of the tool cannot be easily estimated, as this depends on additional factors such as the acceptance by the open source community and the interest in supporting it.				
Time to market	At least one (1) year for the further development and adaptation to the requirements of the research community.				
Foreseen Product/Service Price	The tool is offered as Open Source software and therefore any revenue will be primarily generated by offering hosting, support (e.g. tutorials and education material), or more advanced features offered at an additional cost. The exact or even approximate numbers need a concrete business plan to be in place.				
Availability of exploitation potential and interest in the consortium	The consortium includes a small number of potential users of the tool that have helped into formulating its feature set and user experience. Among these partners there is a strong interest in the availability of the tool, but of course any exploitation and commercialization plan should involve the feedback of larger user groups.				
External Experts/Partners to be involved	The exploitation is conducted by the Center for eHealth Applications and Services (CEHA) of FORTH. CEHA develops and deploys IT software for the healthcare sector providing integrated and qualitative tools and solutions. Although CEHA is not an external expert/partner, it is still a different division of our laboratory devoted to the commercial exploitation of the tools.				
Status of IPR: Background (type and partner owner)	Individual: FORTH				
Status of IPR: Foreground (type and partner owner)	Individual: FORTH				
Status of IPR: Exploitation Forms (type and partner owner)	Direct industrial use, technology transfer, license agreement, publications, standards, trademark applications, copyrights.				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	The Hypermodelling Editor has been developed by FORTH (only contributor).				
Partner/s involved expectations	The exploitation plan is defined around services provided by the CeHA (see above).				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	1 server or 1 VM	Unix /Linux OS preferred Java	0.05 FTE (Maintenance) 0.05 FTE (Bug Fixes)	CHIC Model and metadata repositories	N/A
Sources of financing foreseen after the end of	The support for the continuation of the development of the Hypermodelling Editor will largely come from own resources and the participation of FORTH				

the project (venture capital, loans, other grants, etc.)	is relevant subsequent research projects. The provision of the Editor as an open source software provides opportunities for its sustainability, assuming that the critical mass of the user community contributing to its development (i.e. by submitting ideas, bug reports, fixes, etc.) has been gathered.
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	The release as Open-source of Editor would allow any partner or even the open community of users and modellers to contribute to the maintenance and any needed future development of the code.

3.1.11 Pre-processing tool

Name	Pre-processing tool
Description	Tool to convert labelled metaimages to an alternative metaimage with isotropic grid spacing, defined by the user, and with a custom amount of space around it, that is also user defined. Please see for more information D2.5 and D5.1.1.
Innovativeness of result as compared to already existing Products/Services	Extraction of the necessary segmentations which delineate the tumor areas, processing and transcoding to the proper format to be consumed by the oncosimulator and the BMS.
Impact	The pre-processing tool has its own important key role at the CHIC platform, as it is the mediator, which converts the input data (medical images and segmentations) to an Oncosimulator accessible format and allows its proper initialization. It is a behind the scenes tool that, although of great importance, it is transparent to the end user. Therefore, the pre-processing tool has great impact, which is limited only to the CHIC platform users, but it is invisible as a separate tool.
Unique Selling Point / value proposition (competitive advantages)	This is a component tightly integrated and solely used by the services of the CHIC project. There is no competitor product in the market.
Expected stage of development of result at the end of the project	M0, TRL 1 <u>M48, TRL 6</u>
Exploitation plan summary	As this tool is mostly important and in use by other components of the CHIC platform, it will probably not be exploited in isolation. This does not anyway preclude its exploitation in follow-up projects.
Market specification	Minimal. There is no market for the pre-processing tool (due its limited range of use), apart of potential applications/services which would like to be compatible with and/or extend the CHIC infrastructure.
Prospects/Customers	Clinicians and all users, who are the stakeholders of the CHIC applications, who utilize the pre-processing tool.
Product/Service Market Size	None. Does not apply.
Market Trends/Public Acceptance	See above.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	None.
Competitors	None

Expected cost of commercialisation	None. Does not apply.														
Time to market	As this application is mostly important for other components of the CHIC project, this tool probably will not be exploited as is in isolation. Therefore, it will only be released in the market as a package with other CHIC tools, which make use of it. The release plan (=time to market) is determined by the maturity and readiness of the other tools.														
Foreseen Product/Service Price	Part of the CHIC infrastructure.														
Availability of exploitation potential and interest in the consortium	Required only by the CHIC services.														
External Experts/Partners to be involved	FORTH														
Status of IPR: Background (type and partner owner)	Proprietary: FORTH														
Status of IPR: Foreground (type and partner owner)	Individual: FORTH														
Status of IPR: Exploitation Forms (type and partner owner)	Direct industrial use, patenting, technology transfer, license agreement, publications, standards, trademark applications, copyrights.														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	FORTH is the only contributor.														
Partner/s involved expectations	Fulfilment of the respective project requirements.														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>1 workstation</td><td>Python with numpy (alternatively anaconda python distribution) and SimpleITK in any OS</td><td>0.05 FTE (maintenance) 0.05 FTE (Bug Fixes)</td><td>N/A</td><td>SimpleITK (it has an Apache 2.0 license, allowing unrestricted use, including in commercial products)</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	1 workstation	Python with numpy (alternatively anaconda python distribution) and SimpleITK in any OS	0.05 FTE (maintenance) 0.05 FTE (Bug Fixes)	N/A	SimpleITK (it has an Apache 2.0 license, allowing unrestricted use, including in commercial products)
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
1 workstation	Python with numpy (alternatively anaconda python distribution) and SimpleITK in any OS	0.05 FTE (maintenance) 0.05 FTE (Bug Fixes)	N/A	SimpleITK (it has an Apache 2.0 license, allowing unrestricted use, including in commercial products)											
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The pre-processing tool will be maintained after the end of the project by the adaptation and reuse in follow-up projects.														
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Full commitment to support this tool for the 18 months after the project's completion. After this period, further development and maintenance of the tool depends on the availability of appropriate resources.														

3.1.12 Semantic/metadata services

Name	Semantic/metadata services
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Description	<p>These are web-services for hypermodel annotation. The three main systems are:</p> <ul style="list-style-type: none"> - OWLKB, a semantic reasoning engine, which allows semantically sophisticated queries over a background knowledgebase, including real-time creation of so-called “composite terms” (for example, if the background knowledgebase has terms for “blood” and “aorta”, but not “blood in aorta”, OWLKB can be used to generate a semantically-meaningful term for “blood in aorta” from the two constituent terms). - LOLS, or Local Ontology Lookup Service, a lightweight server/API for translating between International Resource Identifier (IRI) and human-readable label. This tool allows quick lookup of ontology terms based on human-friendly search strings, and conversely. Its API is designed for easy integration into other partners’ projects. - RDFStore, a template system to facilitate queries over bulk CHIC metadata. RDFStore acts as an intermediary in front of a 3rd-party triplestore. It allows SPARQL-experts to create templates using SPARQL (a query language for linked metadata) once, and then those templates can be used by the end-user indefinitely, without the end-user having to know anything about SPARQL. <p>For more details, please refer to D7.2 and D7.3.</p>
Innovativeness of result as compared to already existing Products/Services	<p>The primary contribution of the semantic components is to simplify programmatic access and tailored management of back-end semantic storage. The software is implemented in Java; it reuses third party libraries and presents a convenience advantage over directly interacting with these. In the case of OWLKB, the functionality allowing creation of composed terms provides a key step towards the hard problem of automatic semantic term creation.</p>
Impact	<p>CHIC is optimistic that the semantic metadata best-practices it has committed itself to will have a significant impact on medical research in general. We hope CHIC will prove the utility of having its data so interoperable and reasoner-friendly and thereby provide a precedent for future projects.</p>
Unique Selling Point / value proposition (competitive advantages)	<p>We do not know of an out of the box, open source solution to the problems addressed.</p>
Expected stage of development of result at the end of the project	<p>M0, TRL 2 <u>M48, TRL 4</u></p>
Exploitation plan summary	<p>Provide services around storage and exchange of medical data in a research environment, and custom-made deployments.</p> <p>UCL’s RICORDO systems have been designed with well-documented APIs intended to ease usage in other partners’ software packages. Other CHIC partners can exploit this work by using the APIs to seamlessly integrate sophisticated semantic/metadata operations into their own software. By adopting semantic best practices, CHIC ensures high interoperability of its metadata, as well as making its metadata compatible with all kinds of automated reasoning / knowledge discovery software.</p>
Market specification	<p>Niche market – typically an institution managing a large amount of data and interested in supporting intelligent, semantic search and management as well as virtually any application relying on semantic integration</p>
Prospects/Customers	<p>biomedical researchers, content repository managers</p>
Product/Service Market Size	<p>Unknown</p>
Market Trends/Public Acceptance	<p>The component is a small dedicated element in a potentially large system; there are many sectors in which semantic technologies and integration are</p>

	not mature concepts and there is a steep learning curve to demonstrate the end benefits.										
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	The component is designed and developed as an open source project. It relies on third party software that may have its own legal requirements. There is no inherent ethical requirement.										
Competitors	Potentially any software developer able to reuse the same libraries.										
Expected cost of commercialisation	Unknown										
Time to market	Ready after the end of the project										
Foreseen Product/Service Price	Unknown										
Availability of exploitation potential and interest in the consortium	Unknown										
External Experts/Partners to be involved	Unknown										
Status of IPR: Background (type and partner owner)	Unknown										
Status of IPR: Foreground (type and partner owner)	Individual: UCL										
Status of IPR: Exploitation Forms (type and partner owner)											
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	UCL is the sole partner										
Partner/s involved expectations	To further develop the base components. To build solutions, such as involving front end software or tailored content.										
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>1 server or 1 VM and storage space for the data</td><td>Virtuoso, OWL API, neo4j, node.js, three.js Apache Jena Fuseki</td><td>0.25 FTE (Maintenance, Optimisation, Bug Fixes)</td><td>N/A</td><td>Apache Jena Fuseki OWL API Java</td></tr></table>	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	1 server or 1 VM and storage space for the data	Virtuoso, OWL API, neo4j, node.js, three.js Apache Jena Fuseki	0.25 FTE (Maintenance, Optimisation, Bug Fixes)	N/A	Apache Jena Fuseki OWL API Java
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies							
1 server or 1 VM and storage space for the data	Virtuoso, OWL API, neo4j, node.js, three.js Apache Jena Fuseki	0.25 FTE (Maintenance, Optimisation, Bug Fixes)	N/A	Apache Jena Fuseki OWL API Java							
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	<p>RICORDO is inherently sustainable/maintainable because of the way it constructs its core knowledgebase from open source ontologies. These open source ontologies are maintained by experts in their respective fields, and only a minimum of effort is needed to incorporate these ontology updates into the RICORDO instance running on CHIC hardware (in practice, it is not even necessary to incorporate such updates immediately on their release: regular updates every couple months or so should be more than adequate, based on the already mature status of the reference ontologies in question).</p> <p>Co-operation on the foundation of a platform to provide/sell know-how and services in biomedical engineering, in particular to contribute to the data sharing infrastructure.</p>										

Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes
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3.1.13 Security Tools and Services

Name	Security Tools and Services
Description	<p>A suite of tools and services responsible for the 3A's aspect of security (authentication, authorisation and auditing).</p> <p>Authentication and identity management components are:</p> <ol style="list-style-type: none"> 1) The Identity and Access Management Site (IAM) is responsible for user enrolment and management. IAM allows (virtual) organisations, attributes and roles to be assigned to users. These are then used through access rules defined in the authorisation policies to give the user access to restricted resources. 2) The Identity Provider (IdP) is responsible for the authentication of users who access CHIC services through a browser. It provides identity assertions, which identify the user, to all CHIC Web Sites. 3) The Secure Token Service (STS) is responsible for the authentication of users who access CHIC Web Services (through a non-browser client). It provides identity assertions to all CHIC Web Services. <p>Authorisation components:</p> <ol style="list-style-type: none"> 4) The Policy Decision Point (PDP) is the entity which takes authorisation decisions. A PDP accepts authorisation requests. 5) The Policy Administration Point (PAP) is the endpoint responsible for managing policies. The PAP provides the PDP with all policies required to produce an authorisation decision. The PAP has management services through which authorisation policies can be defined. 6) The Policy Information Point (PIP) provides the PDP with the needed information (attributes) to take an authorisation decision. Most resource and subject attributes are already provided through an authorisation request. If the PDP needs an attribute that was not provided, this can be obtained through the PIP. 7) A Policy Enforcement Point (PEP) is a component which integrates the authorisation services with application code. The PEP is responsible for creating the authorisation request and sends it to the PDP. 8) Audit Service 9) Security gateway/proxy 10) Integration modules and extensions <ol style="list-style-type: none"> a) Various integration modules are available within CHIC to integrate JAVA, PHP and .NET applications into the security b) Extensions (e.g. Liferay). <p>For more information please see D5.2.1 and D5.2.2.</p>
Innovativeness of result as compared to already existing Products/Services	Provide integration for legacy applications.
Impact	The CHIC Security Tools and Services try to solve some of the today difficulties and gaps in security implementations and setup. Many good security standards exist today such as SAML and OpenID connect. Although more and more applications start to embrace and implement those standards, many legacy applications still exist (requiring e.g. username/password authentication) with no support for those standards. For this purpose, the CHIC Security Tools and Services provide a security proxy allowing legacy

	applications to be integrated into modern SSO security solutions based on SAML or OpenId Connect. With the croxy SSO solutions can be deployed compatible with and integrating legacy applications.				
Unique Selling Point / value proposition (competitive advantages)	Through the CHIC security framework legacy applications can be easily integrated in a (SAML) SSO environment without having to change/update the legacy application.				
Expected stage of development of result at the end of the project	M0: TRL 5 M48: TRL 9, used in commercial operational environments.				
Exploitation plan summary	The CHIC security components are exploited by Custodix as one shop security solution including identity management, authentication, authorisation and auditing.				
Market specification	Niche market				
Prospects/Customers	Small or medium sized companies.				
Product/Service Market Size	Unknown				
Market Trends/Public Acceptance	Unknown				
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	ISO 27001 certification				
Competitors	For example, onelogin, imprivata, evidian, stormpath.				
Expected cost of commercialisation	Unknown				
Time to market	Currently on the market via a commercial spin-off. Improvements through European Research efforts will gradually make the commercial spin-off.				
Foreseen Product/Service Price	Unknown				
Availability of exploitation potential and interest in the consortium	The security tools and service have great potential of being exploited in research projects to fulfil the security requirements.				
External Experts/Partners to be involved	N/A				
Status of IPR: Background (type and partner owner)	Individual, Custodix				
Status of IPR: Foreground (type and partner owner)	Individual, Custodix				
Status of IPR: Exploitation Forms (type and partner owner)	Platform as a service or license agreement. Owned by Custodix.				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	Custodix developed the pseudonymisation tools.				
Partner/s involved expectations	N/A				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies

	3 VM's	Java 8	0.5 (Maintenance & Bug Fixes) 0.5 FTE (User Support)	N/A	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The CHIC security components are tightly connected to the CHIC platform. The sustainability plan of the security components is thus tightly connected with the sustainability plan of the CHIC platform as a whole.				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Exploitation support can be provided until the end of 2017. Further support will be provided if appropriate funding is available. In the plenary meeting that took place in Eindhoven in March 2017, a tentative agreement was made to extend the support of the entire CHIC platform until the end of 2018, however the discussion is still ongoing in order to reach an optimal agreement on the data management.				

3.1.14 CRAF

Name	CRAF
Description	The Clinical Research Application Framework (CRAF) is a software platform installed at the clinical side that supports the clinicians in using the hypermodels built and deployed in the CHIC environment for clinical research purposes. Therefore, it makes use of the CHIC infrastructure for running these hypermodels and it comprises a suite of tools for data management (e.g. for uploading new patient data) and visualization (e.g. for the presentation of the results of the simulations). Please refer for more information to D2.5.
Innovativeness of result as compared to already existing Products/Services	The CRAF application aims to bridge the gap between the modelling work done in the CHIC platform and the clinical research and every day's practice that takes place in the health delivery environment (e.g. hospitals). CRAF effectively supports a unified and simple user experience and provides a "CHIC-in-a-box" abstraction for the clinicians to use in clinical research performed in their premises. To this end, its user interface is designed to be simple and smooth by hiding the complexity of the CHIC platform while, at the same time, demonstrating its full potential for clinical research and empowering the clinician to use the underlying technologies for the benefit of the cancer patient. At the same time, CRAF coordinates the functionality of other CHIC components that are also highly important for the clinicians to gain access to the CHIC services, such as the Data Upload tool for uploading patient data to the CHIC cloud, and the Visualization and image processing tools (e.g. DrEye).
Impact	The objectives of CRAF raise a great set of challenges, both because of the technical requirements and the dependence on the production of really clinically relevant hypermodels in the CHIC project, but we expect it to have a strong impact in the community of clinicians and medical experts.
Unique Selling Point / value proposition (competitive advantages)	Currently we are not aware of any product with the same or similar range of features and ambitions. CRAF brings together the computational modelling and simulation results with the clinical practice and the experimentation and research in the clinical domain ("from bench to bedside"). By bringing these two sides together, this tool positions itself as a tangible means for collaborative research and translational medicine.
Expected stage of development of result at the end of the project	M0: TRL 0 M48: TRL 6
Exploitation plan summary	Due to the dependencies on the security framework and the rest of the CHIC architectural components this tool cannot be exploited as is in isolation. The deployment options range from the operational environments of health care

	organizations and hospitals to geographic regions at a European level or in the context of specific clinical trials.
Market specification	Niche and multi-sided market.
Prospects/Customers	<ul style="list-style-type: none"> - Clinical trials and research - Pharma trials and research - Clinicians and Medical Researchers
Product/Service Market Size	It's difficult to provide estimations on the market size as this depends on a lot of factors (e.g. adoption by health care facilities, number of active clinical researchers, etc.).
Market Trends/Public Acceptance	The input gathered during multiple workshops organized in the course of the project has been very positive (see Deliverable 11.3). The major obstacle to overcome seems to be the scepticism of the clinicians on the use of in Silico models for making decisions for a patient. There is a strong need for providing validation of the models used by CRAF with large number of patients.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	CRAF does not aim to be a "medical device" or a full-blown Clinical Decision Support system, and therefore FDA approval and similar certification is not needed. But still some clinical validation must be done to provide some substantial evidence of its results (See above). Also, indirectly, CRAF handles patient data because patient specific measurements and other clinical data are given to the bundled hypermodels during their execution. Therefore, compliance with the legal framework and the European data protection laws is required.
Competitors	None that we are aware of.
Expected cost of commercialisation	This needs to be analysed in the context of a specific business plan.
Time to market	2 years are needed for expanding and completing its feature set after which validation of the predictions of the hypermodels needs to be performed.
Foreseen Product/Service Price	The price of the final product is not known at this time point. Most certainly, revenue will be based on the offering of CRAF related services (hosting, infrastructure, documentation, etc.).
Availability of exploitation potential and interest in the consortium	There is a strong interest in the consortium especially from the clinical partners on the further exploitation and the sustainability of the CRAF platform. Also, the potential for exploitation depends on the availability and commitment of multiple technical partners due to its "internal dependencies" (see table below).
External Experts/Partners to be involved	The exploitation is conducted by the Center for eHealth Applications and Services (CEHA) of FORTH. CEHA develops and deploys IT software for the healthcare sector providing integrated and qualitative tools and solutions. Although CEHA is not an external expert/partner, it is still a different division of our laboratory devoted to the commercial exploitation of the tools.
Status of IPR: Background (type and partner owner)	Individual, FORTH
Status of IPR: Foreground (type and partner owner)	Individual, FORTH
Status of IPR: Exploitation Forms (type and partner owner)	Direct industrial use, technology transfer, license agreement, publications, standards, trademark applications, copyrights
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	CRAF has been developed by FORTH. USAAR contributed to its design and initial concept.
Partner/s involved expectations	The exploitation plan is defined around services provided by the CeHA (see above).
Sustainability needs	

	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	1 desktop computer	Java	0.05 FTE (maintenance) 0.05 FTE (Bug Fixes)	Almost the whole CHIC platform: CHIC Security infrastructure, model and data repositories, execution framework	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	The sustainability of CRAF depends on the sustainability plans of the whole platform, due to its many interactions with it. FORTH will make sure that its core components are maintained and possibly reused in subsequent projects but due to its nature there's no guarantee that CRAF as a whole will be fully functional unless the rest of the CHIC platform is also in place.				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	After the end of the project FORTH will be providing resources and keep supporting it based on the ongoing exploitation plans and the future prospects of the CHIC consortium, and the commitment of other CHIC partners to support and maintain their own tools and services.				

3.2 Modelling outputs

A considerable number of component models (hypo-models), hyper-models and hyper-modelling strategies developed by the CHIC modelling partners are to be provided for reuse by both the CHIC and the extra-CHIC cancer modelling community. Each modelling entity includes a formal description, the corresponding executable, as well as useful additional information.

The four major CHIC hyper-model demonstrators to be provided to the wider research community are the following: 1) the lung cancer hyper-model-based Oncosimulator, 2) the nephroblastoma hyper-model-based Oncosimulator, 3) the glioblastoma hyper-model-based Oncosimulator and 4) the prostate tumor hypermodel. All these hyper-models are based on multiscale and multilevel mechanistic models of tumour growth and response to treatment. Additional statistical models are being developed such as the glioblastoma Oncosimulator.

Impact

- Models being developed and/or integrated within the framework of the CHIC project are expected to boost the European biomedical software industry.
- Due to the vast scientific, technological and clinical scope and depth of the CHIC project a great impact on the academic educational procedure is expected in the form of (post) graduate courses, laboratory classes, as well as the shaping and advancement of new scientific domains such as in silico oncology and in silico medicine is expected.
- Further details can be found in D6.4.

Sustainability

All models and hyper-models will be stored in the CHIC model repository, a copy of which will physically reside in ICCS-NTUA/FORTH. The responsible partners will take care to sustain and curate model beyond the end of CHIC lifetime and provide access to the broader community.

Exploitation

- Hypo-models and hyper-models can be exploited as a model source for the development of Clinical Decision Support (CDS) systems, following the necessary clinical adaptation, validation and certification processes (see clinical and commercial exploitation section). Following the strict prospective clinical validation, models are expected to serve as a clinical support system in order to individualize the treatment scheme and schedule for each given patient, based on their own multiscale data (imaging, histological, molecular, clinical, etc.).
- Generic research exploitation: The models are to be also used as a platform for in silico experimentation in the generic biological and clinical research context (basic science exploitation). In this exploitation track, numerous in vitro and animal testing experiments are expected to be replaced with less laboratory demanding and life-friendlier in silico experiments like those provided by CHIC. Certain hypo-models related to cancer can also be used in order to construct hyper-models for physiological and pathological mechanisms encountered in physiology and pathology outside the domain of cancer.
- Educational exploitation: Apart from components of patient individualized decision support systems and generic research platforms, the models could also be used as educational tool in the context of academic education (basic science, technology and medical education), general public education (patient's and/or parents' education, citizen's education and health literacy), education from an industrial perspective, politician education, epistemological, philosophical and social sciences education.

Details on each modelling output are reported in the following sub-sections.

3.2.1 Glioblastoma Mechanistic Hypermodel

Name	Glioblastoma Mechanistic Hypermodel.
Description	Tumour growth and response to treatment.
Innovativeness of result as compared to already existing Products/Services	A fully functional mechanistic hypermodel for GBM plus response to a combined rTMZ and dendritic cell vaccination scheme is not feasible up to now. A model taking into account several aspects of GBM growth such as cell metabolism, anisotropic diffusion of cells and chemical diffusion plus the macroscopic effects of angiogenesis is being developed. Since there are only a few models in the literature addressing all these issues concurrently, this model is expected to consist an influential addition to existing models.
Impact	Enhancement of the existing in-silico GBM growth models weaponry.
Unique Selling Point / value proposition (competitive advantages)	There are only a few models in the literature addressing these issues altogether. The particular model is expected to consist an influential addition to existing models
Expected stage of development of result at the end of the project	Working, adapted, non-validated, suitable for hypothesis testing. TRL 4: Technology validated in lab
Exploitation plan summary	Free software for suitable for simulations, theoretical considerations and hypothesis testing.
Market specification	Medical-Health.
Prospects/Customers	Life science professionals.
Product/Service Market Size	N/A.
Market Trends/Public Acceptance	N/A.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards

Competitors	No relevant commercial product/service exists in market.				
Expected cost of commercialisation	Freeware.				
Time to market	Not known.				
Foreseen Product/Service Price	N/A.				
Availability of exploitation potential and interest in the consortium	The GBM mechanistic model has potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC.				
External Experts/Partners to be involved	ICCS				
Status of IPR: Background (type and partner owner)	Proprietary, ICCS + KU Leuven				
Status of IPR: Foreground (type and partner owner)	Composite, ICCS + KU Leuven				
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical research use, publications				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS has designed, developed and adapted the Glioblastoma Mechanistic Hypermodel. KU Leuven has provided the clinical data and pertinent clinical information.				
Partner/s involved expectations	To advance knowledge and new services to the ICCS and the clinical partners' portfolio. Compete in the market with an innovative technology.				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	x64, 16GB RAM	Matlab	~ 0,5 FTE	N/A	Matlab
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future research projects funding.				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes.				

3.2.2 Glioblastoma Machine Learning Hypermodel

Name	Glioblastoma Machine Learning Hypermodel.
Description	Tumour growth and response to treatment.
Innovativeness of result as compared to already existing Products/Services	No relevant commercial product/service exists in market. Combined rTMZ and DC vaccination treatment is still an experimental treatment. Results are expected to advance knowledge and to provide support for relevant clinical decisions.
Impact	Statistical, descriptive and potentially predictive results regarding: <ul style="list-style-type: none"> the response of the immune system to dendritic cell vaccination in brain tumor patients. the interaction between brain tumors and the immune system.

Unique Selling Point / value proposition (competitive advantages)	Neither predictive tools nor clinical support systems on the specific subject are available in the market.														
Expected stage of development of result at the end of the project	Validated method forming a basis for a relevant clinical decision support system. TRL 4: Technology validated in lab														
Exploitation plan summary	Available as a free tool for life science professionals.														
Market specification	Medical-Health.														
Prospects/Customers	Life science professionals.														
Product/Service Market Size	N/A.														
Market Trends/Public Acceptance	N/A.														
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards.														
Competitors	No relevant commercial product/service exists in market.														
Expected cost of commercialisation	Not known.														
Time to market	In approximately 3-6 years from the end of the project .														
Foreseen Product/Service Price	Not known.														
Availability of exploitation potential and interest in the consortium	The GBM Machine Learning Model has great potential for being exploited by researchers, clinicians, modellers and software engineers.														
External Experts/Partners to be involved	ICCS, KU Leuven														
Status of IPR: Background (type and partner owner)	Proprietary, ICCS + KU Leuven.														
Status of IPR: Foreground (type and partner owner)	Composite, ICCS + KU Leuven.														
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications.														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS has designed, developed and adapted the Glioblastoma machine learning hypermodel. KU Leuven, has provided the clinical data and pertinent clinical information.														
Partner/s involved expectations	<div>- To add a new product to the portfolio</div> <div>- To add knowledge and new services to the Research center portfolio</div> <div>- Compete in the market with a unique technology</div>														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>x64, 16GB RAM</td><td>Matlab</td><td>~ 0,5 FTE</td><td>N/A</td><td>Matlab</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	x64, 16GB RAM	Matlab	~ 0,5 FTE	N/A	Matlab
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
x64, 16GB RAM	Matlab	~ 0,5 FTE	N/A	Matlab											
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding.														
Would you be ready to commit to support this CHIC component, as part of the	Yes.														

whole CHIC platform, after the end of the project?

3.2.3 Lung Cancer Multimodeller Hypermodel

Name	Lung Cancer Multimodeller Hypermodel
Description	The Lung Cancer Multimodeller Hypermodel provides a detailed multiscale simulator of the complex phenomenon of <i>in vivo</i> tumour growth and response to treatment, primarily in the context of non-small cell lung cancer. The Lung Cancer Oncosimulator acts as the hypermodel integrator and is linked with a vasculature/angiogenesis hypomodel (of which the development has been led by UOXF), a biomechanics hypomodel (of which the development has been led by UBERN), a cell kill rate focusing molecular hypomodel (of which the development has been led by UPENN) and a metabolic network hypomodel (of which the development has been led by FORTH).
Innovativeness of result as compared to already existing Products/Services	<p>No relevant commercial product/service exists in market. In comparison with relevant models found in literature, the Lung Cancer Multimodeller Hypermodel has the following characteristics:</p> <ul style="list-style-type: none"> • <i>Multiscale approach</i> dictated by the diversity of cancer and the complexity of the underlying molecular mechanisms. Moreover, the hypermodel supports the use of multiscale data, such as actual imaging, histopathologic, molecular and treatment data, available for each particular clinical case considered. • <i>Combination of discrete and continuous mathematics</i>: The core of the Hypermodel, the Lung Oncosimulator, is classifiable primarily as a discrete mathematics method (involving discrete entities and discrete events). However, certain aspects of cancer biology, such as drug pharmacokinetics, cell kill rate, angiogenesis and biomechanics simulation, modelled by the rest hypomodels, are treated with continuous mathematics. • <i>Clinical orientation</i>: The hypermodel has been designed so as to respond to real clinical questions concerning the optimization of treatment strategies of individual patients and is continuously refined in the context of clinical trials. • <i>Adaptable</i>: The hypermodel is designed to handle missing data. • <i>Extensible</i>: Hypomodels that address additional aspects of cancer biology can be easily integrated. • While clearly clinically oriented, the hypermodel retains its potential to be used as exploratory tool in basic research.
Impact	A high impact on the physiological, pathological and medical research community is expected due to both the multiscale nature and clinical orientation of the hypermodel.
Unique Selling Point / value proposition (competitive advantages)	Although the Lung Cancer Hypermodel is still under clinical validation and therefore not ready for commercial exploitation, it is expected to be commercial exploited following the completion of the clinical validation stage. Therefore, for the time being it should be considered as research and academic teaching tool.
Expected stage of development of result at the end of the project	TRL 5: Technology validated in relevant environment
Exploitation plan summary	Exploitation as a clinical decision support system: Following the strict prospective clinical validation, lung cancer hypermodel is expected to serve as a clinical support system in order to individualize the treatment scheme and schedule for each given patient, based on their own multiscale data (imaging, histological, molecular, clinical, etc.). Generic research exploitation: The lung cancer hypermodel is to be also used as a platform for <i>in silico</i> experimentation in the generic biological and clinical research context (basic science exploitation). In this exploitation track, numerous <i>in vitro</i> and animal testing experiments are expected to be replaced with a less laboratory demanding and life-friendlier <i>in silico</i> experiments. Educational

	exploitation: Apart from components of patient individualized decision support systems and generic research platforms, the lung cancer hypermodel could also be used as educational tool in the context of academic education (basic science, technology and medical education), general public education (patient's and/or parents' education, citizen's education and health literacy), industry education (education from an industrial perspective), politician education, epistemological, philosophical and social sciences education.
Market specification	Biomedical software market
Prospects/Customers	Basic scientists, modellers, research clinicians, hospitals
Product/Service Market Size	Not yet known
Market Trends/Public Acceptance	The major step before the expected clinical translation is the completion of the clinical validation within the framework of pertinent clinical trials.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards
Competitors	No relevant commercial product/service exists in market.
Expected cost of commercialisation	Not yet known
Time to market	In approximately 3-6 years from the end of the project
Foreseen Product/Service Price	Not yet known
Availability of exploitation potential and interest in the consortium	The Lung Cancer Hypermodel has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.
External Experts/Partners to be involved	ICCS, FORTH, UOXF, UBERN, UPENN
Status of IPR: Background (type and partner owner)	Proprietary, ICCS, FORTH, UOXF, UBERN, UPENN, USAAR
Status of IPR: Foreground (type and partner owner)	Joint, ICCS, FORTH, UOXF, UBERN, UPENN, USAAR
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS, FORTH, UOXF, UBERN, UPENN has designed, developed and adapted the Lung Cancer Hypermodel. USAAR, has provided the clinical data and pertinent clinical information.
Partner/s involved expectations	To add knowledge and new services to the ICCS, FORTH, UOXF, UBERN, UPENN and the clinical partners' portfolio.

	Compete in the market with a unique technology				
Sustainability needs					
	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	x64, 16GB RAM, Ubuntu Linux 14+	C++, Python, Copasi	~ 0,5 FTE	N/A	- Muscle - VTK 6.2 - CGAL 4.6 with VTK support - Xerces and CodeSynthesis XSD for config file handling - Febio -Chaste, FEniCS, VTK.
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes				

3.2.4 Lung Cancer Machine Learning Model

Name	Lung Cancer Machine Learning Model
Description	A machine learning approach that aims to predict the clinical evolution of a surgical treated patient with non-small cell lung cancer adenocarcinoma and identify group of patients with high risk of recurrence based on their miRNA data and/or EGFR/BRAF/ALK mutation and clinical profile.
Innovativeness of result as compared to already existing Products/Services	<p>No relevant commercial product/service exists in market. The Lung Cancer Machine Learning Model has the following characteristics:</p> <ul style="list-style-type: none"> • <i>Clinical orientation</i>: The models have been designed so as to respond to real clinical questions concerning the optimization of treatment strategies of individual patients and are continuously refined in the context of clinical trials. • The model exploits the molecular and clinical data for each particular clinical case considered.
Impact	A high impact on the physiological, pathological and medical research community is expected due to the clinical orientation of the model.
Unique Selling Point / value proposition (competitive advantages)	Although the Lung Cancer Machine Learning Model is still under clinical validation and therefore not ready for commercial exploitation, it is expected to be commercial exploited following the completion of the clinical validation stage. Therefore, for the time being they should be considered as research tool.
Expected stage of development of result at the end of the project	TRL 4: Technology validated in lab

Exploitation plan summary	Exploitation as a clinical decision support system: Following the strict prospective clinical validation, Lung Cancer Machine Learning Model is expected to serve as a clinical support system in order to individualize the treatment scheme and schedule for each given patient, based on their own multiscale data (histological, molecular, clinical).				
Market specification	Biomedical software market				
Prospects/Customers	Research clinicians, hospitals				
Product/Service Market Size	Not yet known				
Market Trends/Public Acceptance	The major step before the expected clinical translation is the completion of the clinical validation within the framework of pertinent clinical trials.				
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards				
Competitors	No relevant commercial product/service exists in market.				
Expected cost of commercialisation	Not yet known				
Time to market	In approximately 3-6 years from the end of the project				
Foreseen Product/Service Price	Not yet known				
Availability of exploitation potential and interest in the consortium	The Lung Cancer Machine Learning Model has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.				
External Experts/Partners to be involved	ICCS				
Status of IPR: Background (type and partner owner)	Proprietary, ICCS + USAAR				
Status of IPR: Foreground (type and partner owner)	Composite, ICCS + USAAR				
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS has designed, developed and adapted the Lung Cancer Machine Learning Model. USAAR, has provided the clinical data and pertinent clinical information.				
Partner/s involved expectations	To add knowledge and new services to the ICCS and the clinical partners' portfolio. Compete in the market with a unique technology				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	x64, 16GB RAM	Matlab	~ 0,5 FTE	N/A	Matlab
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes				

3.2.5 Lung Cancer Oncosimulator (Mechanistic)

Name	Lung Cancer Oncosimulator
Description	<p>The Lung Cancer Oncosimulator is a hypomodel (component model) simulating lung tumour growth and response to treatment. The Lung Cancer Oncosimulator explicitly models cancer cell multiplication, cellular response to treatment and spatial expansion based on the notion of cellular automaton. It considers both radiotherapy and cisplatin-based doublet therapy.</p> <p>The Lung Cancer Oncosimulator is available as a standalone application or as a MUSCLE-enabled hypomodel. The MUSCLE-enabled version of the Oncosimulator explicitly addresses radiotherapy and cisplatin–vinorelbine doublet therapy. However, it can be easily adapted to other types of cisplatin-based doublet therapy.</p>
Innovativeness of result as compared to already existing Products/Services	<p>No relevant commercial product/service exists in market. In comparison with relevant models found in literature, the Lung Cancer Oncosimulator has the following characteristics:</p> <ul style="list-style-type: none"> • <i>Multiscale “top-down” approach</i>: The method starts from the macroscopic imaging data (a high biocomplexity level) and proceeds towards lower biocomplexity levels. When there is a need for an upwards movement in the biocomplexity scales, a summary of the available information pertaining to the previous lower level is used. • <i>Combination of discrete and continuous mathematics</i>: The model is classifiable primarily as a discrete mathematics method (involving discrete entities and discrete events). However, certain aspects of the simulation problem, such as drug pharmacokinetics and cell survival probabilities described by pharmacodynamics and/or radiobiology can be treated with continuous mathematics. • <i>Clinical orientation</i>: The model has been designed so as to respond to real clinical questions concerning the optimization of treatment strategies of individual patients and is continuously refined in the context of clinical trials. • The model supports the use of actual imaging, histopathologic, molecular and treatment data available for each particular clinical case considered. • While clearly clinically oriented, the model retains its potential to be used as exploratory tool in basic research.
Impact	A high impact on the physiological, pathological and medical research community is expected due to both the multiscale nature and clinical orientation of the model.
Unique Selling Point / value proposition (competitive advantages)	Although the Lung Cancer Oncosimulator is still under clinical validation and therefore not ready for commercial exploitation, it is expected to be commercial exploited following the completion of the clinical validation stage. Therefore, for the time being it should be considered as research and academic teaching tool.
Expected stage of development of result at the end of the project	TRL 5: Technology validated in relevant environment
Exploitation plan summary	<p>Exploitation as a clinical decision support system: Following the strict prospective clinical validation, lung cancer oncosimulator is expected to serve as a clinical support system in order to individualize the treatment scheme and schedule for each given patient, based on their own multiscale data (imaging, histological, molecular, clinical, etc.). Generic research exploitation: The lung cancer oncosimulator is to be also used as a platform for in silico experimentation in the generic biological and clinical research context (basic science exploitation). In this exploitation</p>

	track, numerous in vitro and animal testing experiments are expected to be replaced with a less laboratory demanding and life-friendlier in silico experiments. Educational exploitation: Apart from components of patient individualized decision support systems and generic research platforms, the lung cancer oncosimulator could also be used as educational tool in the context of academic education (basic science, technology and medical education), general public education (patient's and/or parents' education, citizen's education and health literacy), industry education (education from an industrial perspective), politician education, epistemological, philosophical and social sciences education.														
Market specification	Biomedical software market														
Prospects/Customers	Basic scientists, modellers, research clinicians, hospitals														
Product/Service Market Size	Not yet known														
Market Trends/Public Acceptance	The major step before the expected clinical translation is the completion of the clinical validation within the framework of pertinent clinical trials.														
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards														
Competitors	No relevant commercial product/service exists in market.														
Expected cost of commercialisation	Not yet known														
Time to market	In approximately 3-6 years from the end of the project														
Foreseen Product/Service Price	Not yet known														
Availability of exploitation potential and interest in the consortium	The Lung Cancer Oncosimulator has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well														
External Experts/Partners to be involved	ICCS														
Status of IPR: Background (type and partner owner)	Proprietary, ICCS + USAAR														
Status of IPR: Foreground (type and partner owner)	Composite, ICCS + USAAR														
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS has designed, developed and adapted the Lung Cancer Oncosimulator. USAAR, has provided the clinical data and pertinent clinical information.														
Partner/s involved expectations	To add knowledge and new services to the ICCS and the clinical partners' portfolio. Compete in the market with a unique technology														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>x64, 16GB RAM</td><td>C++</td><td>~ 0,5 FTE</td><td>N/A</td><td>Muscle</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	x64, 16GB RAM	C++	~ 0,5 FTE	N/A	Muscle
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
x64, 16GB RAM	C++	~ 0,5 FTE	N/A	Muscle											
Sources of financing foreseen after the end of the project	Own resources and eventual future project funding														

(venture capital, loans, other grants, etc.)	
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes

3.2.6 Nephroblastoma Multimodeller Hypermodel

Name	Nephroblastoma Multimodeller Hypermodel
Description	A hypermodel to address the clinical question if a chemotherapy treatment would be beneficial or not for individualized nephroblastoma patients is designed. It consists of five hypomodels covering different aspects of the complex phenomenon of cancer, a molecular, an angiogenetic, a metabolic, a biomechanistic and a cellular hypomodel.
Innovativeness of result as compared to already existing Products/Services	<p>No relevant commercial product/service exists in market. In comparison with relevant models found in literature, the Nephroblastoma Multimodeller Hypermodel has the following characteristics:</p> <ul style="list-style-type: none"> • <i>Multiscale approach</i> to include the complex biological phenomena of cancer. Moreover, the hypermodel supports the use of multiscale personalized data, such as actual imaging, histopathologic, molecular and treatment data of the patients. • <i>Combination of discrete and continuous mathematics</i>: The core of the Hypermodel, the Wilms Oncosimulator, is a discrete cellular automata model, however aspects of cancer biology, such as metabolism, molecular mechanisms, angiogenesis and biomechanics of nephroblastoma, modeled by the other hypomodels, are based on continuous mathematic approaches. • <i>Clinical orientation</i>: The hypermodel has been designed in a clinical content to respond to real clinical questions concerning the optimization of treatment strategies of individual patients and is continuously refined in the context of clinical trials. • <i>Adaptable</i>: The hypermodel is designed to handle missing data. • <i>Extensible</i>: Hypomodels that address additional aspects of cancer biology can be easily integrated. • While clearly clinically oriented, the hypermodel retains its potential to be used as exploratory tool in basic research.
Impact	A high impact on the physiological, pathological and medical research community is expected due to both the multiscale nature and clinical orientation of the hypermodel.
Unique Selling Point / value proposition (competitive advantages)	Although the Nephroblastoma Hypermodel is still under clinical validation and therefore not ready for commercial exploitation, it is expected to be commercial exploited following the completion of the clinical validation stage. Therefore, for the time being it should be considered as research and academic teaching tool.
Expected stage of development of result at the end of the project	TRL 5: Technology validated in relevant environment
Exploitation plan summary	Exploitation as a clinical decision support system: Following the strict prospective clinical validation, nephroblastoma hypermodel is expected to

	serve as a clinical support system in order to individualize the treatment scheme and schedule for each given patient, based on their own multiscale data (imaging, histological, molecular, clinical, etc.). Generic research exploitation: The nephroblastoma hypermodel is to be also used as a platform for in silico experimentation in the generic biological and clinical research context (basic science exploitation). In this exploitation track, numerous in vitro and animal testing experiments are expected to be replaced with a less laboratory demanding and life-friendlier in silico experiments. Educational exploitation: Apart from components of patient individualized decision support systems and generic research platforms, the nephroblastoma hypermodel could also be used as educational tool in the context of academic education (basic science, technology and medical education), general public education (patient's and/or parents' education, citizen's education and health literacy), industry education (education from an industrial perspective), politician education, epistemological, philosophical and social sciences education.
Market specification	Biomedical software market
Prospects /Customers	Basic scientists, modellers, research clinicians, hospitals
Product/Service Market Size	Not yet known
Market Trends/Public Acceptance	The major step before the expected clinical translation is the completion of the clinical validation within the framework of pertinent clinical trials.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards
Competitors	No relevant commercial product/service exists in market.
Expected cost of commercialisation	Not yet known
Time to market	In approximately 3-6 years from the end of the project
Foreseen Product/Service Price	Not yet known
Availability of exploitation potential and interest in the consortium	The Nephroblastoma Hypermodel has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.
External Experts/Partners to be involved	ICCS, FORTH, UOXF, UBERN, UPENN
Status of IPR: Background (type and partner owner)	Proprietary, ICCS, FORTH, UOXF, UBERN, UPENN, USAAR
Status of IPR: Foreground (type and partner owner)	Joint, ICCS, FORTH, UOXF, UBERN, UPENN, USAAR
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS, FORTH, UOXF, UBERN, UPENN has designed, developed and adapted the Lung Cancer Hypermodel. USAAR, has provided the clinical data and pertinent clinical information.
Partner/s involved expectations	To add knowledge and new services to the ICCS, FORTH, UOXF, UBERN, UPENN and the clinical partners' portfolio. Compete in the market with a unique technology

Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	x64, 16GB RAM, Ubuntu Linux 14+	C++, Python, Copasi	~ 0,5 FTE	N/A	- Muscle - VTK 6.2 - CGAL 4.6 with VTK support - Xerces and CodeSynthesis XSD for config file handling - Febio -Chaste, FEniCS, VTK.
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes				

3.2.7 Nephroblastoma Oncosimulator (Mechanistic)

Name	Nephroblastoma Oncosimulator
Description	<p>The Nephroblastoma Oncosimulator is a hypomodel (component model) designed to simulate tumor free growth and response to combined chemotherapy of actinomycin and vincristine. It is a basically discrete mathematical approach (cellular automata) simulating cancer cell multiplication, cellular response to treatment and spatial expansion. The Nephroblastoma Oncosimulator is available as a standalone application or as a MUSCLE-enabled hypomodel. The MUSCLE-enabled version of the Nephroblastoma Oncosimulator addresses actinomycin-vincristine combined chemotherapy. However, it can be easily adapted to other types of therapy.</p>
Innovativeness of result as compared to already existing Products/Services	<p>No relevant commercial product/service exists in market. In comparison with relevant models found in literature, the Nephroblastoma Oncosimulator has the following characteristics:</p> <ul style="list-style-type: none"> • <i>Multiscale top-down approach</i>: the model starts from the individualized macroscopic imaging data of the patient and proceeds to lower biocomplexity levels. • <i>Combination of discrete and continuous mathematics</i>: Wilms Oncosimulator, is a discrete cellular automata model, however aspects of biology, such as cell survival probabilities defined by pharmacodynamics-pharmacokinetics of drugs are based on continuous mathematic approaches. • <i>Clinical orientation</i>: The Wilms Oncosimulator has been designed in a clinical content to respond to real clinical questions concerning the optimization of treatment strategies of individual patients and is continuously refined in the context of clinical trials. • While clearly clinically oriented, the oncosimulator retains its potential to be used as exploratory tool in basic research.

Impact	A high impact on the physiological, pathological and medical research community is expected due to both the multiscale nature and clinical orientation of the model.
Unique Selling Point / value proposition (competitive advantages)	Although the Nephroblastoma Oncosimulator is still under clinical validation and therefore not ready for commercial exploitation, it is expected to be commercial exploited following the completion of the clinical validation stage. Therefore, for the time being it should be considered as research and academic teaching tool.
Expected stage of development of result at the end of the project	TRL 5: Technology validated in relevant environment
Exploitation plan summary	Exploitation as a clinical decision support system: Following the strict prospective clinical validation, nephroblastoma oncosimulator is expected to serve as a clinical support system in order to individualize the treatment scheme and schedule for each given patient, based on their own multiscale data (imaging, histological, molecular, clinical, etc.). Generic research exploitation: The nephroblastoma oncosimulator is to be also used as a platform for in silico experimentation in the generic biological and clinical research context (basic science exploitation). In this exploitation track, numerous in vitro and animal testing experiments are expected to be replaced with a less laboratory demanding and life-friendlier in silico experiments. Educational exploitation: Apart from components of patient individualized decision support systems and generic research platforms, the nephroblastoma oncosimulator could also be used as educational tool in the context of academic education (basic science, technology and medical education), general public education (patient's and/or parents' education, citizen's education and health literacy), industry education (education from an industrial perspective), politician education, epistemological, philosophical and social sciences education.
Market specification	Biomedical software market
Prospects/Customers	Basic scientists, modellers, research clinicians, hospitals
Product/Service Market Size	Not yet known
Market Trends/Public Acceptance	The major step before the expected clinical translation is the completion of the clinical validation within the framework of pertinent clinical trials.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards
Competitors	No relevant commercial product/service exists in market.
Expected cost of commercialisation	Not yet known
Time to market	In approximately 3-6 years from the end of the project
Foreseen Product/Service Price	Not yet known
Availability of exploitation potential and interest in the consortium	The Nephroblastoma Oncosimulator has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.
External Experts/Partners to be involved	ICCS
Status of IPR: Background (type and partner owner)	Proprietary, ICCS + USAAR

Status of IPR: Foreground (type and partner owner)	Composite, ICCS + USAAR + UBERN														
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS has designed, developed and adapted the Nephroblastoma Oncosimulator. USAAR, has provided the clinical data and pertinent clinical information.														
Partner/s involved expectations	To add knowledge and new services to the ICCS and the clinical partners' portfolio. Compete in the market with a unique technology														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>x64, 16GB RAM</td><td>C++</td><td>~ 0,5 FTE</td><td>N/A</td><td>Muscle</td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	x64, 16GB RAM	C++	~ 0,5 FTE	N/A	Muscle
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
x64, 16GB RAM	C++	~ 0,5 FTE	N/A	Muscle											
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding														
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes														

3.2.8 Pharmacokinetics and pharmacodynamics of hormonal treatment for testosterone regulation

Name	Hypermodel of pharmacokinetics and pharmacodynamics of hormonal treatment for testosterone regulation.
Description	The Hormone Treatment Hypermodel is a component model simulating the hormone dynamics (testosterone (TE), luteinizing hormone-releasing hormone (LHRH), luteinizing hormone (LH)) and the regulation of testosterone levels by LHRH agonists. It explicitly monitors the time evolution of LHRH, LH and TE concentration in serum both in a physiological context and in the case of treatment with LHRH agonists.
Innovativeness of result as compared to already existing Products/Services	The hypermodel is clinically driven and clinically oriented. It reproduces the oscillatory nature of unperturbed testosterone levels as well as the hormone dynamics in the case of treatment with LHRH agonists. To the best of our knowledge, it is the only model that predicts both opposite effects of LHRH agonists administration (stimulation of testosterone production when administered in a pulsatile manner and blockage of testosterone production when administered continuously in high doses). Finally, the model is characterized by extensibility in the sense that different hypo-models addressing tumour development can be easily integrated.

Impact	A high impact on the physiological, pathological and medical research community is expected due to the fact that the model not only simulates the therapeutic effect of LHRH agonists but also sheds light on the underlying mechanism of the specific kind of hormone treatment. The aforementioned impact will not be strictly confined to cancer research area but is expected to expand in various pathological contexts since the hypermodel is sufficiently generic to be used for medical conditions caused by imbalanced hormone dynamics (subfertility, precocious puberty etc.).
Unique Selling Point / value proposition (competitive advantages)	Although the hypermodel simulating the hormone treatment effect on testosterone production is still under clinical validation and therefore not ready for commercial exploitation, it is expected to be commercial exploited following the completion of the clinical validation stage. Therefore, for the time being it should be considered as research and academic teaching tool.
Expected stage of development of result at the end of the project	TRL3
Exploitation plan summary	Exploitation as a clinical decision support system: Following the strict prospective clinical validation, the hormone treatment hypermodel is expected to serve as a clinical support system in order to individualize the treatment scheme and schedule for each given patient, based on their own data. Generic research exploitation: The hormone treatment hypermodel is to be also used as a platform for in silico experimentation in the generic biological and clinical research context (basic science exploitation). In this exploitation track, numerous in vitro and animal testing experiments are expected to be replaced with a less laboratory demanding and life-friendlier in silico experiments. Educational exploitation: Apart from components of patient individualized decision support systems and generic research platforms, the hormone treatment hypermodel could also be used as educational tool in the context of academic education (basic science, technology and medical education), general public education (patient's and/or parents' education, citizen's education and health literacy), industry education (education from an industrial perspective), politician education, epistemological, philosophical and social sciences education.
Market specification	Biomedical software market
Prospects/Customers	Basic scientists, modellers, research clinicians, hospitals
Product/Service Market Size	Not yet known
Market Trends/Public Acceptance	The major step before the expected clinical translation is the completion of the clinical validation within the framework of pertinent clinical trials.
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards
Competitors	No relevant commercial product/service exists in market.
Expected cost of commercialisation	Not yet known
Time to market	In approximately 5-8 years from the end of the project.
Foreseen Product/Service Price	Not yet known
Availability of exploitation potential and interest in the consortium	The hormone treatment hypermodel has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.

External Experts/Partners to be involved	ICCS														
Status of IPR: Background (type and partner owner)	Proprietary, ICCS														
Status of IPR: Foreground (type and partner owner)	Individual, ICCS														
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications														
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	ICCS has designed, developed and adapted the hormone treatment hypermodel.														
Partner/s involved expectations	To add knowledge and new services to the ICCS and the clinical partners' portfolio. Compete in the market with a unique technology														
Sustainability needs	<table><tr><th>HW</th><th>SW</th><th>Personnel for maintenance and support (FTE per year)</th><th>Internal CHIC dependencies</th><th>External dependencies</th></tr><tr><td>x64, 16GB RAM</td><td>MATLAB</td><td>~ 0,5 FTE</td><td>N/A</td><td></td></tr></table>					HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies	x64, 16GB RAM	MATLAB	~ 0,5 FTE	N/A	
HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies											
x64, 16GB RAM	MATLAB	~ 0,5 FTE	N/A												
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding														
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes														

3.2.9 Monitoring PSA dynamics after Radical Prostatectomy to predict the timing of recurrence

Name	Hypomodel for monitoring PSA dynamics after Radical Prostatectomy (RP) to predict the timing of recurrence (EUREKA1 database validated).
Description	PSA dosages are collected after RP. Data are compared with the West's tumor growth model, being the model parameters validated on the clinical database EUREKA1, and the timing of biochemical recurrence (0.2 ng/ml) is predicted.
Innovativeness of result as compared to already existing Products/Services	The hypermodel is clinically driven and clinically oriented. Extended clinical validation has been performed on the retrospective database EUREKA1.
Impact	The basic idea of this hypermodel is to provide to clinicians an easy-to-use tool for predicting the PSA behaviour in the follow-up after prostatectomy. Inserting this model in MyHealthAvatar mobile application, a high impact is expected in hospitals and in clinical practice in general.
Unique Selling Point / value proposition (competitive advantages)	Provided it is available as commercial SW is expected to be exploited.

Expected stage of development of result at the end of the project	TRL3				
Exploitation plan summary	Exploitation as part of a clinical decision support system: the model is expected to serve as a clinical support system in order to personalize the treatment plan accordingly to the patient's data. Moreover, many information about the risk and the aggressiveness of the tumor can be extrapolated by the model's output.				
Market specification	Biomedical software market				
Prospects/Customers	Research clinicians, hospitals				
Product/Service Market Size	Not yet known				
Market Trends/Public Acceptance	Already clinically validated				
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards				
Competitors	No relevant commercial product/service exists in market.				
Expected cost of commercialisation	Not yet known				
Time to market	In approximately 2 years from the end of the project				
Foreseen Product/Service Price	Not yet known				
Availability of exploitation potential and interest in the consortium	The PSA hypomodel has great potential for being exploited by researchers, clinicians, modellers and software engineers. These categories of prospective users constitute the majority of the CHIC partners as well.				
External Experts/Partners to be involved	UNITO				
Status of IPR: Background (type and partner owner)	Proprietary, UNITO				
Status of IPR: Foreground (type and partner owner)	Individual, UNITO				
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	UNITO has designed, developed and adapted the PSA hypomodel.				
Partner/s involved expectations	To help both patients and clinicians to improve the personalization of treatment plans.				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	x64, 16GB RAM	MATLAB	~ 0,5 FTE	N/A	
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding				

Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes
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3.2.10 Perisurgical parameters values at Radical Prostatectomy (RP) to predict the risk of prostate tumour recurrence by means of a NOMOGRAM

Name	Hypomodel based on perisurgical parameters values at Radical Prostatectomy (RP) to predict the risk of prostate tumour recurrence by means of a NOMOGRAM (EUREKA1 database validated).
Description	20 – 25% of patients affected by prostate cancer relapses in the first 5 years after radical prostatectomy. Risk assessment is normally performed on consolidated parameters relating the peri-operative tumor characteristics, namely tumor staging, nodal involvement, positive margins, pathological Gleason Score and pre-surgery PSA values. Based on the EUREKA-1 database, which collected clinical data from a large cohort of prostatectomized Italian patients, we validated the nomogram based on the inclusion of the first post-surgery PSA value in the statistical analysis. Early post-surgical PSA evaluation, besides being the starting point for long-time monitoring and a very sensible 'alarm-bell' when the biochemical recurrence threshold (0.2 ng/ml) is approached, is therefore a valuable co-parameter for the post-surgical risk assessment for prostate tumor recurrence.
Innovativeness of result as compared to already existing Products/Services	The hypermodel is clinically driven and clinically oriented. Extended clinical validation has been performed on the retrospective database EUREKA1.
Impact	The nomogram can be used in clinical practice in an easy way; indeed, no heavy computations are needed and the inputs are well-known parameters provided by standard exams. The use of such nomogram in hospitals can help clinicians to find 'at risk' patients and to prevent a possible relapse with adjuvant therapies, such as hormone therapy.
Unique Selling Point / value proposition (competitive advantages)	Provided it is available as commercial SW is expected to be exploited.
Expected stage of development of result at the end of the project	TRL3
Exploitation plan summary	Exploitation as part of a clinical decision support system: the nomogram is proposed to clinicians both by research papers (submitted) and conferences (e.g. Urologist's Conference in Candiolo, 24 th February 2017). Other conferences will be planned in order to diffuse the use of such nomogram in clinical practice.
Market specification	Biomedical software market
Prospects/Customers	Research clinicians, hospitals
Product/Service Market Size	Not yet known
Market Trends/Public Acceptance	Already clinically validated
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards

Competitors	No relevant commercial product/service exists in market.
Expected cost of commercialisation	Not yet known
Time to market	In approximately 1 years from the end of the project
Foreseen Product/Service Price	Not yet known
Availability of exploitation potential and interest in the consortium	The nomogram has great potential for being exploited by researchers, clinicians, modellers and statisticians. These categories of prospective users constitute the majority of the CHIC partners as well.
External Experts/Partners to be involved	UNITO
Status of IPR: Background (type and partner owner)	Proprietary, UNITO
Status of IPR: Foreground (type and partner owner)	Individual, UNITO
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	UNITO has designed, developed and adapted the nomogram.
Partner/s involved expectations	To provide a new clinical decision support to doctors during the first months of the follow-up of prostatectomized patients.
Sustainability needs	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes

3.2.11 Perisurgical parameters values after RADIOTHERAPY to predict the risk of prostate tumour recurrence by means of a NOMOGRAM

Name	Hypomodel based on perisurgical parameters values after RADIOTHERAPY to predict the risk of prostate tumour recurrence by means of a NOMOGRAM (EUREKA2 database validated)
Description	A nomogram, validated on EUREKA2 cohort, is proposed. Starting from standard clinical parameters, such as Gleason Score, stage and so on, a risk of recurrence in 5 years after radiotherapy is provided.
Innovativeness of result as compared to already existing Products/Services	The hypermodel is clinically driven and clinically oriented. Extended clinical validation has been performed on the retrospective database EUREKA2.
Impact	The use of the nomogram in Italian Hospitals could be important. Indeed, previous proposed nomograms are based on European or American populations. This nomogram can predict in a best way the Italian population behaviour.
Unique Selling Point / value proposition (competitive advantages)	Provided it is available as commercial SW is expected to be exploited.

Expected stage of development of result at the end of the project	TRL3
Exploitation plan summary	Exploitation as part of a clinical decision support system.
Market specification	Biomedical software market
Prospects/Customers	Clinicians, hospitals
Product/Service Market Size	Not yet known
Market Trends/Public Acceptance	Already clinically validated
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards
Competitors	No relevant commercial product/service exists in market. Some free applications show the risk of relapse based on a European or an American population.
Expected cost of commercialisation	Not yet known
Time to market	In approximately 2 years from the end of the project
Foreseen Product/Service Price	Not yet known
Availability of exploitation potential and interest in the consortium	The nomogram was already presented to radiotherapists during a conference. Other conferences could be planned in order to invite clinicians to use and improve the tool.
External Experts/Partners to be involved	UNITO
Status of IPR: Background (type and partner owner)	Proprietary, UNITO
Status of IPR: Foreground (type and partner owner)	Individual, UNITO
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	UNITO has designed, developed and adapted the nomogram.
Partner/s involved expectations	To provide to clinicians a useful and easy-to-use tool to assess the risk of relapse after radiotherapy.
Sustainability needs	N/A
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes

3.2.12 On-line Clinical Decision Support System for Prostatectomized Patients running on the ‘My Health Avatar’ platform

Name	On-line Clinical Decision Support System (CDSS) for Prostatectomized Patients running on the ‘My Health Avatar’ platform.
Description	My Health Avatar is a mobile app for patients who want to collect their own data and eventually share them with friends/doctors. A module for prostatectomized patients is under construction. This app should help both patients and clinicians to collect and use the follow-up data; moreover, models, such as the nomogram and the PSA kinetics ones, are implemented in the app. Clinicians can therefore use a user-friendly tool to personalize the follow-up (and eventually the treatment) on each patient.
Innovativeness of result as compared to already existing Products/Services	The app is both clinical- and patient- oriented. Extended clinical validation has been performed on the retrospective database EUREKA1.
Impact	A high impact on patients and clinicians is expected. In particular, patients could be involved in their own healthcare, helping clinicians to collect the data and taking part in the treatment decisions. Moreover, clinicians will be able both to use advanced mathematical models and to provide easy explanations to patients. The app could become also a good and fast way to keep in contact patients, doctors and other stakeholders (e.g. caregivers).
Unique Selling Point / value proposition (competitive advantages)	Provided it is available as free SW is expected to be exploited.
Expected stage of development of result at the end of the project	TRL3
Exploitation plan summary	Exploitation as part of a clinical decision support system.
Market specification	Biomedical software market
Prospects/Customers	Basic scientists, modellers, research clinicians, hospitals
Product/Service Market Size	Not yet known
Market Trends/Public Acceptance	Already clinically validated
Legal or normative or ethical requirements (need for authorisations, certification, compliance to standards, norms, etc.)	Authorization, Certification, Compliance to medical devices standards
Competitors	No relevant commercial product/service exists in market.
Expected cost of commercialisation	Not yet known
Time to market	In approximately 1 years from the end of the project
Foreseen Product/Service Price	Not yet known
Availability of exploitation potential and interest in the consortium	The app was presented both to the public (European Researchers’ Night 2016 in Turin) and to clinicians (Virtual Physiological Human Conference 2016 in Amsterdam and a Urologists’ Congress in Candiolo, Italy) with a good feedback.
External Experts/Partners to be involved	UNITO, BED
Status of IPR: Background (type and partner owner)	Proprietary, UNITO, BED

Status of IPR: Foreground (type and partner owner)	Composite, UNITO, BED				
Status of IPR: Exploitation Forms (type and partner owner)	Direct clinical use, publications				
Which partner contributes to what (main contributions in terms of know-how, patents, etc.)	UNITO has designed, developed and adapted the hypomodels, BED has integrated the model into the My Health Avatar platform.				
Partner/s involved expectations	To add knowledge and new services to both clinicians and patients. Compete in the market with a unique technology				
Sustainability needs	HW	SW	Personnel for maintenance and support (FTE per year)	Internal CHIC dependencies	External dependencies
	Android	Java	~ 0,5 FTE		My Health Avatar platform
Sources of financing foreseen after the end of the project (venture capital, loans, other grants, etc.)	Own resources and eventual future project funding				
Would you be ready to commit to support this CHIC component, as part of the whole CHIC platform, after the end of the project?	Yes				

4 The CHIC platform as a whole

Description: The whole CHIC platform is a suite of tools, services and secure infrastructure that will support accessibility and reusability of VPH mathematical and computational hypermodels for the modelling of tumours treatments.

Reference document: CHIC deliverables

Target users: Clinicians, basic scientists, modellers, technology experts

Time to market: In approximately 3 years regarding the basic science and technology use. However, the clinical utilization of the entire system will be possible after the successful completion of specially designed prospective clinical trials (see later in this section for further details on planned clinical validation).

Owners: CHIC consortium

Foreground type: Composite

Technology Readiness Level		
at M0	at M36	at M48
1	3	5

Sustainability needs/requirements

HW	SW	Personnel for maintenance and support (FTE per year)
Cloud infrastructure 1 VM (Linux/Unix OS, Ubuntu 14.04 LTS) 1 desktop computer (Windows OS 8.0+) Disk for data storage	.net framework 4+ Apache web server ASP.NET MVC / Web API / Razor Bootstrap Celery ClearCanvas Django Django rest framework Dm.xmlsec.binding security library dotNetRDF Entity Framework Fuseki HDF5DotNet Java 7 jQuery Liferay portal framework MUSCLE Mysql Neo4j Newtonsoft JSON Node.js numpy Openstack OWL API Public IP Python 2.7 ReCaptcha	3.3 FTE for maintenance 0.4 FTE for bug fixes 0.2 FTE for user support

	SimpleITK Statismo Taverna Three.js Tomcat application server VDS.Common Virtuoso	
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4.1 Sustainability plan

As reported in the previous sections, all partners have considered the sustainability needs of their owned outputs and have committed to sustain the CHIC platform beyond the end of CHIC lifetime and provide access to the broader community.

After these positive replies for each individual component sustainability, the CHIC consortium agreed and committed to sustain the overall CHIC platform at the last general project meeting that took place in Eindhoven in March 2017. All partners agreed to maintain the overall platform up and running until the end of 2018 on internal funds. This includes FORTH keeping alive the private cloud infrastructure now hosting the CHIC services, CUSTODIX to support security-related issues, and technical and modelling partners' availability to provide basic maintenance support. This agreement also required the needs for additional data protection agreements as described later in the specific sections and managed by WP4 team.

Due to the fact that any commercial exploitation or provision of services related to CHIC would first of all need to have a complete prospective validation and due to the fact that this will take many years, the consortium agreed to temporarily abandon the possibility to pass the exploitation to a third party like StaRC (Study Trial and Research Centre). In this context, the partners identified the steps needed to completely assess the clinical relevance (from retrospective to clinical trial validation). When this will be achieved, the CHIC partner, Philips expressed interest in the long-term exploitation of the CHIC system as a clinical DSS (see later for more details).

The exploitation is then described in the next section divided into exploitation towards research, education and clinical fields.

4.2 Exploitation plan

4.2.1 Research & educational exploitation

Research and education are the core businesses of most of the partners within the CHIC consortium. Thus, further research and education relying on CHIC outputs will continue as part of each partner main activity business.

The return, the partners expect to get from this activity, is not a monetary gain, but the CHIC outputs will be exploited as a mean for the growth of the research excellence of each institution.

To sustain these activities as well as further scientific publications, as stated also before, the CHIC partners committed to keep the technical and modelling outputs up and running until the end of 2018.

4.2.2 Research exploitation

The CHIC platform is to be also used as a platform for in silico experimentation in the generic biological and clinical research context (basic science exploitation). In this exploitation track, numerous in vitro and animal testing experiments are expected to be replaced with a less laboratory demanding and life-friendlier in silico experiments (http://www.vph-institute.org/upload/vphinst-response-to-petition-ban-animal-exp-approved_52efc4606d3d6.pdf). This has also been confirmed by the invitation of USFD to present the "The potential of the Virtual Physiological Human" at the European Commission

Scientific Conference “Non-Animal Approaches - The Way Forward” that took place in Brussels at the end of 2016.

Reuse, extension and adaptation of the developed cancer (hyper)models embedded in the CHIC platform in order to address other tumour types will offer important opportunities for the sustainability and the exploitation of several previous projects funded by the European Commission.

At the same time, the CHIC hypomodels could be also re-used to build and evaluate new hypermodels as will be also supported by the technological platform being up and running after the end of the project.

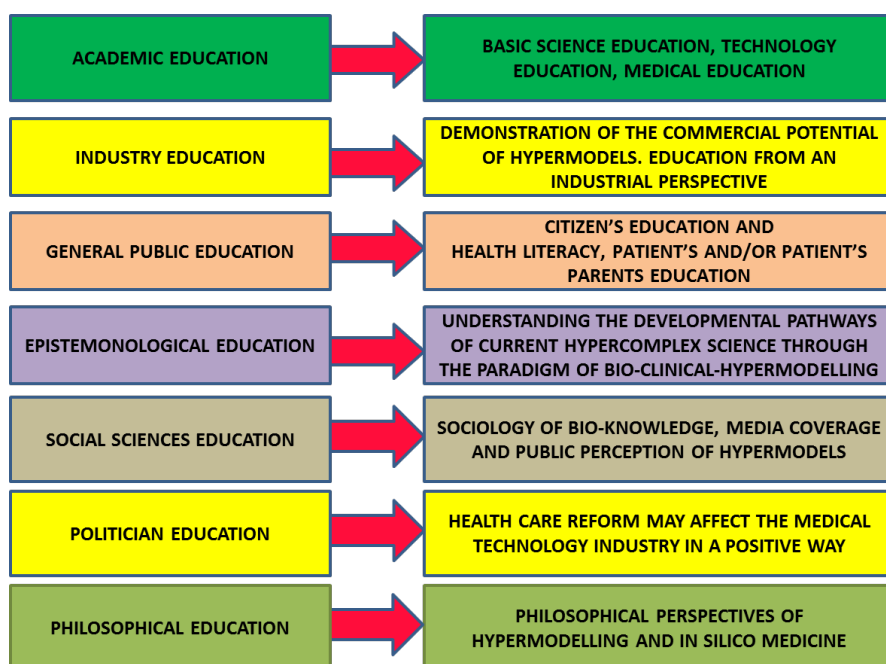
The CHIC technological platform, the software components such the model and in silico trials repositories as well as the strategies for the semantic annotation of multiscale (hyper)models or the hypermodelling frameworks will be extensively reused in the context of in silico oncology related activities and beyond.

Associated to the research outputs, there is also the exploitation by the means of scientific publications.

In order to further disseminate and perpetuate the cutting edge new knowledge created during the development, the clinical adaptation and the partial clinical validation of the CHIC hypermodels and the CHIC integrated platform, a number of joint research papers will be produced after the final review of the CHIC project. A relevant legal document has already been drafted by LUH and it is under revision before it is signed by the CHIC consortium. Obviously additional work especially regarding validation will take place in that period.

4.2.3 Educational/training exploitation

The CHIC platform could also be used as an educational tool in the context of academic education (basic science, technology and medical education), general public education (patient’s and/or parents’ education, citizen’s education and health literacy), industry education (education from an industrial perspective), politician education, epistemological, philosophical and social sciences education. The following diagram provides a comprehensive overview of all major educational and training aspects in a compact form.



Specific exploitation of the CHIC platform for academic teaching purposes will take place within the framework of the globally first postgraduate course on In Silico Medicine (<http://www.vph-institute.org/news/new-postgraduate-subject-on-multiscale-cancer-modelling-and-in-silico-medicine-mscm-ism.html>), which is being taught by the CHIC coordinator, Prof. G. Stamatakis in the affiliated School of Electrical and Computer Engineering, National Technical University of Athens.

Other research and academic bodies of the consortium will exploit the CHIC platform in a similar way.

As an example, TEI-C has introduced a subject called “Bioinformatics and Modeling of Biological Systems” into the curriculum of its undergraduate course on Informatics Engineering based, to a large extent, on the experiences and material developed in the context of the CHIC project.

The educational and the training exploitation of the multifaceted outcomes of the CHIC project can also serve as a paradigm for other branches of *in silico* oncology (e.g. concerning other tumor types) or *in silico* medicine at large (e.g. concerning other diseases).

4.2.4 Clinical and commercial exploitation

Cancer is one of the major causes of morbidity and mortality in the world, with about 14 million new cases in 2012 and the number of new cases expected to rise by about 70% over the next 20 years¹. Considering this, the related economic impact is increasing.

Cancer treatment requires careful consideration of evidence-based options, which can include more than one of the major therapeutic modalities. The planning of the treatment should be based on evidence of the best existing treatment given the resources available. Shared decision-making that takes into account patient factors including patient-specific data and a multidisciplinary approach is best.

Through an efficient prospective validation path driven by the CHIC clinical partners, the CHIC models can be a strong enabler for future Clinical Decision Support (CDS) systems that will help disseminate the knowledge created with clinical groups that are vanguards in oncology for the benefit of all cancer patients. The implementation of knowledge-rich CDS is an especially important prerequisite for reducing the knowledge gap between clinical research and practice in a complex genetic disease such as cancer. Providing meaningful CDS is a strong need in healthcare, and can create strong business opportunities following the successful validation of the models.

A CDS system is “a computer-based information system that supports business or organizational decision-making activities, typically resulting in ranking, sorting, or choosing from among alternatives”². Then, in particular a CDS system is a software application that integrates patient data with a knowledge-base and an inference mechanism to produce patient specific output in the form of care recommendations, assessments, alerts and reminders to actively support practitioners in clinical decision-making.

While urgently needed and must-have components for all Clinical Information Systems of the future, current CDS solutions are unable to support all the complex decisions required for personalized management of cancer patients (including those concerning risk stratification and prevention, diagnosis and treatment). These systems become quickly obsolete and unmaintainable due to the high rate of change in therapeutic options and knowledge, and are hampered in their adoption by the inability to meaningfully leverage for their recommendations all the wealth of data and information collected for each patient, and all the knowledge available in the clinical community. Adoption is also limited by difficulties to seamlessly integrate these CDS systems in the healthcare environments in a manner that does not disrupt the established ways of working.

¹ <http://www.who.int/mediacentre/factsheets/fs297/en/>

² https://en.wikipedia.org/wiki/Decision_support_system

CHIC has the unique opportunity to address all the above needs for meaningful CDS implementation and bring solutions that are significantly better than current offerings, which creates a strong reason-to-believe for success in the market. Firstly, CHIC brought together a multidisciplinary community that includes clinicians, academic scientists and industrial researchers with all the needed capabilities to streamline the development of models, their clinical validation, and their implementation as CDS in clinical information systems for commercial exploitation. Secondly, the CHIC modelers have developed a diverse range of relevant models in the diseases of focus and are well connected in the wider modeling community, which will give us access to a rich set of up-to-date models and the ability to set up processes for the continuous adaptation and improvement of these models. Therefore, we can address both the high rate of change of knowledge in the field and the need for CDS that can support complex decisions along the entire treatment path. Finally, by working closely with the clinical experts of CHIC to integrate the models into new prospective clinical trials we can ensure that our CDS solution will seamlessly integrate in the defined clinical processes which will lead to easy adoption in the hospital.

It is therefore clear that the CHIC platform (from its user interface, hypo/hyper-models, software tool chain) can drive CDS in tumor treatment planning. Such a system, as soon as it is proven clinically effective, can be brought to market through a startup built by the partners who created the innovation or together with healthcare system providers like Philips. Philips, member of the CHIC consortium, has expressed its interest in taking over such exploitation and the long-term sustainability of the CHIC platform.

This long-term exploitation can take place only once the clinical relevance of the CHIC paradigm has been completely proven. The complete clinical validation can be achieved with a sequence of intermediate steps that have been identified and analysed by the partners. Here the overall scenario is presented for the nephroblastoma hypermodel treatment planning validation but more studies will be planned in the future also related to the other tumours types.

1. Retrospective validation of the hypomodels and hypermodels

Status: this validation is expected to be completed 1.5 years after the end of the project. It will take place during the process for the preparation of joint publications mentioned above. Deliverables D6.4 and D11.4 outline the current status of the partial clinical validation.

Data protection: to be able to complete the retrospective validation the data collected during the CHIC project should be maintained accessible to the relevant partners. To this purpose, LUH is preparing a data retention and security agreement for parties to enter into so as to permit continuing storage of the clinical data repository and access to data by relevant partners, subject to continuing data protection and security safeguards as required under EU data protection law.

2. Prospective clinical validation will be the CHIC workflow validation in clinical setting (in parallel to standard clinical practice) and will last for at least 2 years. It will be carried out after the end of the project and self-funded by the partners.

- *Prospective clinical validation for nephroblastoma:* In 2017, a new clinical trial for nephroblastoma (called UMBRELLA) will start to recruit patients with Wilms tumours (nephroblastoma). All patients between 6 months and 16 years of age with a unilateral localized nephroblastoma will start preoperative chemotherapy with vincristine and actinomycin for 4 weeks. In all of these patients imaging studies are performed at the time of diagnosis and after preoperative chemotherapy. In addition, in patients from Germany miRNAs are analysed from blood at the time of diagnosis. Clinical data are available from all patients. An automatic tool for tumour segmentation of DICOM images will be validated during this phase. All these data will (need to) be stored in the data repository of CHIC according to the legal framework of CHIC. CRAF will be used to simulate response of

preoperative chemotherapy in all patients with a complete dataset. The calculated tumour volume of the nephroblastoma hypermodel after preoperative chemotherapy will be validated with the real tumour volume achieved by preoperative chemotherapy in the corresponding patient. This comparison will be used to optimize the hypermodel over time. As soon as the hypermodel predicts the correct tumour shrinkage after preoperative chemotherapy a new trial will be elaborated that will use the hypermodel for nephroblastoma to start with preoperative chemotherapy in those patients, where the hypermodel predicts a tumour shrinkage of at least 10%, or to go to primary surgery, if no shrinkage of tumour volume is predicted. The usage of the hypermodel will be randomized, so that half of the patients will be treated according to the prediction of the hypermodel and the other half of patients according to the standard with preoperative chemotherapy. This will allow evaluating the usefulness of the nephroblastoma hypermodel in a clinical trial. To continue according to the above described plan the following tools need to sustain: CHIC data repository and data upload tool, CHIC legal framework, nephroblastoma hypermodel and the corresponding hypomodels. In addition to fine-tune the hypermodel further development of the hypomodels and the hypermodel is needed. During the first validation phase within the upcoming UMBRELLA study logistics need to be built in a way that the result of the hypermodel can be achieved within 1 to 2 days, so that treatment in a specific patient can start immediately according to the prediction of the hypermodel in case of the mentioned randomized trial.

- *Sustainability*: partners are committed to keep all the CHIC technology and models up and running, but to address risks that this might not happen for any reason, the models/codes will be completely curated and made available in the Model Repository for use also with another available technology (ICCS is committed to pursue this). In particular, FORTH committed to keep the cloud environment with all tools installed up and running and CUSTODIX to provide the technical support on security issues by the end of 2018.
 - *Data protection*: the prospective validation will require the management and upload of new data on the CHIC platform. The legal data protection framework for this further data processing to occur, including patient informed consent and a set of data sharing agreements for the involved parties to enter, has been developed by LUH and was presented in deliverable D4.3.2.
3. Randomised clinical trials: to be carried out after the end of the project and after clinical validation of the hypermodels(s), this will last for at least 5 years.
- *Nephroblastoma clinical trial plan*: After clinical validation of the nephroblastoma hypermodel a randomized trial will be developed in which the hypermodel will be used for decision support. Patients will be randomized after being diagnosed of having a localized unilateral nephroblastoma to receive standard pre-operative chemotherapy for 4 weeks or an experimental arm based on the prediction of the hypermodel: If the hypermodel shows tumor shrinkage then the patient will receive pre-operative chemotherapy for 4 weeks and if the hypermodel predicts no tumor shrinkage the patient will undergo primary surgery. In all patients receiving preoperative chemotherapy the hypermodel can be validated, to see how good the prediction of the hypermodel is. This can be done in the standard arm but also in the experimental arm for those patients receiving pre-operative chemotherapy. Endpoint of the randomization is to show that unnecessary pre-operative chemotherapy can be avoided. As patients are randomized the number of patients being primarily operated in the experimental arm should equal with the number of patients in the standard arm that do not respond to pre-operative chemotherapy. If this is the case it is demonstrated that the hypermodel is able to avoid the usage of pre-operative chemotherapy correctly. In addition, such a randomized trial

can be used as a proof of principle for hypermodels in the clinical care of patients. It may be part of the certification process for hypermodels.

- *Sustainability:* Funding opportunities should be available in the same way as for phase III randomized trials in drug development. In Investigator initiated trials, so called IITs trial proposals are send to funding agencies. For Paediatric Oncology in Germany these are the German Cancer Aid (Deutsche Krebshilfe) and the German Childhood Cancer foundation (Deutsche Kinderkrebsstiftung). In case of new drug development pharmaceutical companies will fund these trials. If a Medical device is developed and need to be certified Industry should be the funding agency, if they want to bring the device to the market. This means that in such a situation an early contact with possible Industries is essential.

As it can be seen from the above descriptions, the complete CHIC will last at least for 7 years. This makes impossible to design a complete business exploitation now as the market conditions can dramatically change in such a long-time frame. Moreover, the validation phase will also show and demonstrate which of the components of the CHIC platform will be needed in the final product to be exploited by Philips. Thus, Philips and the other CHIC partners agreed to enter into a one-to-one negotiation on the terms of the IPR management for those components that will be needed for the tool commercialisation after the validation.

Regulations: as analysed by LUH in deliverable D4.4, further rules on medical devices certification (in relation to stand-alone-software decision support) also stand to apply during the latter phases of validation process. As noted there, the regulatory position is complex, due to the innovative nature of the CHIC models, and also in view of the pending replacement of the applicable Directive 93/42/EC by a new Medical Devices Regulation. Accordingly, it is proposed that the validating partners shall liaise with their competent national medical device authorities at the appropriate time so as to elicit their opinions regarding the detailed procedures to be followed.

5 Individual exploitation plans

USAAR-KU Leuven exploitation plans

The own foreground of USAAR and KU Leuven will be exploited using the same channels as for the clinical exploitation of CHIC described under section 4.

ICCS exploitation plans

ICCS, National Technical University of Athens, as a representative research and academic body of the consortium, will exploit the CHIC platform as follows.

- i. Basic and Applied Research: ICCS will utilize the CHIC platform in order to further expand the Oncosimulator through hypermodelling and utilize it as a major tool for the advancement of in silico oncology. This will also strengthen the mathematical, computational and software engineering potential and expertise of ICCS in the domain of oncology related in silico trials.
- ii. Clinical Collaboration: Through the utilization of the CHIC platform, ICCS will deepen and expand its successful collaboration with clinical centres of world acclaim committed to the advancement of in silico oncology and in silico medicine at large. This will ensure both the clinical drive and the clinical relevance of the research work to be undertaken in the future by ICCS. Two major applications of the CHIC infrastructure are envisaged: (a) the development of Clinical Decision Support systems (CDS) and (b) the development of In Silico Trials Platforms.
- iii. Industrial exploitation: The process of further clinical validation and expansion of the CHIC platform in collaboration with Philips and clinical partners will enhance and advance the already extensive collaboration of ICCS with industry. This is expected to lead to the development of jointly exploitable commercial products in the future.
- iv. Opportunities for exploitation of previous work: Reuse, extension and adaptation of the developed cancer (hyper)models embedded in the CHIC platform in order to address other tumour types will offer important opportunities for the sustainability and the exploitation of several previous projects funded by the European Commission.
- v. Technological Infrastructure: The technological components such the model and in silico trials repositories as well as the strategies for the semantic annotation of multiscale (hyper)models developed by ICCS will be extensively reused in the context of in silico oncology related activities and therefore, they will enhance and expand the technological infrastructure of ICCS.
- vi. Academic Teaching: Exploitation of the CHIC platform for academic teaching purposes will take place within the framework of the globally first postgraduate course on In Silico Medicine (<http://www.vph-institute.org/news/new-postgraduate-subject-on-multiscale-cancer-modelling-and-in-silico-medicine-mscm-ism.html>) which is being taught by the CHIC coordinator, Prof. G. Stamatakis in the affiliated School of Electrical and Computer Engineering, National Technical University of Athens.

USFD-CINECA-FORTH exploitation plans

VPH-HF is a collaborative product developed starting from a previous result achieved during the VPH-OP EC project. The aim is to exploit the final release of VPH-HF developed in CHIC as a customisable platform for the execution of multiscale models to simulate physical phenomena and healthcare systems in different scenarios. The aim is to exploit the final release of VPH-HF developed in CHIC as a customisable platform for the execution of multiscale models to simulate physical phenomena and healthcare systems in different scenarios.

From an IPR point of view, VPH-HF was massively re-written during the CHIC project by partners CINECA and USFD, which now jointly own the intellectual property of this software. Also, it was decided to include into the software distribution the hypermodelling editor developed by FORTH, based on their work on past EU projects (ACGT, TUMOR), which is now called VPH-HE.

After a preliminary market analysis, it became clear that any exploitation opportunity for VPH-HF and VPH-HE revolves around targeted deployments to solve specific problems, where the customisation effort would be predominant. Thus, following an approach adopted by various other similar initiatives, partners USFD, CINECA and FORTH agreed to license both VPH-HF and VPH-HE under an open source license (Apache License, Version 2.0). The source code will be publicly released in conjunction with the publication of a related paper where VPH-HF is described in detail, at this link: <https://github.com/INSIGNEO/VPH-HF>

Partner USFD is currently exploring to establish a spin-off, tentatively called Insigneo Ltd, which will commercialise modelling and simulation on-line services developed by the Insigneo institute, and offer consulting services also based on the VPH-HF open source code.

FORTH exploitation plans

FORTH is planning to also individually exploit some of the developed CHIC technologies first by sustaining them after the end of the project for as long as is possible with own sources. At the same time it will continue the development of the tools by seeking opportunities for new collaborations with organizations for which the tool could be useful or within the context of future projects.

FORTH will also contact Medical University Schools in Greece for evaluating and using the DrEye tool in a scenario where a professor could ask the students to annotate DICOM images and perform a number of post-processing tasks using powerful CHIC technologies. In parallel, FORTH will attempt to further evaluate and promote the tools also in Greek hospital networks by licensing them for clinical sites. To this end, FORTH and in particular the computational medicine laboratory is coupled with the Center for eHealth Applications and Services (CEHA) which develops and deploys professional IT software for the healthcare sector providing integrated and qualitative tools and solutions. CEHA has expressed its initial interest to assess the possibility of commercialization of some of these products.

Moreover, FORTH will seek opportunities to re-use and/or expand its CHIC tools to current or future research projects.

UCL exploitation plans

The RICORDO suite, which UCL developed to handle CHIC's metadata and knowledgebase, are widely applicable outside of CHIC, and UCL is optimistic about sharing these benefits with other research projects as well.

TEI-C exploitation plans

TEI - C is mainly involved in WP5 which focuses on the definition of the architecture for subsequent implementation and integration. The architecture specification will provide the software architecture design patterns to effectively guide and support the construction of a coherent and consistent system. Particular emphasis will be given to the definition of appropriate interfaces among the modules to enable interoperability. As a result, the foreground knowledge that will be generated by TEI-C - through its participation in these highly demanding activities - will be used in updating the relevant courses that Prof. Tsiknakis teaches at TEI-C, which include a) modeling and simulation of biomedical systems, and b) Advanced topics in eHealth and mHealth systems and services

CUSTODIX exploitation plans

Custodix' core business is securing sensitive data. Since its founding, Custodix has always focused on the life sciences sector where the need for data protection is clear. For this the company provides a variety of services and products, such as Trusted Third Party data collection services, de-identification tools, data privacy consultancy, etc.

Within the CHIC project, Custodix is responsible for providing the tools to ensure data protection compliance (such as the security infrastructure and the CHIC de-identification services). Two aspects of the CHIC work are important for exploitation by Custodix. First of all, within the project, research is

continued on the de-identification tools: CATS and PIMS, which contributes to their continuous improvement.

Secondly, the CHIC project is one of the projects in which Custodix has been able to further research its ideas on improving the integration of security in service oriented IT environments (with high requirement with respect to data protection). The goal of this work is to design a unified solution to identity provision, access management and audit, which allows building highly secure IT systems without compromising on development complexity and end-user usability. Custodix believes such a solution has commercial value.

Although the different components of the framework (identity manager, security proxy, access management components, audit services, etc) are envisaged to be marketable in a wide range of domains, the initial focus for exploitation will be the health and clinical domain (where the majority of the Custodix commercial activity resides). The high level of security that the framework aims to bring through its exceptional features (e.g. credential delegation) is expected to be a differentiator in this domain (cf. sensitive medical data).

The rationale behind this approach is the following. It has been understood for already quite some time that collaboration and sharing of clinical data is becoming key to the further advancement of medicine. Trying to find the perfect solution to enable this sharing has therefor been a prominent topic in life sciences IT. Originally the general sentiment was that monolith IT systems would encompass the needed functionality. However, the long time to market, the high maintenance cost (even when one needs only one component the complete system needs to be set up and maintained) and the fact that uniform solutions can't fit the wide range of differentiating requirements has caused researchers and clinicians to look to other solutions. In a rather recent wave of pragmatism, different (isolated) tools are built each tackling a specific sub-problem. Many people faced with the challenge to build more complex clinical application environments are thus now turning towards a "pick and choose" strategy for composing their toolset.

The task that does remain is proper integration of these tools. Next to the obvious functional integration aspect (e.g. exchange of data between tools), the importance of security should not be underestimated. The possible impact on usability and manageability is huge. Imagine daily usage of several tools for which one needs to remember different usernames and passwords (or even use different tokens), imagine that sharing rights needs to be reconfigured in every separate tool (and kept in sync), etc. In practice, security encompasses a substantial part of the system integration work in environments in which data protection is important. A framework that offers the required security functionality at low implementation complexity and integrates (out of the box) with commonly used tools will clearly have a competitive advantage.

In this context, the participation in CHIC not only serves in defining technical specifications and developing the technological components for the security framework, but also to validate if the framework accommodates for all needs of researchers, clinicians, system integrators and compliance officers.

Custodix' exploitation strategy with respect to this security framework already resulted in the spinning-off a commercial version of the Identity Management Service (IdM) (with a reduced feature-set compared to the research work done in the project). This IdM is promoted as an integration tool in the clinical domain in order to find out whether a strategy towards system integration specifically in this domain will pay off. The subsequent result will determine the prioritization of the further development of the security tools or a possible repositioning of the framework.

It goes without saying that with respect to system integration Custodix is complementary to the other CHIC partners, and thus open to any form of commercial cooperation.

UBERN exploitation plans

Developments resulting in the Clinical Data Repository will be exploited by UBERN. The development and maintenance of the database system will be supported in the future by a non-profit foundation. The foundation named Si-CAS is based in Delémont (Switzerland) and aims at becoming a support platform providing know-how and services in biomedical engineering. One of the core competences is linked to medical image analysis and modelling, including statistical shape modelling. In this context, the technical developments will be exploited along different directions. The first exploitation line will be to provide a collaboration tool for clinical trials performed at different locations. The benefit for clinician involved in collaborative research projects is that they have better control on what they share and with whom. Additionally, the dataset does not leave the hospital/data provider before being reviewed and anonymized. Another exploitation option is the development of centralized repository for medical images. Statistical shape analysis techniques are very popular in the medical imaging community and results can be transferred to companies active in implant design or imaging. A large data collection of medical images would be a major issue of the techniques, which is the very large number of dataset required to build a valid model. This constraint is even more critical when pathological situations are concerned. In the same direction, the platform developed with CHIC is used to propose open challenges such as image segmentation competition. On one hand open challenge stimulates research by providing a common set of data to compare new developments with existing benchmarks. In addition, proposing challenges is a great way to attract researcher, process available data and promote the system.

The software BraTumIA has been released to the scientific community and since last May over 450 download requests have been processed. The software has been clinically evaluated at the local hospital in Bern and has been employed as comparison basis for future developments. A professional CE labelling analysis of the software was conducted and measures towards CE labelling has been started. In this regard, the software's core components will be refactored to enable reutilization of the technologies to other diseases of the central nervous system.

UNITO exploitation plans

The hypomodels related to the Prostate Cancer recurrence risk assessment (risk stratification and timing) have been implemented in the platform MYHealthAvatar in cooperation with BED.

Other applications to Third Mission projects using the above hypomodels as predictive tools for prevention and monitoring for elderly patients are under investigation.

UPENN exploitation plans

UPENN plans to utilize molecular components developed by CHIC including by UPENN itself for non-profit research in the space of cancer biology and oncology by adhering to legal and ethical guidelines and rules.

6 Conclusions

This document reports first of all on the activities performed to increase awareness towards the project stakeholders on the CHIC results and positive impacts these might have in the future. Dissemination has been very active also in the last year of the project, which resulted in a high number of dissemination events recorded. On in this last year, the consortium can report:

- 72 publications on peer-reviewed journals and conference proceedings,
- 64 participations of conferences, workshops, events,
- 21 other media disseminations.

These dissemination items clearly show the commitment of the whole consortium in outreaching potential future users of the CHIC platform and stakeholders with the project outputs.

The second aim of this deliverable is to report on the exploitation and sustainability plans for the CHIC platform and its component. The CHIC partners have finalised the list of the exploitable outputs, which have been described together with the type of foreground, the target users, the expected time to market, and the evolution of the respective TRLs from the beginning to the end of the project.

For each output, the responsible partners have identified what will be needed after the end of the project to sustain each component in terms of hardware and software but also effort to support the maintenance of the codes and models. Any dependency to external libraries has also been identified. This helped in identify the sustainability needs also for the CHIC platform as whole.

The CHIC consortium has also defined an approach for long-term exploitation for the CHIC platform as a whole. The exploitation has been divided into research, educational and clinical ones. Research and educational exploitation will continue immediately after the end of the project sustained by the project consortium itself. On the other side, the clinical exploitation cannot be completely achieved until the clinical relevance is demonstrated via an extensive clinical prospective validation. This type of validation was outside the aim of the CHIC project, and the consortium has defined how this will be achieved and sustained after the end of the project. As soon as the clinical relevance of the CHIC paradigm will be confirmed, the natural clinical exploitation will be as a clinical decision support system to be commercialised by medical technology companies (like Philips).

Individual partners have also updated their own exploitation plans for the components for which they are responsible for.

Appendix 1 – Abbreviations and acronyms

<i>WP</i>	Work Package
<i>MoU</i>	Memorandum of Understanding
<i>MRI</i>	Magnetic Resonance Imaging
<i>IPR</i>	Intellectual Property Rights
<i>EC</i>	European Commission
<i>GA</i>	Grant Agreement
<i>CA</i>	Consortium Agreement
<i>CDS</i>	Clinical Decision Support
<i>GBM</i>	GlioBlastoma Multiforme
<i>GNU</i>	GNU's not UNIX
<i>GPL</i>	General Public License
<i>LGPL</i>	Lesser General Public License
<i>BSD</i>	Berkeley Software Distribution
<i>STaRC</i>	Study Trial and Research Centre

7 ANNEX I

CHIC PROJECT INNOVATION RADAR QUESTIONNAIRE FILED IN BY THE CHIC CONSORTIUM

DG CONNECT

Innovation Radar questionnaire

Questions and answer fields

(March 2017)

Provided for info only

Project start date - end date

[1 April 2013 – 31 March 2017](#)

Project Officer *

TO BE FILLED IN BY THE EC SERVICES

Is it the first, interim or final review of the project?*

First

Interim

[Final](#)

Review date*

[23-24 May 2017](#)

Name of the designated innovation expert in review panel

TO BE FILLED IN BY THE EC SERVICES

For each innovation that the project will develop / has developed please answer the questions below:

[Cancer multiscale hypermodelling: clinical relevance, integrative strategies, multimodeller algorithms, simulation software, IT technologies, clinical adaptation, clinical evaluation and partial clinical validation.](#)

Describe the innovation (in less than 500 characters, spaces included)

[Cancer multiscale hypermodelling is an innovative modular approach to the modelling of cancer and its response to treatment. Hypomodels simulating crucial biological mechanisms, possibly developed by different cancer modellers, are integrated into hypermodels. The latter, following clinical validation, predict the response of a given patient to candidate therapeutic schemes. Hypermodels in conjunction with the supportive technologies developed are to serve as a clinical decision support systems and researchers in the testing of new hypomodels.](#)

Is the innovation developed within the project .

a) Under development

[b\) Already developed but not yet being exploited](#)

c) Being exploited

Characterise the type of innovation

Significantly improved product

Significantly improved service (except consulting ones)

Significantly improved process

Significantly improved marketing method

Significantly improved organisational method

Consulting services

[New product](#)

[New service \(except consulting ones\)](#)

[New process](#)

New marketing method

New organisational method

Other

Is the innovation to be introduced to the market or to be deployed within a partner

[Introduced new to the market \(commercial exploitation\)](#)

(→A number of exploitation scenarios have been formulated)

Deployed within a partner (internal exploitation: Changes in organisation, new internal processes implemented, etc.)

No exploitation planned

Is there a clear owner of the innovation in the consortium or multiple owners?

A clear owner

[Multiple owners and IP issues need to be solved \(under negotiation\)](#)

Indicate the step(s) already done (or are foreseen) in the project in order to bring the innovation to (or closer to) the market

Technology transfer

Done or ongoing

[Planned in project](#)

Not planned in project but needed/desirable

Not planned in project and not needed

Engagement of both research team and partner's business units in project activities

[Done or ongoing](#)

Planned in project

Not planned in project but needed/desirable

Not planned in project and not needed

Market study

Done or ongoing

Planned in project

[Not planned in project but needed/desirable](#)

Not planned in project and not needed

Prototyping in laboratory environment

[Done or ongoing](#)

Planned in project

Not planned in project but needed/desirable

Not planned in project and not needed

Prototyping in real world environment

Done or ongoing

[Planned in project](#)

Not planned in project but needed/desirable

Not planned in project and not needed

Pilot, Demonstration or Testing activities

[Done or ongoing](#)

Planned in project

Not planned in project but needed/desirable

Not planned in project and not needed

Feasibility study

[Done or ongoing](#)

Planned in project

Not planned in project but needed/desirable

Not planned in project and not needed

Launch a start-up or spin-off

Done or ongoing

Planned in project

[Not planned in project but needed/desirable](#)

Not planned in project and not needed

Standardisation

[Done or ongoing](#)

Planned in project

Not planned in project but needed/desirable

Not planned in project and not needed

Application for private or public investment

Done or ongoing

Planned in project

[Not planned in project but needed/desirable](#)

Not planned in project and not needed

Securing private investment

Done or ongoing

Planned in project

[Not planned in project but needed/desirable](#)

Not planned in project and not needed

Securing public investment

Done or ongoing

Planned in project

[Not planned in project but needed/desirable](#)

Not planned in project and not needed

Business Plan

Done or ongoing

Planned in project

[Not planned in project but needed/desirable](#)

Not planned in project and not needed

Indicate which participant(s) (up to a maximum of 3) is/are the key organisation(s) in the project delivering this innovation. For each of these identify under the next question their needs to fulfil their market potential.

Organisation 1 [ICCS](#)

Organisation 2 [USAAR](#)

Organisation 3 [FORTH](#)

Indicate their needs to fulfil their market potential

Organisation1 (ICCS)

[Investor readiness training](#)

[Investor introductions](#)

[Biz plan development](#)

[Expanding to more markets](#)

[Legal advice \(IPR or other\)](#)

[Mentoring](#)

[Partnership with other company \(technology or other\)](#)

[Incubation](#)

[Startup accelerator](#)

Organisation2 (USAAR)

[Investor readiness training](#)

[Investor introductions](#)

[Biz plan development](#)

[Expanding to more markets](#)

[Legal advice \(IPR or other\)](#)

[Mentoring](#)

[Partnership with other company \(technology or other\)](#)

[Incubation](#)

[Startup accelerator](#)

Organisation3 (FORTH)

[Investor readiness training](#)

[Investor introductions](#)

[Biz plan development](#)

[Expanding to more markets](#)

[Legal advice \(IPR or other\)](#)

[Mentoring](#)

[Partnership with other company \(technology or other\)](#)

[Incubation](#)

[Startup accelerator](#)

Market size: What is the approximate market size for this innovation

< €25M

€25M - €100M

€100M - €250M

€250M - €500M

> €500M

[Not known](#)

€ amounts are for global markets and per year

Market maturity: The market for this innovation is ...

Not yet existing: customers are not buying such products (or are not yet ready to buy such products/services)

[Emerging: There is a growing demand and few offerings are available](#)

Mature: The market is already supplied with many products of the type proposed

Market dynamics: is the market ...

In decline

Holding steady

[Growing](#)

Level of innovation: What is the level of innovation?

No innovation - other factors contribute to viability

Some distinct, probably minor, improvements over existing products

Innovative but could be difficult to convert customers

Obviously innovative and easily appreciated advantages to customer

[Very innovative satisfies a well-known market need](#)

Market competition: How strong is competition in the target market?

[Patchy, no major players](#)

Established competition but none with a proposition like the one under investigation

Several major players with strong competencies, infrastructure and offerings

When do you expect that such innovation could be commercialised?

Less than 1 year

Between 1 and 3 years

Between 3 and 5 years

[More than 5 years](#)

How does the consortium engage end-users?

[End user organisation in the consortium and is actively engaged in co-creating the innovation\(s\)](#)

End user organisation in the consortium and is NOT actively engaged in co-creating the innovation(s)

An end user organisation outside of the consortium is consulted and is actively engaged in co-creating the innovation(s)

An end user organisation outside of the consortium is consulted and is NOT actively engaged in co-creating the innovation(s)

No end user organisation in the consortium or consulted

Are there in the consortium internal IPR issues that could compromise the ability of a project partner to exploit new products/solutions/services, internally or in the market place ?

Yes

[No](#)

Which are the external bottlenecks that compromise the ability of project partners to exploit new products, solutions or services, internally or in the market place?

IPR

[Regulation](#)

Workforce's skills

Others

Standards

[Financing](#)

Trade issues (between MS, globally)

Indicate how many patents have been applied for by the project.*

[None](#)

How do you consider the project's performance in terms of innovation?

[Exceeding expectations](#)

Meeting expectations

Performing below expectations

General observations of the innovation expert on this project's innovation performance.

How would you rate the level of commitment of relevant partners to exploit the innovation?*

Very low

Low

Average

High

[Very High](#)

None

Please indicate the 1 partner (excluding large enterprises) that the panel considers to be the most impressive in terms of innovation potential

[ICCS](#)

Please provide concrete recommendations for the project to improve its innovations and their potential to deliver impact in - or close to - the market place. Recommendations that imply changes to the project's design and / or work plan must also be detailed in the project review report (Text of 1 to 500 characters will be accepted)

[Clinical validation through specially designed prospective clinical trials to take place after the completion of the project. Implementation of the necessary adaptations to be eventually dictated by the prospective clinical validation process.](#)

Please enter some tag words (comma separated) to represent what "innovation elements" are strong in the project

[basic science \(multiscale cancer hypermodelling, in silico oncology\), clinically relevant hypermodelling technologies, clinical decision support systems](#)