Model Driven Paediatric European Digital Repository

Call identifier: FP7-ICT-2011-9 - Grant agreement No.: 600932

Thematic Priority: ICT - ICT-2011.5.2: Virtual Physiological Human

Deliverable 19.2

Outcomes of the strategic exploitation seminar

Due date of delivery: 30th August 2014

Actual submission date: 30th October 2014

Start of the project: 1st March 2013

Ending Date: 28th February 2017

Partner responsible for this deliverable: Lynkeus

Version: 1.3
Outcomes of the strategic exploitation seminar

Dissemination Level: Public

Document Classification

<table>
<thead>
<tr>
<th>Title</th>
<th>Outcomes of the strategic exploitation seminar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deliverable</td>
<td>D 19.2</td>
</tr>
<tr>
<td>Reporting Period</td>
<td></td>
</tr>
<tr>
<td>Authors</td>
<td>Callum MacGregor</td>
</tr>
<tr>
<td>Work Package</td>
<td>WP 19</td>
</tr>
<tr>
<td>Security</td>
<td>RE</td>
</tr>
<tr>
<td>Nature</td>
<td>Report</td>
</tr>
<tr>
<td>Keyword(s)</td>
<td>Exploitation</td>
</tr>
</tbody>
</table>

Document History

<table>
<thead>
<tr>
<th>Name</th>
<th>Remark</th>
<th>Version</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD-Paedigree Exploitation Discussion Paper</td>
<td></td>
<td>1.1</td>
<td>22nd September 2014</td>
</tr>
<tr>
<td>Report on the Outcomes of the strategic exploitation seminar</td>
<td>Draft sent out for revision</td>
<td>1.2</td>
<td>15th October 2014</td>
</tr>
<tr>
<td>D19.2 Outcomes of the strategic exploitation seminar</td>
<td>Final version</td>
<td>1.3</td>
<td>30th October 2014</td>
</tr>
</tbody>
</table>

List of Contributors

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callum MacGregor</td>
<td>LYN</td>
</tr>
<tr>
<td>Karl Stroetmann</td>
<td>EMPIRICA</td>
</tr>
<tr>
<td>Edwin Morley-Fletcher</td>
<td>LYN</td>
</tr>
</tbody>
</table>

List of reviewers

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giacomo Pongiglione</td>
<td>OPBG</td>
</tr>
<tr>
<td>Olivier Ecabert</td>
<td>SAG</td>
</tr>
<tr>
<td>David Manset</td>
<td>GNU</td>
</tr>
<tr>
<td>Patrick Ruch</td>
<td>HES-SO</td>
</tr>
<tr>
<td>Andrew Taylor</td>
<td>GOSH</td>
</tr>
<tr>
<td>Jaap Harlaar</td>
<td>VRUMC</td>
</tr>
<tr>
<td>Yannis Iannidis</td>
<td>ATHENA</td>
</tr>
</tbody>
</table>

Abbreviations

<table>
<thead>
<tr>
<th>MDPSO</th>
<th>MD-Paedigree Spin-Off</th>
</tr>
</thead>
</table>
Table of Contents

Table Of Contents .................................................................................................................. 3

1 Introduction ......................................................................................................................... 5

2 Seminar Structure ............................................................................................................. 5
  2.1 Presentations ................................................................................................................... 5
  2.1.1 Introduction to the Seminar ..................................................................................... 5
  2.1.2 Presentation of the latest implementation of the MD-Paedigree Infostructure .......... 6
  2.1.3 First outline of an MD-Paedigree's business plan to exploit common foreground - Maturity of the target market and business potential for an MD-Paedigree spin-off .............................................. 7
  2.1.4 Challenges in developing an MD Paedigree Exploitation StrategyAn ....................... 8
  2.1.5 Open Discussion within the Consortium ................................................................. 11

3 Conclusions ....................................................................................................................... 12
  3.1 Next steps ....................................................................................................................... 12

Appendix 1 - MD-Paedigree Exploitation Discussion Paper ................................................. 13

1 Introduction ......................................................................................................................... 14

2 Business Description ........................................................................................................ 15
  2.1 Preliminary remarks on knowledge economics ............................................................. 15
  2.2 The Healthcare Industry .............................................................................................. 16
  2.3 MD-Paedigree .............................................................................................................. 17
  2.4 Motivations for forming a Spin-off Company ............................................................... 18
  2.5 The Proposed Company .............................................................................................. 19
  2.6 Services ......................................................................................................................... 21
  2.7 Additional services ....................................................................................................... 21
  2.8 A Three-layered operational scheme ......................................................................... 22

3 Market Strategies ............................................................................................................. 22

4 Competitive Analysis ....................................................................................................... 23
  4.1 Comparative outline and complementarities: Md-Paedigree vs. Watson ...................... 24

5 Strategy ........................................................................................................................... 25
  5.1 Funding Innovation and Product Development .......................................................... 25
  5.6 Innovating through EC funded projects ...................................................................... 26
  5.7 EU or national funding for business development and technology exploitation ............. 26
  5.7.1 The Horizon 2020 dedicated SME instrument ......................................................... 27
5.8 Venture capital or investment funds .............................................................................. 28
5.9 Public Private Partnership initiatives ........................................................................... 28
5.10 Productise clinical centre node installation .................................................................... 28
5.11 Market Exploration ......................................................................................................... 29
5.12 Growing the network of clinical centres .......................................................................... 30
5.13 Grow the network of technical associates & make strategic alliances .......................... 30
5.14 Productising Services and bringing them to market ......................................................... 31
5.15 Establishing and Building MDPSO’s brand ..................................................................... 31
5.16 Federation of Data ............................................................................................................ 31
5.17 Enhanced Privacy ............................................................................................................. 31

6 Transition from pilot, through start-up phase of direct operations to full operations ........... 32
6.1 Possible distribution of shares with progressive increases in capital ............................... 33
6.2 Potential sources of revenue ............................................................................................. 35
6.3 Market analysis and exploitation plan (March 2015) .......................................................... 35
6.3.1 First market analysis steps ........................................................................................... 35
6.3.2 First business plan steps .............................................................................................. 35

7 Risks ................................................................................................................................... 36
7.1.1 Legal Risks ..................................................................................................................... 36
7.1.2 Technical and Clinical Risks ........................................................................................ 36
7.1.3 Commercial Risks ......................................................................................................... 36

8 Links .................................................................................................................................. 37
8.1.1 Data Storage Competitors ........................................................................................... 37
8.1.2 Hospital Data ............................................................................................................... 37

Figure 1: Selected slides from Dr Manset’s presentation ......................................................... 6
Figure 2: Selected slides from Prof. Morley-Fletcher’s presentation ........................................ 7
Figure 3: Selected slides from Prof. Morley-Fletcher’s presentation ........................................ 8
Figure 4: Selected slides from Karl Stroetmann’s presentation ............................................... 10
1 Introduction

The document reports on the Exploitation Seminar organised as part of the MD-Paedigree project.

The aim of the seminar was to identify the most likely scenarios within which to position the project’s expected exploitable outcomes.

This was realised through presenting a preliminary vision on how MD-Paedigree’s outcomes could be exploited, along with the rationale behind it, in order to provide fuel and structure to the discussions.

To this end, a discussion paper was prepared by Lynkeus Srl in advance of the meeting, and this was distributed to all partners at the meeting. An earlier draft of this discussion paper had been circulated to a number of partners for comment prior to the seminar. In this way the topics it covered were refined and their range widened thanks to input from a number of partners.

2 Seminar Structure

The seminar was structured according to the agenda shown below:

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Description</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.00-14.15</td>
<td>Introduction to the Seminar</td>
<td>Bruno Dallapiccola</td>
</tr>
<tr>
<td>14.15-14.45</td>
<td>Presentation of the latest implementation of the MD-Paedigree Infostructure</td>
<td>David Manset</td>
</tr>
<tr>
<td>14.45-15.15</td>
<td>First outline of an MD-Paedigree’s business plan to exploit common foreground - Maturity of the target market and business potential for an MD-Paedigree spin-off</td>
<td>Edwin Morley-Fletcher</td>
</tr>
<tr>
<td>15.15-15.45</td>
<td>Challenges in developing an MD Paedigree Exploitation Strategy</td>
<td>Karl Stroetmann</td>
</tr>
<tr>
<td>15.45-16.30</td>
<td>Open Discussion within the Consortium</td>
<td>Giacomo Pongiglione, Olivier Ecabert</td>
</tr>
<tr>
<td>16.30-17.00</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>17.00-18.30</td>
<td>Continuation of the Open Discussion</td>
<td>ALL</td>
</tr>
<tr>
<td>18.30-18.45</td>
<td>Wrap-up</td>
<td>Edwin Morley-Fletcher</td>
</tr>
</tbody>
</table>

2.1 Presentations

The seminar began with a series of four presentations, the aim of these presentations was to expand upon the topics covered in the discussion paper and provide further fuel for discussion.

2.1.1 Introduction to the Seminar

Giacomo Pongiglione gave an introduction to the Exploitation Seminar on behalf of project coordinator Bruno Dallapiccola, who attended the Seminar, but had to leave immediately after the first two presentations.
Pongiglione welcomed all partners and asked them to participate fully in developing the plan for the future of MD-Paedigree after the FP7 funding has finished. He also stressed the great potential that the exploitation of MD-Paedigree represents, and the long-term commitment of the OPBG in developing a routine, big-data based, digital repository in paediatrics, moving first from its already operational Cardiac Digital Paeditric Repository.

2.1.2 Presentation of the latest implementation of the MD-Paedigree Infostructure

David Manset of Gnumila and head of the Infostructure group gave a presentation on the MD-Paedigree infostructure status and progress.

A selection of Dr Manset’s slides may be seen below:
2.1.3 First outline of an MD-Paedigree’s business plan to exploit common foreground - Maturity of the target market and business potential for an MD-Paedigree spin-off

Edwin Morley-Fletcher of Lynkeus and Project Manager gave a presentation on the possibility of forming an MD-Paedigree spin-off company with which to continue the project. This presentation complemented and expanded on the discussion paper that was circulated before the seminar and that can be found in Appendix 1.

Prof. Morley-Fletcher began with a brief look at the history of MD-Paedigree and then moved on to consider its future. He then continued to give the motivations for forming a spin-off company before giving an outline of how such a company might be formed and operate in the short to medium term. Finally he then looked at a number of different options for funding such a spin-off, including: Public-Private Partnership (PPP); EC Horizon 2020 project funding (for new research only); the Horizon 2020 Dedicated SME instrument; structural funds (e.g. European Investment Bank); and venture capital. Prof. Morley–Fletcher also discussed the vision of creating an ecosystem for data intensive biomedical products that could be created around and on top of the MD-Paedigree infrastructure.

A selection of Prof Morley-Fletcher's slides can be seen below.

Figure 2: Selected slides from Prof. Morley-Fletcher’s presentation
Figure 3: Selected slides from Prof. Morley-Fletcher’s presentation

2.1.4 Challenges in developing an MD Paedigree Exploitation Strategy

An

Prof. Karl Stroetmann of empirica gave a presentation on the perspective for and core concepts of developing a comprehensive exploitation strategy for the final outcomes of this project, including an introduction to business modelling and core building elements to be considered, an analysis of the market segments to look at, an exploration of the value added proposition for exploitation, the products and services to be offered, the concrete production/value change and its positioning in a wider infrastructure value system, considerations concerning marketing and distribution channels, as well as cost structure and financial funding needs arising.

As core requirements at this stage he outlined:

- Develop a vision and identify strategic exploitation issues
- Prioritise core challenges, and identify possible solution options
- Select most appropriate option(s) (in line with project needs and requirements, feasibility, ...) for further examination
- Agree on next steps

He identified these basic ingredients of a business model:

- Value proposition: ‘Why should a customer ‘buy’ our product or service?’ (and not another one)
Outcomes of the strategic exploitation seminar

- The target customer(s)
- Key „products“ and services
- Production/service provision value chain(s) & value system
- Marketing/distribution channel(s)
- Cost structure (representation in money of resources employed for production and marketing)
- Revenue model (How to recover costs)
- Surplus (or profit: decisive factor for longer-term survival, sustainability)

With respect to the "products" and services to be delivered, he suggested to look at:

- Tools (like image processing tools)
- Atomic services, or discrete tools, to create new workflows
- Multiscale in silico models, disease-specific workflows
- Data and knowledge:
  - Interface and easy access to wealth of data from medical research, clinical processes, medical knowledge
  - Secure storage, semantic annotation, identification, integration, sharing, linking
  - Data inference and similarity search
  - Reduction and representation
- Collaborations and training within the community
- Workflows/clinical decision support (CDS) tools for specialised consultants and (tertiary) hospitals, ...
- Clinical decision support service applications for busy physicians
- Access to (or provision of) grid, cloud, HPC resources (plus software tools?)

To assure sustainability of these efforts in the medium term, the following revenue options should be explored in greater detail:

- **Public good** approach (RTD/societal eInfrastructure, provided from public sources, like research funding, or through the health system, ...), based on resources of present partners, others ...
- Continuous funding as global, European (or national ?) infrastructure *project*
- Membership / *shareholding* approach
- Pay-as-you-go, *fees*
- **Mixed model(s)** (like: maintenance and development in the public domain; usage on own HPC, private cloud and similar resources, or public cloud services; access to tools & workflows via Open Source licensing)

Setting up an ERIC – European Research Infrastructure Consortium – is probably beyond the scope of the present consortium as it requires participation of Member State governments or their competent authorities or intergovernmental organisations.

In a long and detailed discussion, various points were raised, like:

- We are not dealing in a free market, we are dealing in a health market that is driven by regulation not market value. Regulation is of great influence on markets.
We need to begin with value proposition. Where is the customer who is prepared to pay for what we offer? How do we define a clinician? They are not a homogenous group.

Small is beautiful. We should start with a small and targeted market. So we don’t have to support multiple types of customer.

E.g. look at genomics. It is getting more and more specialised, as it is so broad a field.

In Europe we have on the one hand large infrastructures for research (e.g. CERN, Biobanks etc) while on the other there are small specialised companies connecting them to customers.

We must also consider the timeline – 10 year view is not unreasonable as shown by some companies.

Edwin Morley-Fletcher has given us a great vision. However we need to work further to make the vision concrete and prioritise where we want to go and what we want to do. This will take time and thinking. We should all go away and think about what concrete value propositions can be made and come back together, having thought about these challenges, in a few months. The core question is what is our value proposition – what concrete solution can we offer clinicians?

We must also look at customer management – how do we find and support customers? In Europe right now there do not seem to be longer term plans for supporting the current large-scale infrastructures beyond to continue project funding approaches. They are supported by public subsidies, but MD-Paedigree can not hope to survive like this.

There are infrastructure concerns – data won’t be allowed to move, but can it be run on a private cloud? And who are our competitors? VPH-SHARE, p-medicine, others? Will we collaborate with them?

Medicine these days is so complicated that there is not just one provider, there are multiple suppliers involved.

Research market vs. commercial market vs. health market – all are different with different drivers.

---

Figure 4: Selected slides from Karl Stroetmann’s presentation
2.1.5 Open Discussion within the Consortium

There was a wide-ranging and lively discussion among the partners with speakers coming from all segments of the consortium. Notable contributors were:

- Olivier Ecabert – Siemens AG
- David Manset - Gnubila
- Giacomo Pongiglione – Ospedale Pedriatico Bambino Gesu
- Xavier Pennac - Inria
- Yannis Ioannidis – Athena Research and Development Institute
- Patrick Ruch – HES-SO
- Andrew Taylor – Great Ormond Street Hospital
- Alex Jones – University College London
- Jaap Harlaar – VU Medical Centre

Topics of discussion:

- Both presentations are important for further discussions and planning of exploitation activities – we need to be careful but also should go ahead with developing a more detailed plan
- Should definitely have the involvement of at least one hospital in the consortium for a new venture
- In case outcomes of MD-Paedigree fall under the medical device directive, we need to note that approval for a medical device is hard to realise if it is associated with medical decision taking (like clinical validation may become mandatory)
- We may not need to be specifying that MD-Paedigree provides Decision Support Tools: we only provide research outcomes which are then responsibly made use of by clinicians, who are the deciders on diagnosis and treatment
- Whether MD-PSO will be able to market something that is not a fully fledged medical device
- Opportunities for EC funding
- Opportunities and hurdles for venture capital funding
  - Particularly investment in unproven technology
  - Angel investors
  - Margins required for obtaining funding
- Whether researchers are entrepreneurs
- Facilitation of selling services on top of infrastructure
- Brand recognition as value for spin-off and therefore for MDPSO partners
- Have specialisation in paediatrics
- Paediatrics is a small market but we could
  - start in a niche and then move on
  - a Trojan horse for the market
3 Conclusions

The seminar provided an engaging and informative forum for discussion of the issues surrounding the exploitation of MD-Paedigree, with input coming from all sectors of the consortium. While some concerns were raised about the complexity of obtaining a market authorization for a decision-support instrument, the general tone of discussion was optimistic. The issues raised are to be further circulated using a modified form of Alignment Optimisation to determine the common position and potentially to gather a group of partners who would like to jointly take the initiative of collaborating on exploiting the outputs of the project.

3.1 Next steps

The exploitation seminar process is to be repeated at the next internal meeting, with further details on the plan to be circulated before then. A survey and alignment process is to be conducted to determine which partners of the consortium are interested in forming some form of joint enterprise or spin-off company to exploit the outputs from MD-Paedigree.
Appendix 1 - MD-Paedigree Exploitation Discussion Paper

ABSTRACT
This discussion paper provides a first analysis of the motivations and options for exploitation of the MD-Paedigree project. In particular it gives an outline of some options for a business plan for a spin-off from MD-Paedigree.
1 Introduction

Over the last 8 years OPBG, GOS/UCL, Siemens, Maat/gNúbila, Athena, Lynkeus, and others, have conducted various pioneering projects in medical ICT (Health-e-Child, SIM-eChild). We continue to be at the forefront of such work through our involvement and leadership of the MD-Paedigree and Cardioproof projects, having recently submitted EC-Clouds (which could lead to developing a user-friendly specialised adult cardiac imaging repository operating on top of MD-Paedigree) and having already submitted m²D1 (which could widen MD-Paedigree’s area of interest also to diabetes type 1). Through these projects we are developing knowledge, ICT systems and technical partnerships. We are now in a position to build on these developments to create a network of hospitals that can work together to harness their patient data to improve diagnosis, treatment pathways and patient outcomes. This document provides a discussion of the motivations and options for exploitation of the MD-Paedigree project. In particular it gives an outline of some options for a business plan for a spin-off from MD-Paedigree that would allow those involved to collaborate in bringing these innovations to a global market that sorely needs them. It is worth pointing out that it should be seen as an exploration of the ideas and motivations for creating a spin-off company, as well as investigating ways in which such a company might be implemented. As such it should provide food for discussion at the MD-Paedigree Exploitation Seminar on 22nd September 2014.
2 Business Description

2.1 Preliminary remarks on knowledge economics

We are in the era of Big Data analytics

- Where information is growingly becoming a public good
- Where the primary scarce resource is human creativity
- An era in which peering becomes a more cost-effective institutional form than either markets or hierarchical organizations.

Different organisational modes have different strategies for overcoming uncertainty

- Markets reduce uncertainty regarding allocation decisions through prices
- Firms or hierarchical organizations resolve uncertainty by ordering information about which actions are to be followed.
- Both are, however, ‘lossy’ mediums: much of the information not introduced in a form or at a location that entitled it to ‘count’ toward an agent’s decision is lost.
- Human creativity linked with the usage of big data analytics based on information handled as public good is difficult to standardize and specify within the contracts customarily employed for either market-cleared or hierarchically organized production.

The knowledge economy is inherently an economy of growing abundance

- The non-rivalness, non-excludability, cumulativeness, and network characteristics of knowledge have the potential of creating a combinatorial explosion.
- Correlatively, a knowledge-based economy would seem to prevent natural market incentives from achieving allocatively efficient outcomes, determining a “tragedy of the commons”.
- For managing ‘knowledge commons’ the social regulations which are needed are fundamentally different from those used for regulating systems founded on exhaustible resources.

The new Knowledge Economy environment

- It implies a new way to compete: moving beyond the abundance to find the adjacent scarcity.
- Steven Johnson, Where Good Ideas Come From, 2010: we are better served by connecting ideas rather than by protecting them […] Ideas want to complete each other as much as they want to compete.
- Perhaps ‘commons’ is the wrong word. Another metaphor is preferable: the coral reef.
- The most extraordinary engine of biological innovation: coral reefs make up about one-tenth of one percent of the earth’s surface, and yet roughly a quarter of the known species of marine life make their homes there.
What makes them so inventive is not the struggle between the organisms but the way they have learned to collaborate.

Let’s raise, with regard to this background, 2 key questions, and let’s leverage on 3 consequent bets on how MD-Paedigree can successfully move towards becoming a ground-breaking player in the new arena of personalised medicine applied to paediatrics:

Questions:

• What can work as a sort of coral reef in paediatric innovation?
• What new competitive market can be established on top of a freemium access system?

Bets:

• A free-access paediatric digital repository, capable of encompassing and automatically curating all types of medical data, and of attracting by its user-friendliness and sheer big data dimension, a growing number of clinical and research institutions, as well as of interested individuals.
• Similarity Search, at clinicians’ and patients’ level, can be a game-changer in medicine, allowing paediatric big data to be increasingly harvested, taking stock from outcomes analysis and risks stratification, making prevention a concrete reality.
• Patient-specific prediction and simulation, based on advanced disease modelling and similarity search, recurrntly validated and specified with reference to ever increasing stratifications of patient characteristics, can open the way to a growing dynamic digital market of multivendor health applications, providing industry with clinicians and patients ready to demand this innovative service

2.2 The Healthcare Industry

Healthcare around the world is at the beginning of a revolution. On the one hand the costs of healthcare are increasing to beyond what a taxation-based welfare state can afford: medical expenditure grows faster than the GPP. On the other hand, modern data analysis technologies offer the promise of better, cheaper and more personalised medicine. By making smart use of the ever-increasing amount of patient data, researchers will find new insights by re-examining the data or combining it with other information. This means not just mining patient records, medical images, biobanks, test results, etc., for insights, diagnoses and decision support advice, but will come to be the continuous analysis of the data streams produced for and by every patient in a hospital, a doctor’s office, at home and even while on the move via mobile devices. Current medical hardware, monitoring everything from vital signs to blood chemistry, is beginning to be networked and connected to electronic patient records, personal health records, and other healthcare systems. The resulting data stream will be monitored by healthcare professionals and healthcare software systems. This will allow healthcare professionals to care for more patients, or to intervene and guide patients early before an exacerbation of his/her (chronic) disease. At the same time data are provided for bio-medical and clinical researchers to mine for patterns and correlations, triggering a process of “data-intensive scientific discovery”, building on the traditional uses of empirical description, theoretical computer-based models and simulations of complex phenomena.
2.3 MD-Paedigree

MD-Paedigree is a clinically-driven in silico project, where 7 world-renowned clinical centres of excellence pursue improved interoperability of paediatric biomedical information, data and knowledge by developing together a set of reusable and adaptable multi-scale models for more predictive, individualised, effective and safer paediatric healthcare, being scientifically and technologically supported by one of the leading industrial actors in medical applications in Europe operating in conjunction with highly qualified SMEs and some of the most experienced research partners in the computerised medicine community.

MD-Paedigree validates and brings to maturity patient-specific computer-based predictive models of various paediatric diseases, thus increasing their potential acceptance in the clinical and biomedical research environment by making them readily available not only in the form of sustainable models and simulations, but also as newly-defined workflows for personalised predictive medicine at the point of care. These tools can be accessed and used through an innovative model-driven Infostructure powered by an established digital repository solution able to integrate multimodal health data, entirely focused on paediatrics and
conceived of as an implementation of the VPH-Share and the p-Medicine projects, planned to be interoperable and cooperating with both of them.

In MD-Paedigree, the computer-based Infrastructure is designed to accommodate the chosen paediatric clinical areas, starting from the considerable experience capitalized in the Health-e-Child and Sim-e-Child projects. The latter developed grid and cloud-based eHealth repositories, models and simulations for specific diseases and patients, and, further eHealth tools are now been developed for data management and distributed high-performance computing, which aim at gradually transferring into clinical practice the most advanced modelling. This will be starting from paediatric cardiology to support more precise outcomes analysis of pathologies and develop optimal therapies, particularly building on top of current developments within OPBG (Ospedale Pediatrico Bambino Gesù) – soon to be followed by GOSH (Great Ormond Street Hospital) and DZHB (Deutsches Herzzentrum Berlin) – as well as on the parallel proof-of concept project Cardioproof (www.cardioproof.eu) and the (just submitted) bioinformatics project EC-Clouds (www.ec-clouds.eu).

MD-Paedigree’s goals therefore are to:

- integrate and share highly heterogeneous biomedical information, data and knowledge, using best practices from the biomedical semantic Web,
- develop holistic search strategies to seamlessly navigate through and manage the integrative model-driven Infrastructure and digital repository
- jointly develop reusable, adaptable and composable multi-scale VPH workflow models,
- support evidence-based translational medicine at the point of care, and
- ultimately facilitate collaborations within the in silico medicine community.

2.4 Motivations for forming a Spin-off Company

There are a number of motivations for forming a spin-off company to explore and progress the exploitation of MD-Paedigree’s innovation and outputs:

1. to provide a means of partners to contribute IPR and effort without risk, or fear of risk, of losing either
2. to provide a vehicle for building the trust necessary to collaborate effectively and enthusiastically
3. to create a legal entity that can be used to enter into contracts, search for funding, raise capital, conduct business

The first two of these motivations are driven by the need to provide the contractual and organisational framework conditions for a successful exploitation. While the Consortium Agreement provides these conditions for the length of the project, it is limited both in time and scope. Once the project has been completed the partners “enter the unknown” in terms of their relationships to each other and to MD-Paedigree. Understandably, and quite naturally, the lack of contractual guarantees results in a degree of uncertainty that makes committed collaboration difficult, if not impossible. Given the substantial investment made by the partners, albeit enabled by the EC funding, those who wish to participate must feel confident in doing so.
The third motivation is more pragmatic. In order to realistically find the necessary investment for commercialisation of MD-Paedigree and in order to enter into contractual relationships with clients and suppliers it will be necessary for there to be an MD-Paedigree legal entity. The transaction costs of contracting between a consortium of partners would be too high for commercial progress to really be viable.

2.5 The Proposed Company

This proposal has at its core the marketing of the computer platform (Infostructure) that is being implemented on the foundations laid by the Health-e-Child (www.health-e-child.org) and Sim-e-Child (www.sim-e-child.org) projects and in the course of MD-Paedigree (www.md-paedigree.eu), with further applications within Cardioproof and (hopefully also) EC-Clouds.

This Infostructure will give clinical and research centres the opportunity to access the large volume of data that is produced every day in the normal course of clinical work and enables them to take advantage of those data in several ways which relate to trends emerging in the context of Big Data analytics in medicine. This will lead to improvements in:

- patient care
- the efficiency and efficacy of clinical and therapeutic pathways
- administrative and management performance of healthcare professionals

All this leads to the preparation of a decision support system that could be of great interest to clinical centres.

A series of Knowledge discovery and semantic organization of data services have already begun to be implemented and integrated, and the demonstration of them won Best Exhibit Award ICT'13, 6-9 November 2013, Vilnius, and was further appreciated by the European Commission in the MD-Paedigree review held on 6-7 March, 2014.

A further set of instruments, especially related to the physio-pathological models of human organs and of the progress of the disease (useful for the optimization of the diagnosis on the basis of patient-specific simulation & prediction, and customization of therapies, to the provision of patient-specific clinical workflows “model - and-data-driven”), will be progressively integrated in the MD-Paedigree Infostructure. These additional tools will be sold through the Infostructure as a specific application (app), requiring a certain level of access or the payment of additional fees.

As set out in MD-Paedigree’s DoW, Lynkeus is committed to introduce this Exploitation Seminar, taking place today in Utrecht, and must prepare, by March 2015, an Exploitation Plan describing the future of commercial exploitation of the outcomes of MD-Paedigree.

In view of this, the proposal is as follows: let’s imagine that (at least) three-to-five key partners in the initiative (at least one path-breaking Clinical Partner, Lynkeus, gNúbila/Maat, Athena, a technological partner) form a spin-off company, bringing together the data, the Infostructure and the strategic steering committee. For the purposes of this document we will refer to the MD-Paedigree Spin-Off as MDPSO.

The definition of “real capital”, which consists of planned investments in labour, machinery, software and data, should become the subject of an agreed estimate, about the values that will be contributed, regardless of the actual capital (essentially minimal) which will formally equip the MD-Paedigree SPV.
The participation shares should reflect the contribution of the respective partners, with due respect to the pre-existing know-how they are able to demonstrate.

Each of the four participating partners would be allocated a portion of the basic start-up company based on the contribution of the initiative, through a process of optimization/estimation of the individual contributions:

- **Clinical Partner**: data, hardware instrumentation (log information), clinical advice, sponsorship initiative.
- **Lynkeus**: work, business management in the first three years, physical structures, initial finance raising.
- **gNúbila/Maat**: work, instrumentation software.
- **Athena**: work, data curation, knowledge discovery tools
- **Research Partner**: similarity search and organ and disease modelling for patient specific prediction and simulation

This process of preliminary valuation, in addition to allowing the establishment of values in the field and the initial shares, could also provide the criteria for the subsequent opening up of the company to the participation of other partners, according to a valuation of the contributions and the simultaneous sale of additional shares.

Looking ahead, the composition of the Company could follow the percentages below:

- 50% clinical partners
- 25% management
- 25% of IT partners responsible for the development of the Infostructure
- a research partner, besides possibly directly intervening as an industrial partner (with a separate percentage, not yet taken into account), could also establish special commercial agreements for the use of its products

The proposed Company, however, would be expected to remain “inactive” until the end of the project, giving Lynkeus (or another willing SME) for the first 3 years the task of acting as experimental manager of the initiative, with the option to use the facilities of data and infostructure, also on the basis of funds that will be collected by Lynkeus. These funds will be used to carry out an initial exploration of the potential of the market, test the possible clinical applications derived from models of disease modelling, develop the initial business contacts and promote desirable agreements with additional clinical centres inside and outside the MD-Paedigree project consortium.

During this period, besides offering assistance to all partners for solving related IPR or regulatory issues and providing an operational meeting place to exchange ideas, information, and hands-on learning opportunities both on “technical aspects” as well as on potential hurdles and risks, Lynkeus (or another company, but let’s keep now the Lynkeus hypothesis for the sake of argument) will be entitled to enter into any agreements with partners for the implementation of specific additional features of the platform, to enhance its capabilities and increase its attractiveness for clinical professionals and institutions, as well as to move the first steps to finding the necessary funding for the initial development of the initiative. Lynkeus’ management of MDPSSO would terminate at the end of the exploration period of three years, to go back under the control of the new company, which will become fully operational at that point.
Lynkeus, in recognition of the work and of its likely outcome, would receive an additional portion of the MDPSO, in proportion to the value generated and collected in the three years of operation of the pilot.

2.6 Services

The Digital Repository that is being built within MD-Paedigree will put in place a system that allows the storage and use of large amounts of clinical data of many different types, providing services such as data mining, data curation, knowledge discovery, similarity search, multi-scale modelling, patient-specific simulation & prediction, optimal treatment decision support, patient-specific clinical workflows, access to scientific literature reference, according to the following scheme of development:

MD-PAEDIGREE: How big data reengineer medical practice. The challenges ahead...

2.7 Additional services

There is a wide range of services that could be offered by MDPSO, either directly or through associates or value-added resellers.

- Similarity search not only for clinicians ("patients like mine"), but also geared to provide additional information tools to the patients ("patient like me")
- Outcome analysis
- Risk stratification
- Cost analysis
- Access to anonymised patient datasets
• Access to VPH Models
• Disease specific information apps
• Second opinion from clinicians in the network
• Disease specific advertising space
• Enhanced privacy (patients who voluntarily make available additional data get additional customized information which is constantly updated)
• Provision of specific cohorts of virtual patients for in silico clinical trials
• Hypothesis generation

2.8 A Three-layered operational scheme

3 Market Strategies
The main client groups of the MDPSO offering are:

• Clinical centres
• Individual physicians
• Patients
• Pharmaceutical companies (for clinical trials, both in vivo and in silico)
• Biomedical firms (for the promotion of specific products)

Each of them will be outlined a specific offer for specific service lines.

The spread of our services will be primarily based on:

• Ad hoc promotion at hospitals, research centres, and on all occasions of international presentation
Word of mouth informed between clinicians / researchers, technologists and business operators
Direct and indirect advertising social network both general and specialized

In 2008, in Europe there were on average 2.6 hospitals for 100,000 inhabitants, ranging from 1 in the Netherlands to almost 6 in Finland. This implies around 19,000 hospitals in Europe. If we assume these hospitals have an average of 20,000 admissions per year who each result in €50 of simulation spend on average, the outcome is: $19,000 \times 20,000 \times €50 = €19 billion$ (approx. 0.001% of Europe’s total healthcare spend).

From this we can estimate the market for hospital-based clinical simulations alone to be around €19 billion.

In order to gain share in this market requires:
- The technology to conduct the simulations
- The data from which to develop the models
- The network of clinicians to buy the product

The technology is being developed in the MD-Paedigree project, but will require further and ongoing investment.

4 Competitive Analysis

Leaving aside Watson by IBM, which deserves to be dealt with separately, there is not yet so much competition in the sort of predictive healthcare promised by the MD-Paedigree project, while there are competitors in the healthcare data storage market such as:
- Intel
- IBM
- Hitachi Data Solutions
- Netapp
- Bridgehead Software

The companies above are all offering data storage platforms to healthcare providers. However, what they offer is essentially a “bespoke” service for each clinical centre, without the benefits offered by joining a network.

In general, healthcare analytics is been widely recognised as a market on the point of maturing and one into which many new vendors wish to enter, even though – as stated in a section titled “Big Money, Uncertain Return” within the *Data-Driven Health Care* report published by the MIT Technology Review in July 2014 – “the return on investment for health-care analytics programs remains elusive and nearly impossible for most to calculate”.

The MD-Paedigree Infostructure provides a technological foundation for entry into this market, with the tools being developed in MD-Paedigree giving services to provide on top of this foundation. The other requirements are data on which to build the analytics and clients to whom to sell them. These requirements may both be served by growing the network of clinical centres that are contributing data. There are two aspects to this:

1. growing the number of clinical centres contributing data and using services
2. growing the number departments within those clinical centres that are contributing data.
4.1 Comparative outline and complementarities: Md-Paedigree vs. Watson
As stated again in the already quoted the July 2014 Data-Driven Health Care report published by the MIT Technology Review, when launching Watson’s cognitive computing system IBM has aimed to “make medical expertise a commodity”. Teaming with the Sloan-Kettering Cancer Center, Watson has begun to be used to recommend treatments, integrate information and help teach medical students. Clinicians have, however, had to “spend more time than anticipated teaming up with IBM software developers to chase down the misunderstood acronyms or wrongly parsed sentences that caused Watson to misinterpret medical records or suggest incorrect treatments”.

Since August 2014, a new Watson service has additionally entered the scene, dubbed Watson Discovery Advisor. It is a software-as-a-service product acting as a scientist’s assistant, available as a cloud service. It is a natural language tool specifically geared for research and development. The new service, is expected to have a major impact in fields like molecular and comparative effectiveness, where a research usually takes several months just to identify the papers and perform the manual data-gathering, while Watson should be able to have it “done in minutes”.

IBM has announced that it will invest $1 billion into the Watson division, including $100 million to fund startups developing cognitive apps1. Watson division, led by Michael Rhodin, former senior vice president of IBM’s software solutions group, and based in New York City’s Silicon Alley, will have about 2,000 employees focused on software, services, research, experts, including a new unit which will provide the necessary support for making Watson fully commercialized. Of course, this refers not only to healthcare applications, but also to insurance, financial services and other vertical industries.

---
1 It is worth observing that a meeting is planned between Patrick Ruch’s team (HES-SO) and Watson’s representatives on Oct 28, 2014 under the umbrella of the SIB Swiss Institute of Bioinformatics.
5 Strategy
The proposed strategy for the MDPSO is based on the following three pillars:

- Innovation
- Productisation
- Network growth

Innovation and productisation will require significant and on-going investment, and finding ways to fund this investment is the key objective for the strategy in the short term. As we will see below there are a number of avenues to be pursued to find funding, but until innovations have been turned to products and brought successfully to market, MDPSO will not be able to sustain itself. However, once products have been brought to market, the network growth that is the third pillar can begin to show rewards. The network of clinical centres will both provide the data that is required to fuel the model development for innovation, but more crucially it will also act as the marketing and distribution network for the products that those models are based upon.

Looking further into the medium and long term, the strategy will be to develop the Infostructure into a market and ecosystem for data centric medical products. Through providing the Infostructure as a platform for 3rd party innovation MDPSO will facilitate bioinformatics as a service to organisations acting as value-added resellers of its products.

5.1 Funding Innovation and Product Development
In order to bootstrap on top of the work conducted during MD-Paedigree and ensure a timely entry into this rapidly developing market it will be necessary to find funding for MDPSO. This task will be taken on by
Lynkeus, as primary goal of the MDPSO management team for all three years. There are four main potential sources of funding:

5.2 EU funding for further innovation projects e.g. extending the MD-Pedigree approach to new disease areas
5.3 EU or national funds for business development and technology exploitation
5.4 Venture capital or investment funds
5.5 Public Private Partnership initiatives

Funding may come from a mixture of all four sources, but it should be noted that further funding focussed solely on innovation would be unlikely to be enough on its own. Significant resources will be needed to convert successful innovation into market-ready products and services. Whichever funding sources MDPSO is able to access, it goes without saying that the concrete, detailed and communicable plans will be necessary. Either in the form of H2020 proposals (a format well-known to all project partners) or comprehensive business plans with well-worked development models (less familiar to some of our partners).

5.6 Innovating through EC funded projects
The MD-Pedigree project is the descendent and heir of the Sim-e-Child and Health-e-Child projects. The approach of building on top of existing research and innovation actions has been successful as well as productive. This continues to be a productive approach, as is evidenced by Cardioproof, another FP7 funded project to determine the applicability and effectiveness of predictive modelling and simulation tools for cardiology, which shares several partners (UCL, gNúbila, DHZB, Fraunhofer, Lynkeus) and will be using the MD-Pedigree Infostructure.

The EC’s new funding regime is Horizon 2020 and several MD-Pedigree partners have been working together to find new projects that can use the MD-Pedigree Infostructure. One such example is EC-Clouds, which involves MD-Pedigree partners UCL, gNúbila, DHZB, La Sapienza and Lynkeus). EC-Clouds aims to build a cloud-based bioinformatics platform built on top of MD-Pedigree’s Infostructure.

The MDPSO will be able to enter in to proposals as a partner itself, substantially simplifying the process of putting together project proposal consortia.

5.7 EU or national funding for business development and technology exploitation
There are a number of funding sources for business development and technology exploitation, both national and from the EU. The various national funding sources are too numerous to cover in any detail here, however it should be noted that they might be prepared to provide proportionately matched funding to and EU funds that can be accessed. As such, they can be seen potential bootstraps both to any central EU funds, but also to any pitches for such funds.

Two target EU funding sources should be the European Investment Bank and the Horizon 2020 Dedicated SME Instrument.
5.7.1 The Horizon 2020 dedicated SME instrument

Horizon 2020 funds high-potential innovation through a dedicated SME instrument, which offers seamless business innovation support under the section Societal Challenges and the specific part Leadership in Enabling and Industrial Technologies (LEITs).

Through this SME Instrument, the European Commission is looking for highly innovative firms that are ambitious and have the potential to develop, grow and have a European or international impact. The SMEs are requested to have, and be able to demonstrate, a good knowledge and experience in the markets they intend to master. The European Commission is interested in companies which follow a development strategy that pursues breakthrough innovation and/or the potential to disrupt existing markets.

Start-ups are not excluded. However, the SME Instrument is not designed to be a company creation vehicle, but to support the growth of companies with innovative ideas with European or global commercialisation potential.

Provided with about €3 billion in funding over the period 2014-2020, the SME Instrument helps high-potential SMEs to develop ground-breaking innovative ideas for products, services or processes that are ready to face global market competition. Available to SMEs only, which can however organise a project in the way that best fits their business needs (subcontracting is not excluded), the new scheme opens a new highway to innovation through phased, progressive and complimentary support.

- Business innovation grants for feasibility assessment purposes (optional phase I): EUR 50,000 (lump sum) per project (70% of total cost of the project);
- Business innovation grants for innovation development & demonstration purposes (possible phase II): an amount in the indicative range of EUR 500,000 and 2.5 million (70% of total cost of the project as a general rule);
- Free-of-charge business coaching (optional in phases I and II), in order to support and enhance the firm’s innovation capacity and help align the project to strategic business needs;
- Access to a wide range of innovation support services and facilitated access to risk finance (mostly in optional phase III), to facilitate the commercial exploitation of the innovation.

For phase I, and typically for a duration of around 6 months, the funded activities funded could be: risk assessment, design or market studies, intellectual property exploration; the ultimate goal is to put a new product, service or process in the market, possibly through an innovative application of existing technologies, methodologies, or business processes. The project should be aligned to the business strategy, helping internal growth or targeting a transnational business opportunity. The outcome of a phase 1 project is a feasibility study (technical and commercial), including a business plan.

Phase II, typically with a duration of around 1 to 2 years, should aim at innovation projects underpinned by a sound and strategic business plan (potentially elaborated and partially funded through phase 1 of the SME Instrument). The activities funded in phase 2 can be of several types: prototyping, scaling-up, design, performance verification, testing, demonstration, development of pilot lines, validation for market replication, including other activities aimed at bringing innovation to investment readiness and maturity for market take-up. The expected outcomes are a new product, process or service that is ready to face market competition, a business innovation plan incorporating a detailed commercialisation strategy, and a financing plan in view of market launch (e.g. on how to attract private investors, if applicable).
Phase III does not provide direct funding. It offers a range of services in support to go-to-market and access to finance, in particular via the financial facilities supported under Horizon 2020 and COSME programmes, providing a Loan Guarantee Facility or an Equity Facility for Growth.

The calls for proposals are continuously open, but there are several cut-off dates per year within the end of the 3rd MD-Paedigree Period Year: 09/10/2014, 17/12/2014, 18/03/2015, 17/06/2015, 17/09/2015, 16/12/2015, 18/03/2015.

Two topics seem to fit particularly well for our purposes:

- **High risk ICT innovation:**
  - ICT-37-2015-1, 90 projects, €4.5m
  - ICT-37-2015, ~26 projects, €40m

- **Diagnostics devices and biomarkers:**
  - PHC-12-2015-1, 90 projects, €4.5m
  - PHC-12-2015, ~26 projects, €40m

If MD-Paedigree really wants to mean business with regard to its future exploitation, this opportunity should not be dismissed.

### 5.8 Venture capital or investment funds

Venture capital and private investment funds could provide the funds required to propel MDPSO to a significant market player. This would of course bring with it dilution of the ownership of MDPSO. The more established MDPSO has become the less the dilution would be, equally the earlier such a funding “shot in the arm” were to come the greater the likelihood of being first/early to market. Given the number and resources of healthcare and IT specific venture capital and investment funds, it is crucial that significant effort is put in to establishing dialogues with these bodies, as it seems probable that at some point private funding will be a part of the mix. Therefore, developing the business model and plan, as well as building MDPSO’s image in the financial sector should be seen as significant short and medium term goals.

### 5.9 Public Private Partnership initiatives

The current trend for PPP shows no sign of abating. A growing number of successful PPP’s have been implemented in a range of sectors in several EU countries and many healthcare systems across the EU implement different varieties of state-backed private healthcare delivery. For new ventures in healthcare, PPP’s are currently an increasingly popular method of combining state funds with private sector expertise. For example, both UK NHS and Catalonia’s Health System have introduced PPP schemes on some projects.

The EC has responded to this trend by beginning to factor PPP’s into its planning. Structuring MDPSO in such a way as to encourage and facilitate PPP involvement could be directly advantageous for obtaining such funding, but also indirectly through making it better aligned with current EC thinking.
5.10 Productise clinical centre node installation

A key point of the MD-Paedigree Infostructure is that is can also provide clinical centres with a platform for research data storage, curation (automated and manual) and access. This can be leveraged as a way to extend the network of clinical centres and increase market share. A “barebones” version of the software stack required at the clinical centres will be productised to create what is an onsite research data storage, curation and search platform. This “Infostructure Node” will act in one of two ways, depending on the requirements of the clinical centre:

- as a local “research data warehouse” for the clinical centre, ingesting, curating and analysing the patient data
- as a local client for the Infostructure private cloud, anonymising the data and then uploading it to the cloud

Note that these are two separate architectural models running in parallel. The MD-Paedigree Infostructure is essentially a distributed “private cloud”. Having a central main node and data store, but with nodes in each of the clinical centres.

By productising the software stack, the cost of adding a new clinical centre to the network can be greatly reduced, while also adding value for the clinical centre.

It should be noted that the goal here is not to provide a routine clinical health record system, this market is already well-developed and has some large players in it. There are also high accreditation hurdles that act as barriers to entry.

5.11 Market Exploration

As part of the initial work of the MPDSO, and as a necessary part of building a case for further investment, a comprehensive market exploration will be conducted. The aim of this will be to identify new marketplace opportunities for competitive advantages and thus come to understand which markets are a fit for MDPSO’s products/services. Part of this may be undertaken as part of the MD-Paedigree exploitation plan.

This work will involve analysing each of the following groups:

- Clinicians
- Patients
- Researchers
- Clinical centres
- Pharma companies
- Health Maintenance Organizations

The analysis will aim to determine what are these groups’ wants and needs, and more importantly, what unmet needs exist today. The market exploration will also analyse other movers in the market, partly to have an idea of the competition, but also to determine whether they are strategic alliances to be made.
5.12 Growing the network of clinical centres

The network of clinical centres connected to the MDPSO is both a marketing and distribution network, as well as a network of clinical data providers. As it is this data that is needed to develop all the services that the MD-Paedigree Infrastructure can offer, the network of clinical centres will be key to MDPSO’s innovation.

The current MD-Paedigree Infrastructure has 2 nodes, both belonging to OPBG. One in the OPBG in Rome and one in Taormina. However, two further nodes are planned, one at DHZB in Berlin and another a GOSH in London. The other 4 hospitals involved in MD-Paedigree (Amsterdam University, Gaslini in Genova, Leuven University, Utrecht University) are expected at least to have ad hoc gateways installed.

The Network of clinical centres can provide growing data and clients:

- by organising a yearly meeting of representatives from network
  - For communication between MDPSO and network and between network members
- by generating a network effect

5.13 Grow the network of technical associates & make strategic alliances

In order to drive continual improvement and addition of services it is necessary to have a healthy network of technical associates. They may be former project partners or new associate organisations. Some may join in the MDPSO, but this should not be seen as either necessary or given. The vision of creating an “ecosystem/marketplace” for products and services based upon the Infrastructure, requires that there should be a network of providers of these products and services. As the network grows it can also become more formalised. Communication and collaboration in the network should be fostered by organising regular events. These events will provide the channels of communication both between the network and MDPSO as well as between the network members themselves.

In addition to growing the network, MDPSO should look for strategic alliances. There are some large organisations with whom it would be far more productive to work than to compete, these sorts of organisations are one’s whose competences could be used to magnify those of MDPSO. Two such examples are:

- IBM
  - IBM’s Watson’s text based processing methodology would be highly complementary to MD-Paedigree’s model-driven approach. IBM’s scale and global market penetration could be extremely helpful for MDPSO.
- European Bioinformatics Institute
  - The EBI’s status as Europe’s flagship laboratory for the life sciences as well as their repositories of bioinformatics data could be useful to MDPSO both politically and technologically. Integration with their data services could also be leveraged to accelerate MDPSO partners’ research.
- Elixir
  - Beyond the EBI, the recent creation of the Elixir network of national nodes can provide access to other European data repositories for life sciences, including more health-related contents such as Orphanet, neXtProt and national registries.
5.14 Productising Services and bringing them to market
It is crucial to turn the services that MD-Paedigree’s Infostructure can provide into products that can be taken to market. The first such product is likely to be similarity search, however there are other candidates, such as EHR-based medical literature search. Whichever service, or services, are chosen, they need to be targeted, user-friendly and high-quality. The services would first be trialled internally to the clinical partners of the MDPSO and then amongst the wider network of clinical centres before being made available externally, for example to patients.

Initial services to be determined on the basis of market exploration with a balance being struck between market need and market readiness of service. Different services will need different models. E.g. literature search might be a yearly subscription, but simulations might be on a pay as you go model. One market strategy might be to provide the initial product, say similarity search, for free to clinical centres who are part of the MDPSO network, with paid for products being brought on line later.

Possible examples of services to be productised are:

- Similarity search for clinicians - “patients like mine”
- Similarity search for patients – “patients line me”
- Patient specific literature search
- Patient specific simulation

5.15 Establishing and Building MDPSO’s brand
Establishing and building MDPSO’s brand in Europe and around the world is a clear medium and long term target. Nevertheless, there is much work to be done to lay the foundations for this brand recognition in the short term. First and foremost, this can be done by leveraging the dissemination efforts of MD-Paedigree, Cardioproof, hopefully also EC-Clouds, and any other EC funded projects in which MDPSO becomes a partner. Coordinating between these dissemination efforts should enable the MDPSO’s brand to be built before any services are brought to market.

The main thrusts of the brand building strategy should be:

- Demonstrate thought and technological leadership in big data healthcare and bioinformatics
- Build an portfolio of research publications referencing MD-Paedigree and MDPSO
- Develop an active online presence, including a social media presence
- Gain media coverage based on the outputs of the EC funded projects

5.16 Federation of Data
Patient data can either be “warehoused” in a central data repository or made available using a federated database system. This means that the data does not leave the hospital’s network.

5.17 Enhanced Privacy
It is crucial that data made available to the network is usable for research and for commercial exploitation. Any method of doing so that is not centred on the patient will eventually face potentially insurmountable
obstacles. However, by developing a system of Enhanced Privacy, where patients are given control of the uses of their medical records, we can make use of their data while involving them in that use.

6 Transition from pilot, through start-up phase of direct operations to full operations

- Lynkeus
- gNúbila/Maat
- Athena

Agreements with clinical partners for further implementation of the database

Testing of products and services

Searching for funding

Reliance on LYNKEUS for three years

Agreements with technical partners for further implementation of the disease modelling

Exploration of the market

First commercial agreements

Agreements with technical partners for development of the Infostructure

2014

2015

2018

New Co. MD-Paedigree:

LYNKEUS – increase in value added determined

Clinical Institution/s – increase valuation according to data added

gNúbila – increase in value based on work done to develop the Infrastructure

Athena – increase in value based on KDD work done

Reallocation of shares

Admission restricted (through a capital increase) to other MD-Paedigree Partners - shares allocation recognise project contribution

2020
6.1 Possible distribution of shares with progressive increases in capital

The following tables are an attempt to sketch out how shares in MPDSO might be distributed over time. Please note that they are not prescriptive, giving only an outline picture of one way in which this might be implemented.

<table>
<thead>
<tr>
<th>Phase 1 - MDPSO 2014</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partner</strong></td>
<td><strong>Quota</strong></td>
</tr>
<tr>
<td>Clinical Institutions</td>
<td>45%</td>
</tr>
<tr>
<td>Individual clinical staff</td>
<td>5%</td>
</tr>
<tr>
<td>Technical</td>
<td>25%</td>
</tr>
<tr>
<td>LYNKEUS</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 2 - 2017 - Capital increase reserved for founder partners for re-valuation before the opening to new members. The capital raised from 100 to 150</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partner</strong></td>
<td><strong>Quota</strong></td>
</tr>
<tr>
<td>Clinical Institutions</td>
<td>33%</td>
</tr>
<tr>
<td>Technical</td>
<td>23%</td>
</tr>
<tr>
<td>Other core competencies strategic team</td>
<td>10%</td>
</tr>
<tr>
<td>LYNKEUS</td>
<td>33%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 3 - 2017 - Capital increase reserved for MD-Paedigree partners. The share rose from 150 to 250</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partner</strong></td>
<td><strong>Quota</strong></td>
</tr>
<tr>
<td>Clinical Institutions</td>
<td>20%</td>
</tr>
<tr>
<td>Technical</td>
<td>14%</td>
</tr>
<tr>
<td>Other core competencies strategic team</td>
<td>6%</td>
</tr>
<tr>
<td>LYNKEUS</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Total core partners</strong></td>
<td>60%</td>
</tr>
<tr>
<td>HOSP 1</td>
<td>8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinical partners</th>
<th>52%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological partners</td>
<td>22%</td>
</tr>
<tr>
<td>Management</td>
<td>26%</td>
</tr>
</tbody>
</table>
Outcomes of the strategic exploitation seminar

<table>
<thead>
<tr>
<th>Phase 4 - 2020 - reserved capital increase open to new strategic partners. The capital increases from 250 to 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Institutions</td>
</tr>
<tr>
<td>gNúbila</td>
</tr>
<tr>
<td>Other core competencies strategic team</td>
</tr>
<tr>
<td>LYNKEUS</td>
</tr>
<tr>
<td>Total core partners</td>
</tr>
<tr>
<td>HOSP 1</td>
</tr>
<tr>
<td>HOSP 2</td>
</tr>
<tr>
<td>HOSP 3</td>
</tr>
<tr>
<td>HOSP 4</td>
</tr>
<tr>
<td>TECHNO 1</td>
</tr>
<tr>
<td>TECHNO 2</td>
</tr>
<tr>
<td>Total new MD-Paedigree partners</td>
</tr>
<tr>
<td>HOSP 5.</td>
</tr>
<tr>
<td>HOSP 6</td>
</tr>
<tr>
<td>HOSP.7</td>
</tr>
<tr>
<td>TECHNO 3</td>
</tr>
<tr>
<td>Total new partners</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Clinical partners: 58%
Tecnological partners: 13%
Management: 23%

After 2020, the company will not proceed to new capital increases, thereby stabilizing the shareholdings, which will remain unchanged, unless it decides to go public as IPO.

Thereafter, the relationships with clinical centres will be exclusively commercial in nature, but may differ according to the level of access given to their data.

Risk associated with these scenarios

The number of partners is relatively large so that decision process are likely to be inefficient and ineffective. Start up companies require agile & responsive management organization. IP audit is needed, in particular for academic partners since IP pollution is one of the highest risk associated with technological products generated by researchers.

Mitigation: operational management should be very strong yet consensual.
6.2 Potential sources of revenue

<table>
<thead>
<tr>
<th>Source of revenue</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual subscription – patients</td>
<td>Possibly with a free access that is limited in time or with basic functionality</td>
</tr>
<tr>
<td>Annual subscription - clinicians / researchers</td>
<td>Again, you might have a free limited access, possibly with access to scientific reading and other basic functionality</td>
</tr>
<tr>
<td>Annual subscription Institutions</td>
<td>You could propose a discount of up to 50% for the clinical centres who wish to contribute data</td>
</tr>
<tr>
<td>Single sign-on functionality for use</td>
<td>For use in Ex Models, simulations, etc.</td>
</tr>
<tr>
<td>Granting advertising</td>
<td>Dedicated to pharmaceutical companies and companies in the biomedical field. It will be appropriate for such forms of advertising are provided only in the accounts of clinicians and institutions (a sort of virtual sales representative).</td>
</tr>
</tbody>
</table>

- Break down revenues per area and show projection

6.3 Market analysis and exploitation plan (March 2015)

6.3.1 First market analysis steps

1) Identification of resources (databases, storages, models, algorithms, experts, etc.)

2) Identification of users (clinicians, researchers, patients, students, etc.)

3) Identification of user cases (diagnosis, treatment, training, research, consultation, etc.)

4) Identification of market segments

5) Identification of boundary conditions

6.3.2 First business plan steps

1) Definition of:
   a. Vision
   b. Mission
   c. Objectives
   d. Values

2) Determination of:
   a. Key partners (hospitals, institutions, research centres, etc.)
   b. Channels (clinicians, researchers, patients, students, etc.)
   c. Value propositions

3) Establishment of:
   a. Cost structure
   b. Detailed Revenue streams
   c. Geographic coverage
7 Risks

There are some risks to the business plan, which may be considered by area.

7.1 Legal Risks

- Data protection regulation relegates the repository to use solely as a research tool.
- Complexity of obtaining adequate informed consent of patients / carers to be able to use the data in anonymous form.
- Difficulty in obtaining clearance for use as a medical device (both in terms of Infostructure, and models, it is consequently model-driven medical guidance).

European regulators are keen to allow the reasonable use of data in ways that will serve the public good. The danger here is not from being prevented from operating due to regulations, but being delayed from beginning to operate.

7.1.2 Technical and Clinical Risks

- Difficulty in using the data due to problems of integration and interoperability;

**Mitigation:** there exist relatively well spread onto-terminological standards in Europe as well as sustainable efforts to maintain pan-European interchange formats across EU countries (e.g. epSOS → EXPAND)

- Ineffectiveness or / usability of the models (due to inadequate validation) in their clinical use.

**Mitigation:** clinical partners are part of the consortium so that concrete needs are likely to be captured already from day 1.

The technologies for the building of the Infostructure are all relatively mature, while the modelling and simulation algorithms being used in MD-Paedigree have largely been shown to work as proof of concept. The strength of the Infostructure is that it acts as a data storage and analysis platform and so its success is not dependent on any one of the analytical techniques that can be implemented using it.

7.1.3 Commercial Risks

- Inadequate maturation of the target market.

By seeking to meet current needs (e.g. data storage, data curation and data access), while growing a network of clinical centres, the Newco will be positioned to take advantage of the maturation of the market whenever that occurs.

**Mitigation:** the long term commitment of the partners (~10 years) is likely to reduce the risk: basically all partners have long term perspective so that delaying the market delivery is not per se an issue.
Mitigation 2: at least one contract with a large private company, not counting companies associated to the consortium, must have been signed.

8 Links
8.1 Data Storage Competitors
http://www.bridgeheadsoftware.com/solutions/healthcare_data_management_hdm/
http://www.netapp.com/uk/solutions/industry/healthcare/

8.1.2 Hospital Data
http://www.hope.be/03activities/quality_eu-hospitals/eu_country_profiles/00-hospitals_in_europe-synthesis_vs2011-06.pdf