BUSINESS MODEL DESIGN FOR UNIVERSITY TECHNOLOGY VALORISATION

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Abstract

Nowadays innovation is a multi-actor process that implies intra- and inter-organisational integration managed through networks and facilitated by Information and Communication Technologies (ICTs). Newest innovation management models consider systemic approaches, flexible, immediate and customized responses, multidisciplinary and complex projects involving competent people. It is in this context that universities represent an important player that ultimately contribute to socio-economic wealth generation, through education, research and -gradually increasing and intensifying- third mission activities such as technology valorisation and commercialisation. Even policy makers do realise the importance of such activities and create favourable conditions and incentives towards its realisation, the reality of the academic community as knowledge transferor has great potential towards improvement in both quality and quantity. The Open Innovation defined as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model considers the business model a key aspect of the new paradigm. A recent report of the European Commission (2012) on knowledge transfer in Europe titled "Barriers and drivers in European university - business cooperation" identifies a series of barriers that act as hindering factors. Barriers are grouped in three main categories: i) usability of results, ii) funding, and iii) relational barriers. Beyond the mentioned categories, teaching and research staff representing the academic community often also lacks knowledge on the complex process of technology valorisation implying strategic analysis and decision-making, innovation management, market research and consumer behaviour and satisfaction aspects.
Accordingly the aim of the present contribution is to provide a decision making framework in order to elaborate some innovative possible business models so as to valorise specific research carried out in universities. The case of the Universitat de Girona, Spain (UdG) and more precisely the Visió per COmputador i ROBotica (ViCOROB) research group will be discussed. Discussions about implication, future works and limitations of this framework are also given.

Keywords: Business model design, innovation, technology transfer, research valorisation.

1 INTRODUCTION

Nowadays, all actors constituting main pillars in any innovation system must pay special attention to changes, since their relevance is conditioned by their ability to adapt to changes and catch up with fast moving trends. In a relatively recent study the authors [1] predict the future of innovation management which is captured in Figure 1.

Proactive business model innovation is a must. Organisations should consider business model from a dynamic approach, while business model analysis *per se*, without taking into account renewal, innovation, transformation of the concept makes less sense. Paradoxically, even innovation faces innovation and trends are powerful predictors of transition and possible ingredient for survival and success.

At a slower pace, universities are also facing major transformations, each time more integrating business principles, but without missing their three main missions: education, research and –more recently- knowledge valorisation. Even policy makers do realise the importance of such activities and create favourable conditions and incentives towards its realisation, the reality of the academic community as knowledge transferor has great potential towards improvement in both quality and quantity.

One of the largest study ever into European university business cooperation (UBC) [2] accounting with the participation of 4,123 academics and 2,157 from HEI management offers a detailed picture of what is the current situation regarding UBC in Europe and describes the factors that facilitate or inhibit UBC.

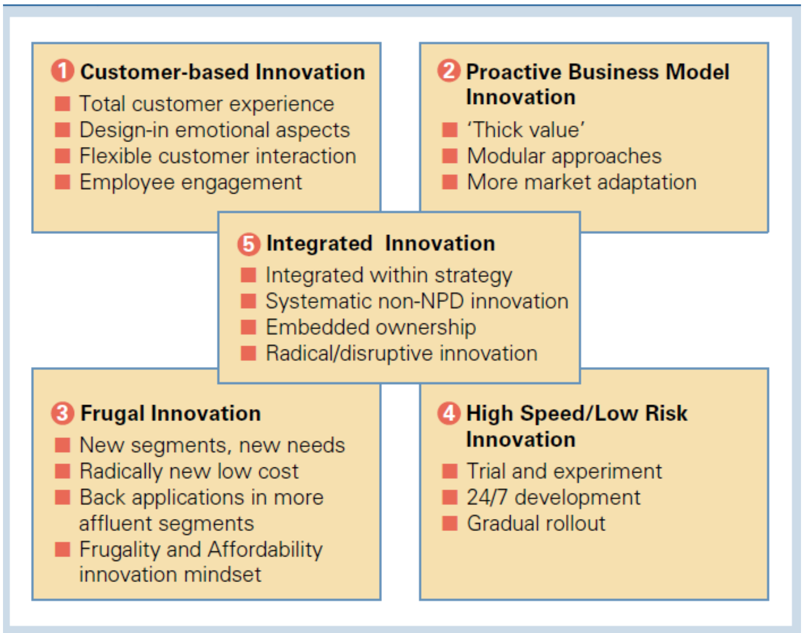

Figure 1: Five innovation management concepts to watch [1]

According to the results of the cited study, the extent of university business cooperation is relatively low and uneven, since a series of real and perceived influencing factors (situational factors such as age, faculty, years in business, etc.; barriers; drivers and perceived benefits) strongly impact knowledge transfer. A main finding consists in the statement that lack of funding and excess of bureaucracy at all levels are the highest barriers to UBC. All barriers are showed in Figure 2.

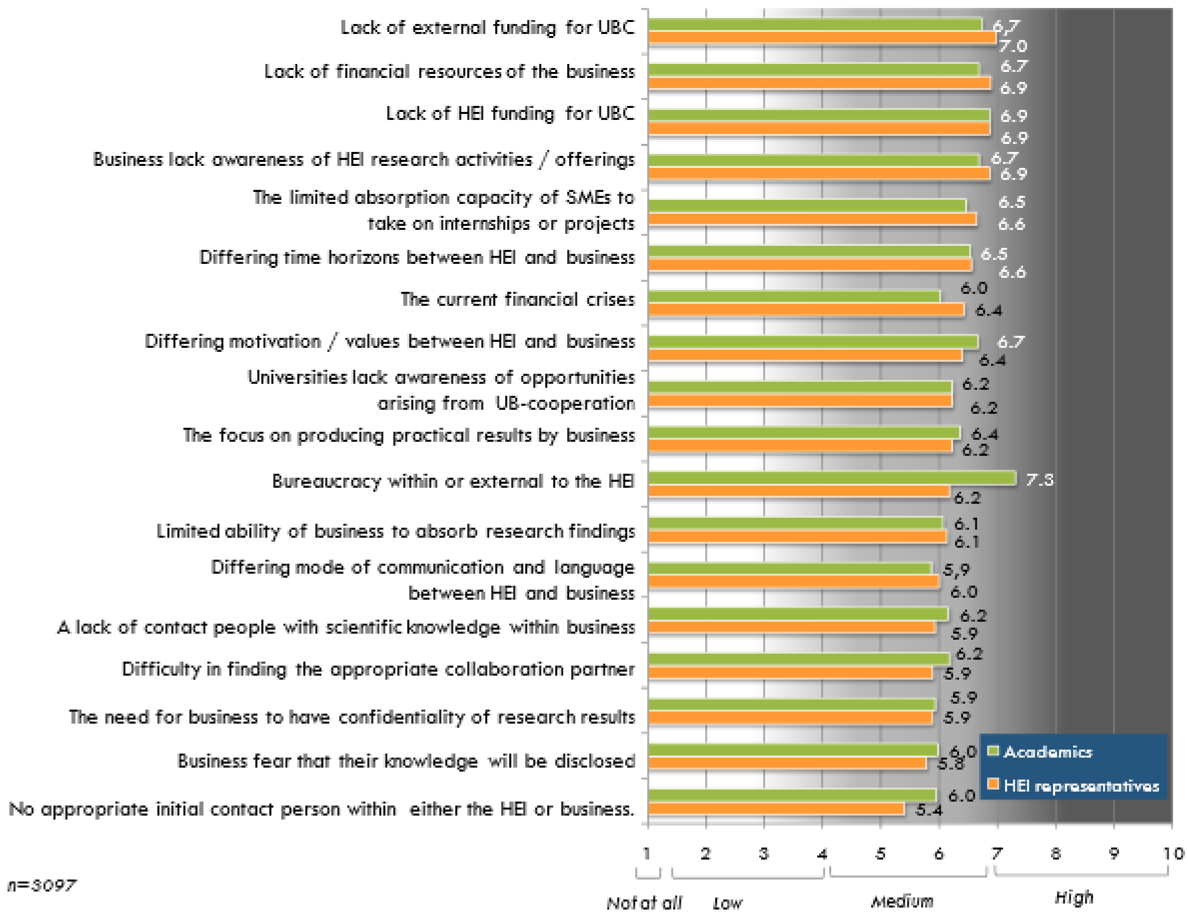

Figure 2: Five innovation management concepts to watch [2]

It is in this context, in which academics often perceive barriers and lack of technology valorisation knowledge and expertise that we base our study aiming to provide a decision making framework in order to elaborate some innovative possible business models so as to valorise specific research carried out in HEIs.

2 THEORETICAL ASPECTS

The need of technology transfer that facilitates latent knowledge in the research community to reach the society is quite clear at this point. However, the strategy for creating successfully innovative business models fulfilling this goal in a profitable manner, reminds uncertain or, worst: it is considered to be bounded to a desultory wandering resulting in spontaneous creative conception. Despite this popular misconception of creativity, research indicates that creativity is a repeatable process far from being random [4] while innovation is the profitable implementation of strategic creativity [3]. Therefore the current interest and the emergence of novel tools, procedures, models, mindsets, etc. intend to convert business innovations that are profitable into a repeatable process.

This work takes advantage of both: well-established and emerging tools for designing and evaluating business models to propose a systematic methodology based on a sieve strategy to generate profitable innovative business models. The sieve strategy can be posted as systematically outcast the undesirable solutions from all the possible solutions allowing to survive only the desired solutions[1]. The application of the sieve strategy for our purposes carries two major falls: (a) the need for a pool with all the possible business model solutions, which is impossible to compute; and (b), the need for accurate outcasting criteria, which is lacking. In spite of these facts, to achieve our goal of proposing innovative business models in a systematic manner, the former condition can be relaxed as a pool of possible business models large enough to contain solutions that would pass the sieve process; whereas, the latter can be derived from already existing business designing tools. The overall strategy outline is as follows:

- Obtain a large pool of possible innovative business models
- Apply a rough sieve to outcast models with inconsistencies in micro-environment conditions
- Apply a fine sieve by ranking the survivors based on macro-environment conditions

2.1 Generation of a large pool of innovative business models

The main concern of this step is that such a pool is large and broad enough to contain suitable business models. Therefore, our effort in define a strategy for systematically generate business models. Despite being an open question, there is a large set of tools for designing, mapping or evaluating business models. However, it lacks a one-size-fits-all methodology or a common framework wide enough to host them all. Each and every one of these methodologies available conceptualizes a business model in a very particular and independent manner. Despite the fact that each tool provides its own advantages and disadvantages by focusing on a specific area of the business representation, as a whole, they all present a large overlap since that the elements projected are the same. The work here presented takes advantages of several of those existing strategies and relates them to drive the aforementioned sieve strategy.

All the business modelling strategies can be grouped in to two categories: (a) business modelling, and (b) environment analysis. The former describes the internal structure of the business model, while the later describes the relation between the business and its environment either in a micro- or macro-scale.

2.1.1 Business modelling

The micro-environment business modelling tools used in this study are reported in Fig. 3. These are nothing but diagrams to map, illustrate, design and analyse the business model in hand. The tools present in Fig. 3, are: (a) the value proposition CANVAS [6], (b) the business model CANVAS [6], and (c) the magic triangle [7].

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1 A clear application of the sieve strategy can be found in [5].

The value proposition CANVAS is a focused view of the business canvas model that allows for fine design of the value proposition to build the business model up on this value proposition design. The business model canvas seems to be the most generic tool allowing to map the most information in the most compact form by incorporating not only the business itself but also the micro-environment and macro-environment (as explained further in this document). The last diagram, the magic triangle, is proposed by Gassman et al. [7] in a manner to test a business model against 55 innovative business model patterns in order to evaluate if any of these patterns can be incorporated to the initial design.

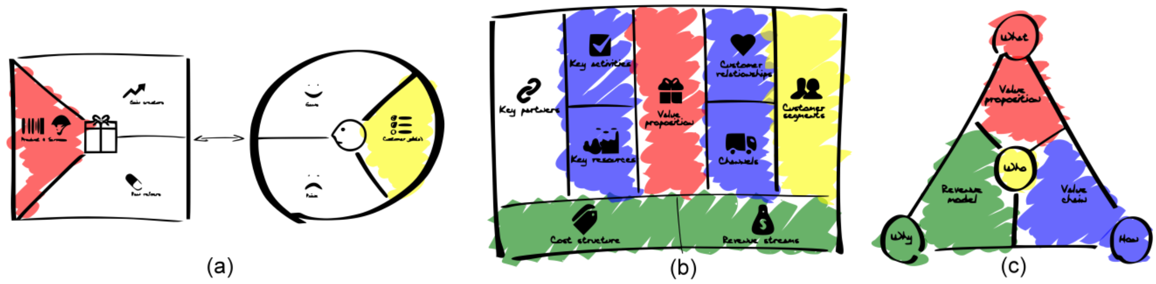

Figure 3: Relationships between the value proposition canvas, the business model CANVAS and the magic triangle. Areas with identical colours are highly related and can be mapped together.

Fig. 3 offers a coloured overlay describing the relation between the three modelling tools. The three tools are used in conjunction in an (a)-(b)-(c) manner in order to populate the pool of possible innovative business models. The value proposition canvas allows for aligning an initially spotted customer segment with the available products or services. Once aligned the two, an initial business model is build up based on those using the business canvas model. At this point other services, products, costumer segments or business needs might arise during the completion of the canvas itself. In order to systematically trigger the emergence of all these elements, the business model is mapped within the magic triangle where its 55 patterns can be applied to force changes within the business model. Using these model relationships, in conjunction with the 55 patterns of business models accompanying the magic triangle in [7], can be used to adequately and rationally carry out the design of multiple the business model canvas and their evolution. The bottom line is that all the business models are evolved in an iterative incremental manner by looping endlessly using the a-b-c sequence until the business model no longer evolves. When disjunctives in the models are found during this process all the variations are evolved independently and the resulting models are added to the pool.

2.1.2 Environment mapping

A business is not an isolated entity and particular environment conditions affect the validity of a particular business model or might even reshape the entire model. Fig. 5 illustrates the diagrams used to map the micro- and macro-environmental conditions using the well-known Porter's five forces analysis [8] for micro-environment mapping, and the PEST analysis focusing on the evaluation of the macro-environment. The business model canvas is used to map the influence of the environment analysis parts towards the existing business model. Again, these relations are illustrated as a coloured overlay in Fig, 4. The application of these environmental constrains will certainly invalidate some business models within the pool, validate some others and trigger new designs.

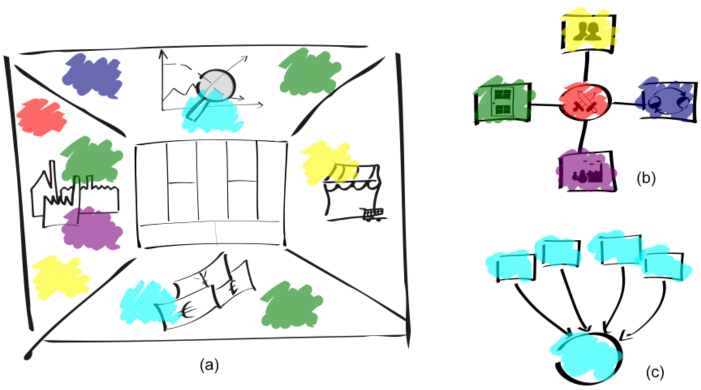

Figure 4: Correspondences between the external forces of the business canvas model, the Porter's five forces and PEST analysis.

2.2 Rough Sieve stage

At this point, the business models pool contains a large amount of possible business models, most of them with flaws, shortcomings or simply undesired business ethics as a consequence of applying an automatic generative business modelling. Therefore a rough sieve strategy is applied in order to cast out from the pool models holding contradictions or inconsistencies in their modelling.

2.3 Fine Sieve stage

Not all the surviving business models are equally desirable, however a criteria to find goodness of the business model solution in an analytical manner is neither available. Therefore, this work presents a modification to an existing tool to overcome such a lack. Such a tool should relate or measure the readiness of the existing resources within the lab with respect the business model value proposition. Therefore we build up on the House of Quality (HoQ) to construct such a tool.

Originally, this tool aims to rationalize the design phase for product manufacturing by focusing the product capabilities directly to the customers' needs. Our motivations for the use of the HoQ are slightly different from its original purpose. In brief, the HoQ is used here as an aided-decision tool in order to assess the value proposition maturity and categorize the business model in hand accordingly.

From the surviving business models, the bundle of products, services, features (i.e., value proposition) is already designed and so the “characteristics” of our value proposition. By targeting a customer segment, the needs of this segment are also a fixed input variable. Thus, the principle of the HoQ will be to evaluate the strengths and weaknesses of the value propositions when confronted with the customers' needs.

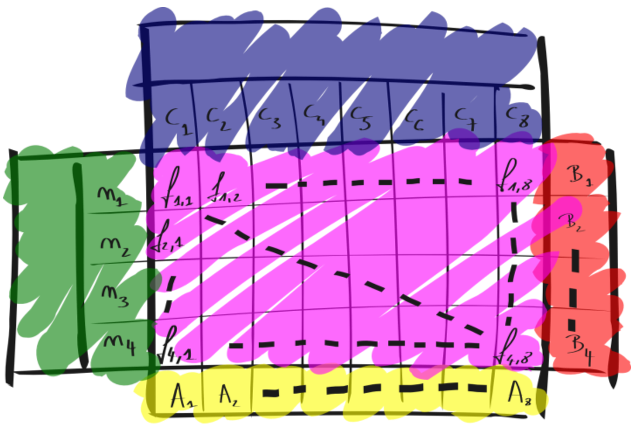

Figure 5: House of Quality - the following information are represented into the matrix - blue: technological features (i.e., “hows”) - green: customers' needs (i.e., “whats”) - magenta: needs vs. features (i.e., “whats vs. hows”) - red: completeness criteria - yellow: technical impact.

The HoQ is represented by a two dimensional matrix as depicted in Fig. 5. The matrix can be break into five main blocks:

Customers' needs correspond to the customer segment analysis in which the needs of the customers are identified. The value proposition canvas is the ideal tool to determine these needs. Each of the need can be more or less desired by the customer and can be weighted with a set weights n_k. The customers’ needs can be found through surveys and by using the value proposition canvas.

Technological features represent the characteristics which composed the value proposition. The importance of each feature can be weighted through a set of weights c_l. The technological features can be identified by in-house expert knowing the value proposition.

Needs *vs.* features is the core of the matrix. Each cell of the matrix correspond to the degree of fulfillment of a need by using a particular feature $f_{k,l}$. From this matrix, the marginal ``probabilities'' can be computed which correspond to the projection of the probability along one dimension. Thus, the following statistics can be computed:

Technical impact corresponds to the relevance of a feature on all the customers' needs and can be formalized as:

$$A_l = \frac{\sum_{i=1}^{K} f_{i,l} n_i c_l}{K}, \forall l \in L, \backslash$$

where K and L are respectively the number of customers' needs and the number of technological features. A_k is then normalized by $\sum_{k=1}^{K} A_k$.

Completeness criterion is related with the degree in which a need of the customer is fulfilled through all the features proposed and can be computed as:

$$B_k = \frac{\sum_{i=1}^{L} f_{k,i} n_k c_i}{L}, \forall k \in K,$$

where K and L are respectively the number of customers' needs and the number of technological features.

Therefore, by computing $\sum_{l=1}^{L} A_l$ for the L features composing the value proposition, the statistic obtained is related to the relative maturity of the technology in order to answer to the needs of the customers. Thus, building a matrix for each specific customer segment follow by a comparison of the previous statistic can lead to make the right decision to select the right customer segment and subsequently the right business model.

3 APPLICATION TO THE MEDICAL IMAGING GROUP OF VICOROB

3.1 Presentation of ViCOROB

3.1.1 Research laboratory

The computer vision and robotics group, ViCOROB was founded over twenty years ago at 1993, by three professors, and a bit of founding. This institute as part of UdG nowadays consists of 54 members and an average competitive founding of one million euros per year, from both research projects national and international. ViCOROB combines top level research with technology transfer, focusing on basic and applied research projects. At 2008, ViCOROB with the power of Catalonia Government was recognized as of Center of Technological Innovation Network (TECNIÓ), identifying it as a leading research group specialized in industrial research and technology transfer in Catalonia. This institution consists of four main lines such as:

- Underwater robotics
- Underwater vision
- 3D perception
- Medical Image analysis

This last line aims to provide hardware and software solutions for analysing of data with a particular focus of medical data and images. This line develops computer algorithms, such as image segmentation, pattern recognition, object detection and characterization, statistical signal processing and registration and is able to analyze different image modalities including X-ray, Magnetic Resonance Imaging (MRI), Ultra-Sound (US) and Computer Tomography (CT). This line includes the following subcategory research lines: (i) breast imaging, (ii) prostate imaging, (iii) brain imaging and (iv) diagnosis of cutaneous skin cancer lesion

3.1.2 Description of the projects developed within ViCOROB Medical Image Analysis line

In medical imaging field, the current trend of research is linked with the development of computerized aided systems. These software aims at assisting and facilitating the tasks of the radiologists during the daily jobs. Furthermore, MRI imaging becomes the cutting-edge modality for diagnosis and detection of diseases. The strategy of the ViCOROB's medical imaging line is to develop cutting-edge technology and algorithm for this new imaging technique. In the next section, an overview of the different projects in which the medical imaging group was involved will be presented.

ASSURE is a project financed by the European commission (FP7-Health-2012-Innovation 1-306088) for a total budget of 5,357,154 euros for duration from December 2012 to December 2015 and coordinated at the UdG by Dr. Robert Martí. The project is composed of ten top field organizations with a mixed partnership between industries and universities. At ViCOROB, the research is composed of eight researchers. In this project, new innovative solutions to overcome the shortcomings in breast screening using mammography imaging. MRI imaging as well as US are investigated and computerized tools developed in order to create a more personalize breast cancer screening.

IA-BioBreast project (TIN2012-37171-c02-01) is coordinated by Dr. Joan Martí for a total budget of 33,257 euros. The project has an identical thematic than ASSURE project and focus on developing computerized tool using MRI and US for breast cancer screening.

Segmentación automática de lesiones de esclerosis múltiple en imágenes de resonancia magnética (SALEM) project (PI09/91018) was coordinated by Dr. Xavier Lladó from June 2006 to June 2011 for a total budget allocation of 100,000 euros. The highlights of this project were to provide a computerized tool in order to detect, segment and describe multiple sclerosis lesions using MRI imaging. The project was undertaken by a team of six researchers. A strong partnership with three local hospitals (Hospital Dr. Josep Trueta, Cliníca Girona and Hospital Vall d'Hebron) was created in order to collect data from patients.

PROSCAN was a project coordinated by Dr. Robert Martí focusing on developing a computerized aided system in order to help doctor to perform prostate guided biopsy by making the fusion between MRI and US modalities. Two PhD candidates were dedicated at developing cutting-edge segmentation and registration methods which are the core of the computer aided system.

3.2 Study case: valorization of the research in prostate cancer

In this section, we present the guideline followed to retain a business model applied for computer-aided diagnosis system for prostate cancers.

After applying the business model generation and rough Sieve as described in Sect. 2.1, Sect. 2.2 and Sect. 2.3, the remaining business models are used to populate the fine Sieve stage. The rest of the section describes the ranking process whereas further details in how other sections have been applied to this study case can be found in [9].

However, some configurations are more appropriate than others depending of the readiness of the value proposition. Thus, the HoQ can be used to take decision on the final business model to select. The HoQs generated are presented in Fig. 6, Fig. 7 and Fig. 8 for the different customer segments identified in the first stage of the framework. The matrices have been filled by evaluating the criteria in accordance to the description given in the Sect.

Needs \ Features		Segmentation	Registration	Fusion	
Fast	0.6	2	4	5	
Easy	0.9	1	1	1	
Accurate	1.0	8	8	7	
Repeatable	1.0	8	7	10	
Compatible	0.8	10	5	6	
Ready-to-use	0.7	2	2	0	
Certified	0.9	0	0	0	
		3.96	3.41	3.67	11.04

Figure 6: HoQ for medical doctors segment.

Needs \ Features		Segmentation	Registration	Fusion	
Innovative	1.0	8	8	1	
Tested	0.7	9	9	0	
Accurate	0.7	8	8	9	
Fast	0.5	2	4	5	
Short time-to-market	0.8	2	2	1	
Published	1.0	0	0	10	
		3.75	3.92	4.93	12.60

Figure 7: HoQ for medical companies segment.

Needs \ Features		Segmentation	Registration	Fusion	
Visibility	0.6	7	9	0	
Know-how	1.0	8	8	7	
Promising	0.7	7	7	7	
Data	1.0	10	10	10	
Network	0.7	8	7	5	
		6.82	6.64	5.08	18.54

Figure 8: HoQ for research segment.

Considering a monetary valorisation, the suitable customer segment is the private sector. Nevertheless, in a case of research valorisation, the research segment appear to be the most appropriate.

4 CONCLUSIONS

Knowledge valorisation and technology transfer are trendy topics in which the aim was to make flow back to society the knowledge trapped inside universities. In this sense, in this paper, a study case at the UdG was analysed in order to illustrate the drawbacks and also propose a solution at these drawbacks. Concretely, we applied a theoretical framework, previously developed, to the ViCOROB's medical research line focusing on the prostate cancer topic.

Therefore, the objective of this paper is twofold: (i) proposing of a theoretical framework aiming at generating rationally innovative business model for valorising research carry out in universities. This framework is generic enough to be applied to other area than the one study in this thesis (i.e., medical imaging field) and (ii) applying this framework on the ViCOROB's medical imaging research line and specifically to the computerized system aiming at prostate cancer detection and diagnosis.

However, several limitations can arise from this paper. Mainly, the drawbacks are linked with the application of the theoretical framework. One important aspect to apply the valorisation procedure is to identify the customers' needs. In our implementation, we think that the customers' needs identified could be further analysed and refined through surveys. The right definition of these needs is important since that they are the bases of the HoQ analysis which help to make decision to target the right customer segment and generate the subsequent business model.

Subsequently, future works would focus on further analysis. Firstly, the design of a survey to define the customer needs which will be plug into the framework should be performed. We would like also to further analyse the different research topics at the ViCOROB's medical imaging research group. Technologies linked with breast cancers and multiple sclerosis developed in-house the laboratories could be valorise through our proposed framework. Finally, the background of the author being linked with pattern recognition and machine learning, they noticed that the formulation of the HoQ could be further investigated since that the utilisation of this tool could lead to an automatic determination of derived value propositions to be valorised by using spectral clustering for instance.

Finally, as previously mentioned, the universities have been assigned to a third mission linked with economic development transforming them from "Ivory Tower" to entrepreneurial universities. To our mind, by shifting toward this model, universities are driven toward economic or more precisely monetary benefits and the differentiation between universities and companies shrinks. It would imply that both entities enter in frontal competition which should have some effects on the strategies and organization of these structures which should be further investigated. It would be interesting to analyse the consequences of these shifts on the two primary missions of universities which are teaching and research. Another random thought concerns the process of valorisation. In the valorisation procedure, one of the first steps will be to protect the IP through patenting or copyright. To our mind, policy have two drawbacks: (i) monetary valorisation implies a limitation regarding the scientific publication due to the incompatibility between patent process and scientific publications and (ii) subsequently patents could lead to a slow down regarding the innovation by useless rising barriers. To our mind, universities should be involved to a fully open valorisation process by offering their knowledge openly which would speed-up the process of innovation in the private sector. One could argue that there is no existing mechanism allowing cash stream to flow back into universities and could lead to a dead end. However, we are thinking that government should play the role of referee by reinjecting financial resources from companies to universities in the case of an open stream valorisation.

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