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Chair of Entrepreneurship, Innovation and Technology

**The role of patents and geography of innovation in the
biomedical industry: the case of a new biomedical venture
in the diabetes devices segment.**

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Introduction

Biomedical industry is a science based industry. With the need to protect new discoveries in order to profit from them, the single firm has developed a constant need of knowledge accumulation systems to protect innovation from other firms or, in general, other competitors and organizations that could undermine company competitive advantage.

The literature has highlighted the importance of such methods to protect innovation in the biomedical industry during the last years and generally in science based industries. Such systems have acquired even more importance especially in the biotechnology and biomedical devices segments that now are leading the pharma and drug industries to another step of evolution.

The pharma industry has evolved in the last fifty years. Pharma companies that sell blockbuster drugs (over 1 billion dollar profit) have become more and more bigger and they have transformed their activity from only R&D activity to marketing activities. They could be considered in fact as “pharma holding” that prefer to acquire or create partnerships with small companies (e.g. biotechnological companies) rather than search themselves the way to prevent and cure new disease by Research and development. R&D has become, on the other hand, a prerogative of small firms, especially biotechnological firms in the drug case or new startup ventures in the case of biomedical devices. These companies are specialized in the upstream research and they try to catch the attention of big pharma to finance downstream research and further development of drug or device. In order to grant the correct growth, these small companies need innovation protection systems and to be placed inside a geographical cluster to improve their rate of success. Patents in fact could grant them a legal monopoly in producing a certain product and make profit from it, while geography of innovation let companies and especially new companies to acquire and share more competences and knowledge thanks to positive externalities that would have been impossible to acquire otherwise if simply located in an other place in the country or in the world. So, thanks to this analysis it could be understood how much it is important to protect innovation for a firm

in order to grant the company a competitive advantage, even if temporary, that could lead it to success.

On the other hand patents and geography of innovation could represent an important issue. In part 1 it will be analyzed the role of patents in these industries and how the situation could change in case of many rights on the same R&D activity causing a “tragedy of anti commons”. In the case of geography of innovation and location of such R&D activities a company must be able to detect the perfect cluster for its activities in order to have the better return on growth thanks to positive externalities. Usually the choice will fall in the most specialized cluster for the segment in term of other companies, players and public and private organizations. The most important obstacle in this consideration, especially for a new startup venture, is the ability to communicate with the different type of players and organizations, from competitor firms to public organizations such hospital or R&D centers that have an important role in developing the cluster business. In part 1 it will also be analyzed and discussed the importance of geography of innovation and cluster phenomenon. It will be also discussed the main characteristics of a biomedical cluster and its major players presented.

In order to let the reader have a better comprehension of such topics in the first half of part 1 it will be analyzed the main characteristics of biomedical industry with an important focus to biotech and biomedical devices segments especially in the actual techniques used to finance a small firm or a new company, the role of R&D and the role of partnerships that lead big pharma companies to incorporate with acquisitions and other instruments R&D activities of such small firms.

In part 2 it will be proposed the business plan for a new startup company in the biomedical devices for diabetes segment. In order to respect the main themes of this paper, and in order to avoid too much confusion, the business plan has been simplified and focused only on the most important parts. In fact have not been considered suppliers relationships, highly technical sections and a very accurate financial analysis. However a deep product description has been considered and a focus group market analysis based on interviews and the financial feasibility of the project thanks to the projected income statement for the next five years.

In part 3 the business plan will be analyzed taking into account the considerations made in part 1 and feasibility will be analyzed considering the role of patents and geography of innovation.

As these two factors are extremely important in this industry it's not possible to take into consideration only a financial feasibility of the project and it's fundamental to consider them into a deeper analysis.

Even if financial forecast are positive, the evidence will show that without a huge support by patents and geography of innovation in the form of clusters and positive externalities, new biomedical diabetes devices company will not be able to reach success and will fail in their first year of life due to lack of knowledge, lack of investments and lack of opportunity to acquire knowledge and technologies.

Part 1.0 The Biomedical industry

1.1 An introduction to the Biomedical industry

This chapter describes biomedical industry main features following, as key line, the arguments set out by Löffler and Stern (2006). Their vision is fundamental to understand industry ongoing and to manage the differences that take place inside the different industry segments.

Main biomedical industry target is to research, develop and produce drugs or medical devices that could help human beings to fight against diseases.

The biomedical industry can be considered as divided into four segments: the pharmaceutical segment, the biotechnology segment, the medical device segment and the diagnostic segment. The biotechnology segment as well as the medical device segment will be considered in this paper. The last one is strong engineering based if compared to others. All segments, and especially the ones we are taking into consideration (due to their role as motors of future biomedical innovation), are science based and driven, and they present an important characteristic that cause high entry barriers: they are highly regulated (e.g. in Europe EMA or in USA the FDA).

Regulatory activities concern all the studies, the analysis and the relative documentation that make possible a new biomedical device or a new drug to be commercialized by the company which has requested the authorization. After the time needed for the discovery and the research and development phases, the approval phase could take at least one and half year and generate costs that obviously company which develop the product must charge on the revenue of the same product or previous developed products. Once a product has been approved by regulatory authorities it can be commercialized. From that moment onwards there will be the possibility to conduct more clinical testing and collect data in order to evaluate further indications and to discover any other side effects and acquire more product information.

There are six main forces that interact within the industry and impact the two considered segments. They are the specialized human capital, the approval process (different in any

country or region e.g. EU), the financing mechanism, the risk due to the high rate of innovation of the industry and the high sunk costs and the ethical and political issues.

Patents and geography of innovation (that complete the analysis) will be analyzed singly in the second half of this chapter.

Specialized human capital is really important to grant correct growth of a company in the industry. In fact the high rate of innovation in biomedical and engineering fields requires employees that are not only able to manage the two segments singly but also together (in the case of medical devices in which biology meets engineering). It's very important for a company, thus, to acquire the right human capital and knowledge that will lead the company to success if any molecule or new product will be discovered during the Research & Development phase (R&D) and will be approved during the approval process by authorities. A good human factor could make the difference between firm failure or success.

The approval process¹ is the step that let the company introduce a product into the market and it's aimed to ensuring the product to bring benefits to the final user/patient without being without health risk for patients. This process obviously has a cost that must be supported by the company.

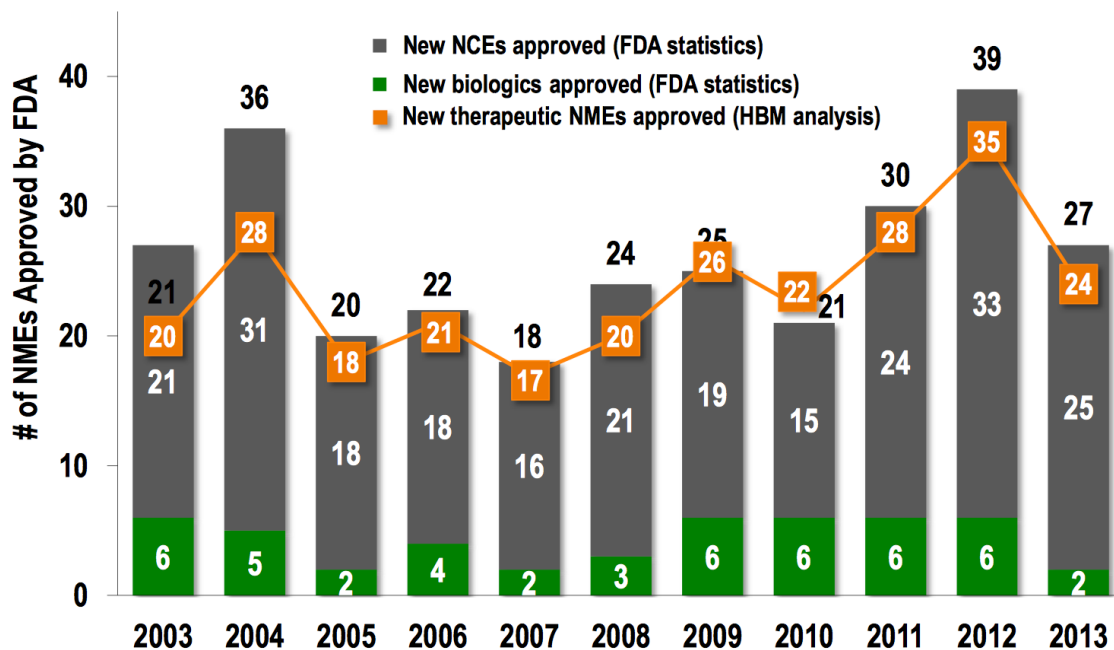


Exhibit 1: New Drug Approvals by FDA (2003-2013)
Source: FDA (www.fda.gov), HBM Analysis

The financing mechanism, instead, may vary depending on which segment we are considering. Here we will consider the main difference between the classic pharma segment and the biotechnology and biomedical devices segments (in this paper we are considering the foundation of a new venture and not a company that is linked to any Big Pharma company).

In the first case the search engine is focused on chemistry, and network is based on large and integrated pharmaceutical firms. In the second one the search engine is focused on molecular biology and network is based on a small and dedicated biotech firms or specialized centers. The different engines of growth of two examples cause obviously different financial structures and obviously different ways to finance their activities. The fact is very important if we consider that the R&D process is a very extensive process, and that discovering phases, and all new product developing operations take usually 10-15 years with an average cost of \$1.3 billion, in the case of extremely innovative new molecules, while it is \$800 million for more traditional molecules (the R&D process will be explained in more detail in the next paragraph). Faced with these data the two companies react differently. In the case of Big Pharma companies R&D expenditures could be covered with revenues of already offered to market products especially in the case of “blockbuster products” (drugs that generate sales greater than \$1 billion), only if they are not affected by end of patent protection.

The same consideration can be applied to biomedical devices and biotech segments in which such companies are owned by major players in the market (usually big pharma). The reality is quite different for those medical devices and biotech companies which are disconnected from the biomedical ecosystem and proceed without establishing relations with others companies. For this companies, which do not generate revenues, there are two ways to continue the R&D phase. The first is to create partnerships or to be acquired by large companies, the second is funding. The partnership method is usually frequent in case of product/drug development process in advanced stages when another company see the business opportunity to participate or share risks with the developer one and so to invest money. It must be considered that in most of cases there will not be a real acquisition but just a partnership finalized to product or products development

(e.g. the partnership between Pfizer, a big pharma company, and Protalix, a small biotechnology firm).

Partnership funding is just one of the way to fund a biomedical venture. It must be also considered venture capital funding, government funding and public offering (IPO). Venture capital funding has few importance in investing in early stage R&D. In fact 2008/2009 economic crisis modified investors behaviors (they are more likely to invest their money in low-profile investments). Government funding plays a greater role in investment in advanced early stage R&D. Funds could be disbursed in different ways, like government grants or tax credit but both are usually finalized to cover expenditures, and not to have a huge role in financing the totality of R&D in companies. The final method of funding is Public offering² (IPO).



Exhibit 2: Biotech IPOs valuations
Source: The future of the biomedical industry in an era of globalization
(part 1, exhibit 15)

IPOs are very important to give the new company a stable financial plan and the opportunity to research and develop products. This instrument has increased its power in the last years. In fact the current historical moment presents investors which have less capital to invest and fundings that are more difficult to be obtained for companies. Obviously (when approaching to an IPO) companies must not consider only their

product pipeline and how they will be developed, but also the general IPO environment that could be favorable or unfavorable.

Usually this type of companies represent a great example of small public firms and have their stock price extremely correlated to their R&D success. Thus, when a patent is approved or capitals are going to be invested stock price peaks, as the case of Oramed Pharmaceutical Inc. which is trying to develop an oral solution for type I and type II diabetes disease³.



Exhibit 3: Stock Chart Oramed Pharmaceutical Inc. ORMP (U.S. Nasdaq)
Source: The Wall Street Journal

Exhibit 3 presents the lower value at the end of September 2013 and the highest value in the middle of January 2014 (the chart is based on the last 12 months). The lower value represents the average Oramed price per stock since its IPO. The rising stock value in December and the high value in middle January show a higher interest of investors due to the two following important facts: the release of new stocks to finance R&D, and the obtained patent protection for Oral Delivery of Proteins in Russia, European Union, Israel, China Australia, Japan and New Zealand. The subsequent micro trend is going down probably because approval of the R&D 2 stage was not able to replicate the same

positive growth that Oramed showed at the end of 2013 and in early 2014. However trend is positive.

Biomedical industry and especially the two segments (biotechnology and medical devices) we are analyzing are characterized by high risk and high sunk costs. This is probably one of the most important factors that have made less investors undertake biomedical activities projects and lower number of investments. The high risk and the high sunk costs are mainly due to the R&D⁴ process that, once has been undertaken by the company, could lead to no value for the enterprise if the new product will not be discovered, or if the final product will not be approved by authorities. The higher risk of this segments is most understandable compared to other industries considering that biomedical has the highest R&D cost compared to all other therapeutics drugs industries, and if we consider that R&D costs are very high. Average spending to develop a new product starts from \$800 million to \$1.7 billions and, on average, it takes approximately 12-15 years (from patent registration). Patents duration, on average, is 20 years. It means that a company must be able to get return on its investment in only 7 years. A short time if compared with the R&D one.

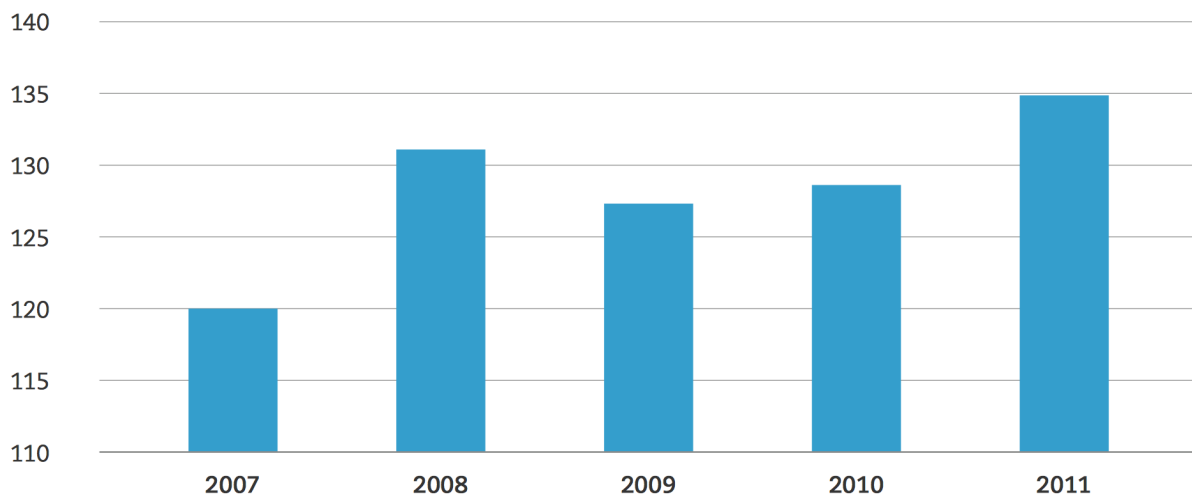


Exhibit 4: R&D total spending in \$billion
Source: ifpma.org

The drug development process⁵ is usually divided into three stages: the discovery stage, the development stage and the commercialization stage. Before these three stages R&D experts work in order to discover how a particular disease could be targeted.

In the discovery stage a particular drug candidate must be validated. It means that the drug (in biotechnology could start from a cell of mammals or bacteria, that are genetically modified in order to express a protein) must have an efficacy against the selected disease. This stage usually takes 4-6 years.

The development stage is divided into two stages: preclinical testing and clinical trials. In the first one the new drug will be tested in laboratory and on animals, while the clinical trial provide to test the drug on humans. This second stage is also divided into three phases; phase I, phase II and phase III. In phase I it will be determined the safety dosage on 20-80 volunteers patients, in phase II it will be determined the side effects and the efficacy of the new drugs while in the phase III (that is also the first step for regulatory drug review) new drug will be prescribed to 1000-5000 volunteers patients to monitor reactions and long term effects. The preclinical testing take usually 1 year while the three phase takes 6-7 years to be completed.

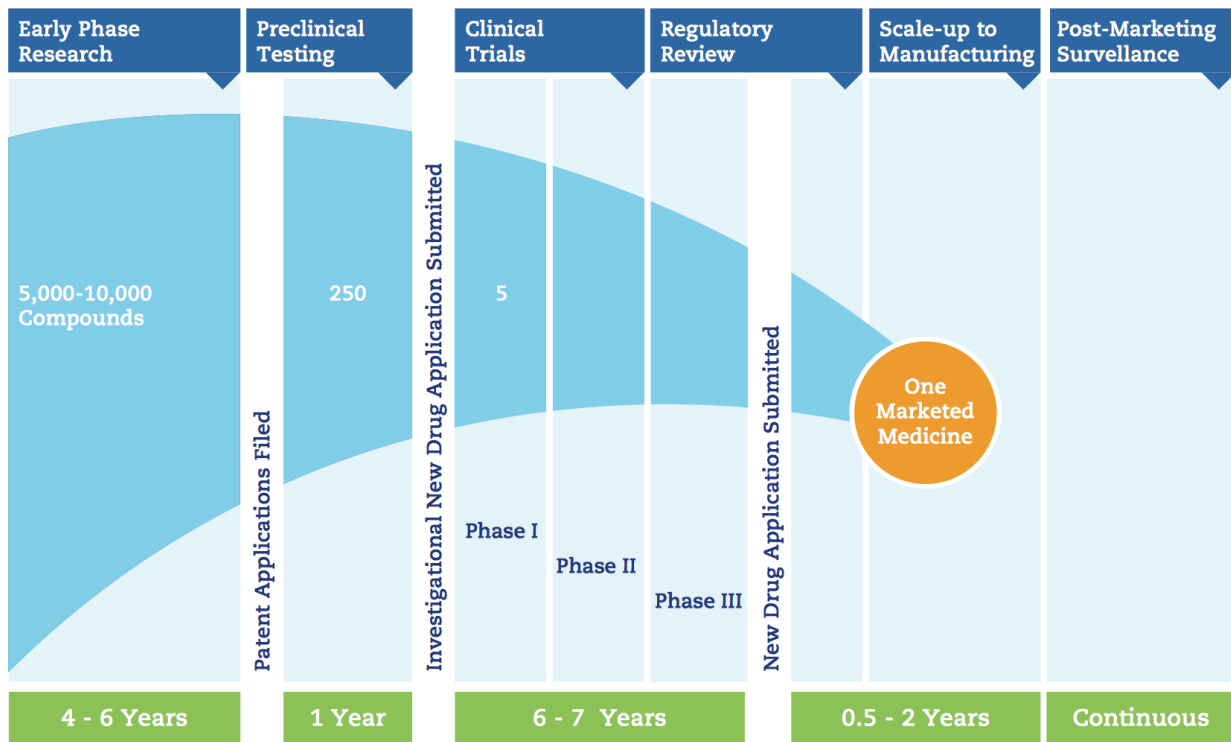


Exhibit 5: R&D process and drug funnel
Source: ifpma.org

In the last stage (commercialization stage) the new drug will be manufactured. After commercialization, the knowledge on the drugs increases, additional clinical tests on patients are undertaken to identify new potential indications or therapies, and the post marketing surveillance allows to verify new side effects and create the basis for making the drug more safe.

All these processes are depicted in exhibit 5.

Biomedical R&D presents a characteristic funnel shape. In fact, it must be considered that not all new drug candidates will reach the final stage. Usually, data show us that on 5000-10000 new potential drugs only 250 reach preclinical testing, only five reach the three clinical trials phases, and only one will be able to reach the authorities endorsement and to be commercialized.

The high industry risk is due to great amount of R&D losses⁶ that a company must experience. Obviously amount of losses is directly proportional to advanced stage of discover. An early stage failure (Early Phase Research) will cost less losses for a company if compared to a late stage failure (e.g. if the final drug will not be approved by FDA or EMA). Furthermore in the last years authorities has applied harder testing requirements that, with increasing R&D costs, have caused a drop in approved drugs.

The same general risk rules are valid for the biomedical device sector. Even if in this sector there is not the drug funnel shape, R&D development is extremely influenced by regulatory activities that could cause losses on investments if the final product will not be endorsed.

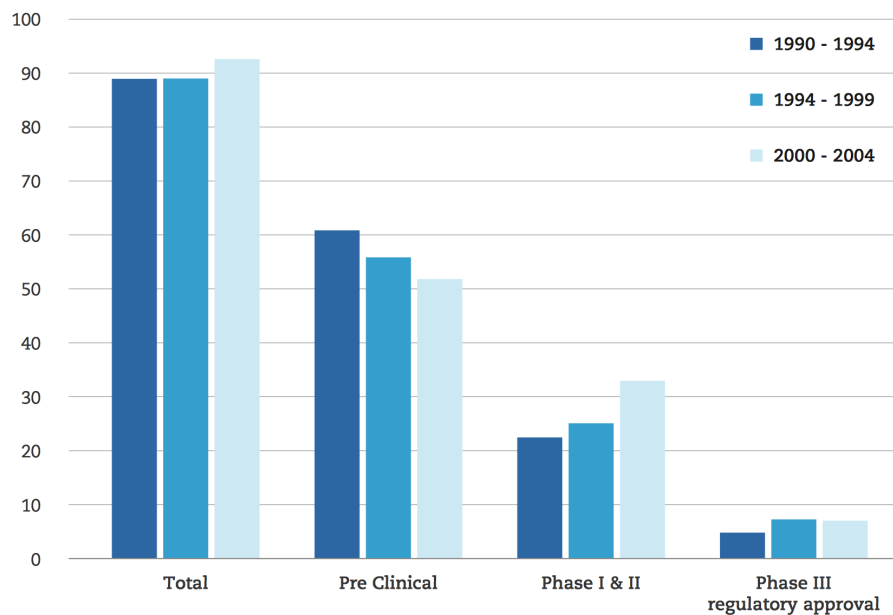


Exhibit 6: R&D rate of failure (Note that the rate decrease when increase the R&D stage)
 Source: ifpma.org

Political and ethical issues are the last but not less important item to be considered. The biomedical industry is very particular due to the interaction between players⁷ (consumer, health provider and payer of services) and healthcare industries. Unlike than the traditional companies, where there is a direct relationship between company and consumers, in the biomedical industry a third party is present between them. Other players, such as governments and insurance companies, pay for patients and own the direct cost for healthcare. In the European countries this cost is usually undertaken in high part by government and in a small part by insurers. The situation is reversed in Anglo-Saxon countries. It has to be considered anyhow that the final cost of healthcare is partially or completely sustained by the patients, although with different mechanisms, such as taxation of voluntary insurance payments.

The advertising channel is also different. Two main types of drugs and devices must be considered: ethical drugs/products and OTC (over the counter) drugs/products. Ethical

drugs and devices are drugs that patients could assume only if prescribed by a physician or if authorized (e.g. an insulin pump to manage diabetes). OTC drugs/products are items that don't require prescription. It means that for the last ones, marketing operations are lead in the same way other industries do. A different marketing approach usually lead ethical drugs/medical devices. In fact, in these cases, marketing efforts are addressed to physicians, very often specialized physicians more than family physicians and not to patients. These drugs utilization in fact is linked with physician prescription and suggestions (e.g. in Italy a patient to buy insulin must be registered in the diabetic register). In the gap between Consumer (patients) and Health Providers (hospital, doctors etc.) there are the Payer of service (insurance, governments etc.). Thus there is no direct relationship between biomedical innovators and patients but this one is intermediated by health provider as shown in exhibit 7.

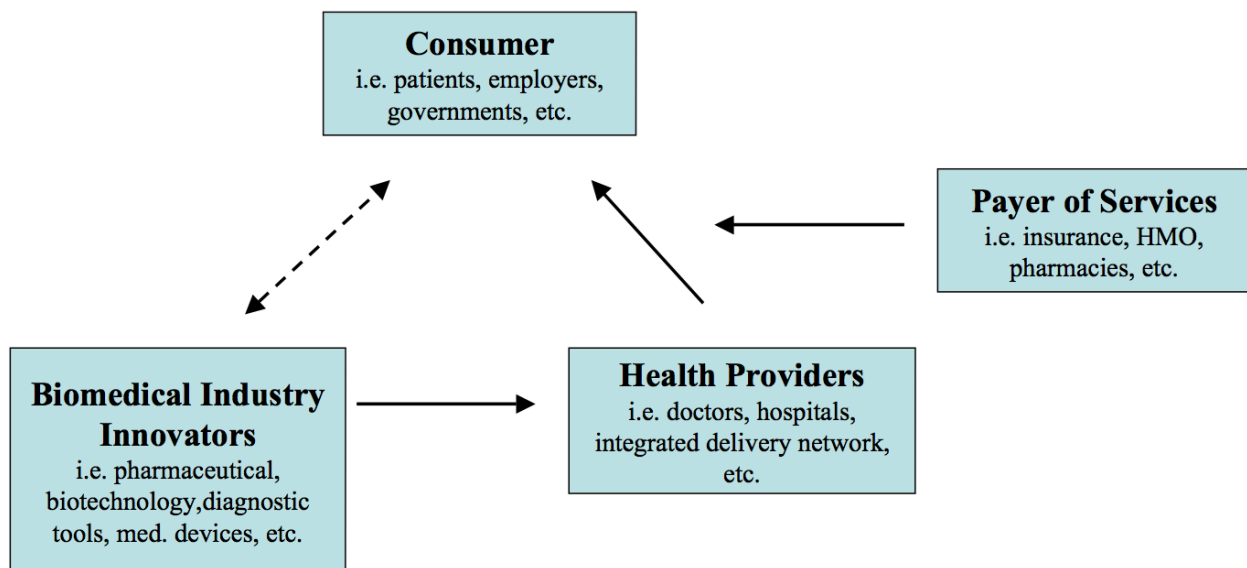


Exhibit 7: relation between players in the biomedical industry. Dot lines show direct-to-consume advertise. Plain lines show indirect advertising.
Source: The future of the biomedical industry in an era of globalization (part 1, exhibit 2)

1.2 The role of patents in the biomedical industry. The “Tragedy of the anti-commons”

The most important feature that represents the biomedical industry is the constant need of innovation. Innovation in fact is the most important engine of growth for biomedical companies. A key factor that let companies which operate in the industry to reach success is intellectual property protection.

As we have analyzed in the previous paragraph biomedical companies, especially those which work on projects with high rate of innovation, spend a sum that may vary between \$800 million to \$1,7 billion in R&D. Intellectual property rights, and especially patents, exist to justify this sum. In fact, without patents, companies wouldn't be able to attract investment on R&D due to the inability to fully make profit from R&D results. In fact other players in the industry could copy their R&D results and develop similar products if R&D is not protected.

Patents grant a situation of temporary monopoly in favor of the company which has claimed the right until the end of the same right. When a patent right ends, other companies will probably produce a drug or a product with the same characteristics (obviously a different name). This is the case of generic drugs. In this case companies could not have a similar R&D phase to let the product be approved, but they have the possibility to only demonstrate (to regulation authorities) equivalency.

A different situation affect biological drugs. In fact they present a different scheme of composition (without any process that could prove an empirical equivalency). In this case this type of endorsement won't be applied.

Thus, patents let biomedical companies to have a protection from imitators. In the innovation process the role of patents is dual.

First, patents grant academic knowledge growth. In fact patent holders are forced to codify the knowledge they have acquired with their R&D, and they are obliged to deposit knowledge in order to commercialize them.

Second, they let successful R&D companies pick-up their R&D results.

Governments set ideal patents duration and amplitude. In fact, if patent duration is too high, companies will register patents and they will use patent right, but positive effect for common knowledge will be delayed. If the duration of patent is too low, companies would not see any convenience to make R&D (e.g. 12-15 years of R&D for a new drug with no possibility to have revenues). The same trade off must be analyzed for amplitude. If a patent is too ample it will be generic, and that means that it will be difficult for other companies to develop a similar product, and the company which has patent right will be overly protected. On the contrary a low amplitude won't be able to protect new inventions. So a trade-off has been applied. Average patents duration is 20 years, and they have middle amplitude.

An important point of view is the one proposed by Heller and Eisenberg (1998). This opinion is the base of many reflections undertaken by different authors in the last years, and it is one of the most controversial IPR arguments in the biomedical industry. In 1969 Garret Hardin, a nature scientist, published on "Science" journal an article called "Tragedy of the common". The aim of this article was to explain some biological problems like extinction, and overpopulation. The result was that, in his opinion, a common property becomes overused (social benefit slowly go down from a certain point) because anyone has the incentive to conserve and to exploit the property in the most profitable way for society.

On the contrary Michelman (1982) coined the term of "Tragedy of anti-common". In this case the overuse of property is not due to common property rights, but due to many rights given to many owners where any subject, the right owner, have the possibility to exclude another right owner. Without transaction costs, owners could easily sell their rights and so the two "tragedies" will be avoided but in the reality there are many transaction costs and rights transactions are not usually possible. As Michelman (1982) defined, anti commons are *a type of property in which everyone always has rights respecting the objects in the regime, and no one, consequently, is ever privileged to use any of them except as particularly authorized by others.*

This situation describes perfectly what is happening to biomedical industry where innovation pivots exactly on such rights.

The focus role of patents, especially for upstream patents (patents that characterize the early stages of a new research), is to create and fortify better incentives to R&D research, granting investments in different ways, and let the company to have a better distribution of costs during different R&D stages. The problem is that if the early stage R&D is crowded of rights owners, this could create obstacles to future research work success.

With an extremely variety of patents in the early stage R&D, and a huge number of scientists and institutions that want to claim their rights, the road to biomedical innovation could be stopped, or at least, very slow. Thus, the privatization of upstream research could be useful to increase the number and the amount of money invested in R&D but could create a “tragedy of anti-commons” with an overlapping system that will cause clashes between different rights. In this case the role of public institutions become more important. They should be able to minimize licensing on upstream research in order to spur downstream research and avoid the tragedy making scientists and organizations able to avoid rights overlapping. Overlapping rights could deter organizations to proceed with downstream research and so to lock the innovation. This means that innovation could be reached, but that anyone (scientist or organization) will be able to reach it due to the impossibility to proceed with R&D without clash with other rights owners, and fall into legal troubles.

However, in the most of cases, the described situation is an ideal situation. It could be right to apply “Tragedy of the anti-commons” in the case in which there are no information asymmetries and patent holders are able to apply all upstream R&D benefits to downstream R&D. However this scenario is not generally possible due to two different reasons.

First, institutions, in the most of cases, are not able to proceed with downstream R&D and their limits block their actions.

Second, R&D is characterized of much uncertainty that let impossible to a single patent-holder to have clear ideas on what upstream discoveries study in deep in downstream research, and to understand the real commercial impact of a new product (success is commercialization).

In those cases upstream research patents are not able to make ever a negative influence in downstream research and so they are not able to avoid scientists and organizations to proceed with the R&D process.

Whatever will be biomedical companies future, (big pharma will probably become only marketing entities, and they will lost their R&D power increasing acquisitions of small biomedical firms) patents will have ever a crucial and important role in order to grant a correct stream of innovation to let biomedical R&D firms grow.

Regulators role will be also extremely important. It should be able to assure innovation and grant at the same time its protection.

1.3 Clusters and geographical proximity in the biomedical industry

Different industries have different ways to produce innovation. An interesting point of view is the conclusion reached by Mariani (2006) that has compared the R&D driver of innovation in traditional chemical companies and in biotechnology companies. The results show that in the first ones, valuable innovations are produced only with internal R&D and company support (usually big chemical companies). What makes these companies reach valuable innovation are competencies. The biomedical industry, and especially the biotechnology sector, not only base its R&D success on its competences but also on geographical proximity (that let companies have access to knowledge easily). The presence of this factor, thus, affects in a positive way the rate of discovering a new “technological hit”.

When scientists, or in general people and organizations, are very closed (in a geographical way of meaning) to each other, consequence is reciprocal exchange of

information that brings to higher and shared knowledge. When knowledge is produced by universities or firms, it could “spills over” and create positive externalities. It means that other organizations, that are in the range of previous ones, could use this knowledge for free without asking royalties or pay for patent licensing. Such knowledge transmission will be possible only when firms (the ones which create knowledge, and the ones which receive knowledge) are extremely close one to another and they are bounded in space.

This is the reason why in some regions knowledge spillovers have an higher rate of impact if compared to other regions without a huge group of firms that create and transmit involuntarily knowledge, and that firms that are really close to the knowledge fulcrum are able to attract more positive externalities if compared to more distant ones. Thus, knowledge spillovers are classified as local public goods because their primary characteristics (in the local areas) are non-rivalry and non-excludability.

It means that all firms that receive positive externalities are able to take advantage of them without excluding others firms, and it will be difficult exclude a company from positive externality (all firms in range could use them).

In the biomedical contest, knowledge spillovers result to be very important due to main biotechnology and biomedical devices knowledge accumulation characteristics.

The importance of knowledge spillover become higher if the knowledge we are taking into consideration is tacit or complex. Tacit knowledge is very difficult to codify and transmit. Complex knowledge, instead, require a direct contact between the knowledge sharer and the knowledge receiver because it could not be easily understood. In these cases geographic proximity importance rise and let firms to have more successful R&D and innovation processes.

Thus, to assure successful biomedical R&D and innovation must be undertaken inter-institutional-relationships. Inter-institutional relationships, with knowledge as a positive externality, stimulate biomedical clusters born and their following development.

In these regions (clusters) we could find extremely concentrated activities of biomedical firms that let innovations have a better rate of growth and success, if compared to other regions with same type of firms. The fact that connects high innovation rate to this

places is that, usually, there is a cyclic effect which characterize them. It means that any innovation in the cluster could only generate more innovation in the same cluster allowing innovations put their roots in a place and never abandoning it⁸.



Exhibit 8: USA biotechnology and biomedical devices clusters. Colored states indicate high biomedical employment and specialization
Source: The future of the biomedical industry in an era of globalization (part 1, exhibit 9)

Clusters are characterized by four statements. If in a particular region will be noticed the presence of these statements, the place could be considered a cluster.

First: companies must be very closed one to each others (geographical proximity).

Second: it should exist a type of co-ordinating mechanism that let firms interchange information and knowledge. Firms, furthermore, must be able to understand they are part of a cluster.

Third: activities should be linked (in a biomedical cluster, biomedical activities).

Fourth: cluster companies must have an higher rate of growth and innovation if compared to similar companies that are not part of a cluster.

Waxell and Malberg (2007) describe the actual structure of Uppsala biotech cluster. It's writer opinion that this type of structure split could be applied not only to the Uppsala case, but also to the most variety of biotechnology and biomedical devices clusters.

Cluster fulcrum is industry (all the firms that compound the industry) and this is the place where innovation is transformed into successful products. Thus, the first block is “biomedical industry”.

The second block is “public and private research organizations”.

The role of universities and public organizations is fundamental to help firms codify in the right way knowledge

The third block is “financial organizations”. This block is fundamental to grant investments on ongoing R&D.

The fourth block is “supporting and complementary organization”. They are organization that help knowledge to spillover and innovation processes to be deployed.

Cluster composition is visible in Exhibit 9.

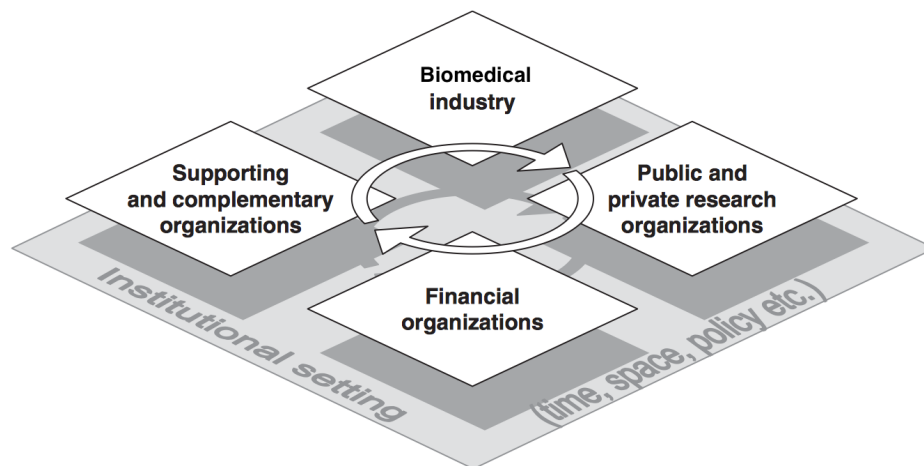


Exhibit 9: The four block that characterize a biomedical cluster
Source: What is global and what is local in knowledge-generating interaction? The case of the biotech cluster in Uppsala, Sweden (2007), exhibit 1, modified

What make finally all these blocks work is interconnection. Only with blocks interconnection a cluster will be able to grant better performance to internal companies.

Part 2.0 Business Plan for an innovative medical device to help patients to manage type I diabetes

Business plan of a new startup company will be analyzed in this chapter. Main new start-up companies target is to create a new medical device that will help patients to better manage type I diabetes. This business plan will consider all keys factors that are important to start-up a new company in this industry. However in the analysis will be omitted some parts that are not useful for paper purposes. In particular have been omitted supply chain analysis, some financial forecast (balance sheet, cash flows and ratios) and date milestones chart. It will be included a basic financial analysis.

Part 2.1 Executive summary

Armidal, Inc. (the company) is a medical device development company which has, as main target, to design, develop and patent a new medical device that will let type I diabetes patients to better manage their disease. Armidal need, to start with design and development processes, to obtain patent license for a new particular micro-needle technology that it's fundamental to reach final product design.

This technology in fact is Armidal most important asset.

Diabetes market

Type I diabetes is a metabolic disease characterized by the presence of high quantity of glucose in human beings blood. In healthy human beings cells capture glucose and consume that thanks to insulin. Diabetics human beings are not be able to do that. There are two types of diabetes: type I and type II.

In type I diabetes (youth diabetes) pancreas is not able to produce insulin, the hormone that let body to eliminate glucose. Insulin in fact is able to inhibit glucagon that has the

role to increase quantity of glucose in the blood. Thus, cells capture glucose but they don't have insulin to metabolize it. It's usually diagnosed before 20.

In type II diabetes (senile diabetes) cells are not able to metabolize glucose due to a deformation that has reshaped their frame. It's usually diagnosed after 50.

Armidal market is people with type I diabetes (see market analysis for more information).

Type I patients must assume external insulin but they can't do via oral because gastric juices will destroy insulin before it will be able to reach blood. Insulin assumption is very traumatic because it must be injected via skin (3-4 times in a day). Syringes have been outdated by insulin pens that have a thinner needle, and by insulin pumps. However these solutions are painful, not discrete and traumatic (patients require to change portion of skin for injection due to abrasions and bruises).

As a 50 type I diabetes patients between 20 and 50 years focus group shows there is the need for a less traumatic, more discrete and painless diabetes management device.

In the world there are 70 million people with type I diabetes but data show that the number is growing. In 2035 affected patients will be 100 millions.

Technology

Micro-needle technology patent (A minimally invasive microchip for transdermal injection/sampling applications) is registered by University of Pisa in Italy (Armidal must obtain in license or acquire the patent) and grants painful injections and help to sample glucose and inject insulin in a painless way.

The core is a micro-silicon plate with micro-silicon needles (not visible to human eye) that are able to penetrate skin painless because they not reach pain receptors. When they are into the skin they are able to sample glucose level (complete working description in product description) and to inject insulin from a reservoir.

This technology will be extremely powerful if integrated into Armidal final product. This is the reason because it is considered a key asset.

Strategy and Milestones

The main strategy pursued by Armidal is to obtain in license micro-needle patent technology, proceed with biomedical device design and development, register patents to conclude the development process, obtain EMA and FDA authorizations for production and commercialization, produce the biomedical device and sell them starting from the second half of 2017 (first as a prototype).

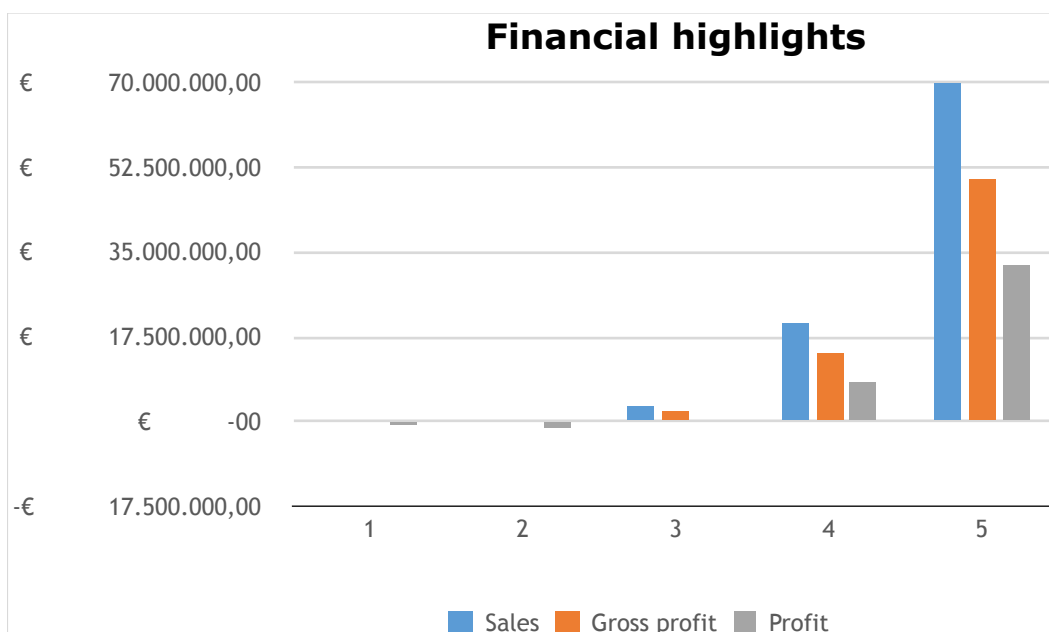
Acquisition by big pharma companies or biomedical devices companies will be evaluated.

Armidal competitive advantage will be based on “Life” innovative diabetic management system.

Compared to other products Armidal product (see the product section) will be less traumatic, more discrete and painless.

Financial

Based on financial projections, if start-up company will receive €5 million (private funding) in the first 6 months and will make an IPO before the end of the second year, it will be able to be profitable in 4 years (by 2017). It will reach €32.684.400 profit in year 5. More details in financial section.



Part 2.2 Company Summary

Armidal purpose is to develop a device for type I diabetes management, and after the commercialization of such product it wants to continue R&D activities to produce medical devices for diabetes care at least for 10 years. At the same time Armidal wants to create an important market position in diabetes segment in order to conquer patients and physician trust. Company's growth could be summarized in these focal points:

- License micro-needle patent technology from University of Pisa
- Develop the biomedical device product and design it for a better patient experience
- Build brand and reputation in the diabetes market, especially patients and physicians
- Set company structure and organization
- Complete the development and begin commercialization of the product (at the beginning public and private organizations)
- Continue R&D in diabetes market for medical devices products
- Use old product revenue to financing new R&D projects

Startup summary

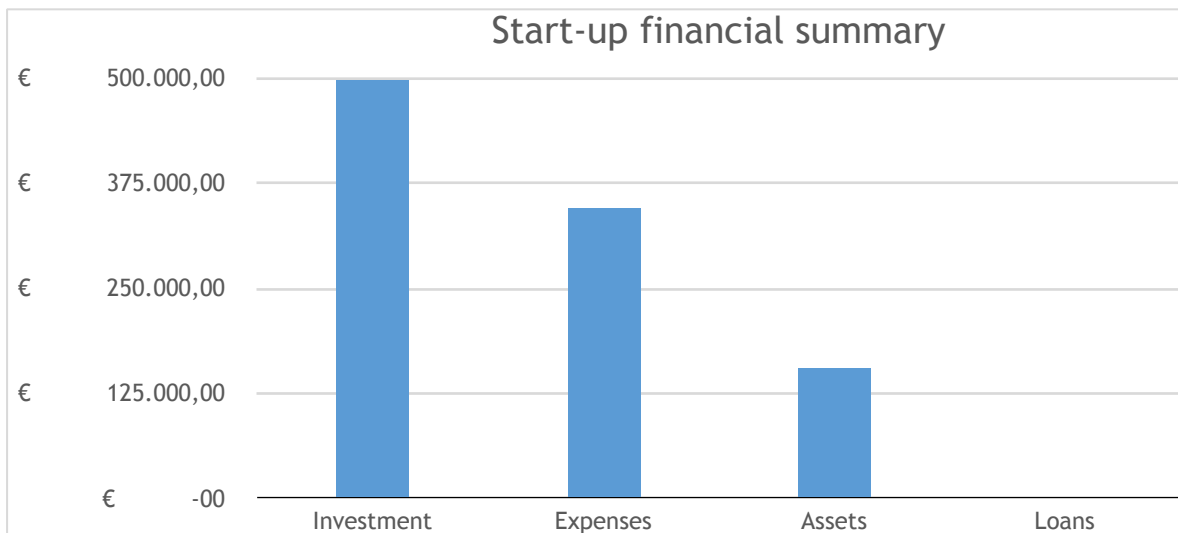
In order to start the company in a successful way some key elements must be respected:

- Set the location of the business (R&D and offices)
- Corporate identity establishment
- Legal start expenses
- Funding working capital, basic equipment and necessary funding for operating activities
- Salary (workers and management)

In order to grant sustainability of startup expenses and in order to grant a sufficient capital to let the company grow, founders must fund the new company with €500.000.

The €5 mln funding must be provided by selling owners shares via private placement within the first 6 months of activity. The scope of fundings would be in part to finance operative costs and R&D and in part to acquire or obtain in license the micro-needle technology patent.

In the table above are explained main startup expenses and final Capital and Liabilities of Armidal Inc. at the end of the start-up process.



Start-up

Requirements

Start-up expenses

Legal	€ 100.000,00
Consultants	€ 7.000,00
Rent	€ 5.000,00
Insurance	€ 10.000,00
R&D	€ 200.000,00
Expensed equipment	€ 15.000,00
Other	€ 8.000,00
Total start-up expenses	€ 345.000,00

Start-up Assets Needed

Cash balance (day 0)	€ 155.000,00
Start-up inventory	€ 0,00
Other current assets	€ 0,00
Total current assets	€ 155.000,00

Long term assets	€ 0,00
Total assets	€ 155.000,00
Total requirements	€ 500.000,00

Funding

Owner	€ 500.000,00
Total owner investment	€ 500.000,00

Current liabilities

Accounts payable	€ 0,00
Current borrowing	€ 0,00
Other current liabilities	€ 0,00
Current liabilities	€ 0,00

Long-term liabilities	€ 0,00
Total liabilities	€ 0,00

Part 2.3 Product summary

Product description

Armidal Life is an innovative product for type I diabetes management. It is an armband that will be positioned on the upper part of arm, one of the position suggested for insulin injection and glucose sampling. It contains, inside, a glucose meter and a small insulin pump that allows patient to have a three days insulin autonomy, and it's charged with small insulin cartridges. Battery autonomy is also three days. Micro-needle must be changed, in order to have no sampling and injection problems, every three days. So, every three days patient could remove the armband, change components and charge battery.

In order to let all the processes be comfortable Life has two lock-unlock systems that let patient to change in just a few seconds insulin cartridges and micro-needles.

The actual production techniques let Life to be very small and light. A particular design and development process will be implemented in order to grant the perfect ergonomics for all types of upper arms. When set on the arm a button will be pushed and the micro needle will penetrate skin granting sampling and injection actions.

In the armband will be also included different sensors in order to make Life able to detect motion, calories burned, heartbeat, body temperature, distance, quality of sleep and other movements characteristics.

Life target is people between 20 years and 50 years, and it include people with type 1 diabetic that everyday play sport (see market segmentation section), so it must be able to resist to all sport required conditions, normal or extreme. In order to meet these patients needs Life must be projected to be dust resistant, water resistant and shock resistant.

Micro-needle technology will be able to absorb and not damage patient skin, in case of shocks, if compared to traditional needles technology.

Life materials and design technology will let Life to be ever on arms in every moment of patient life without causing skin irritation.

Life Cloud app is Life direct communicator. It will be installed on mobile devices and computers and it will receive and store Life data in databases. Thanks to cloud technology patients will be able to see a summary of this data at every moment on mobile devices or on computers or via browser.

How the product works

Life will be positioned on patients upper arm. Thus, it will be able to sample glucose in blood. Glucose in blood will not be detected using normal technique (chemical way with litmus test) but using a new technology called electrochemical detection.

Micro-needles will not penetrate the skin to the blood (this will cause pain), but only to the most superficial layer of skin (micro-needle technology in particular will be able to do this without touching human pain receptors granting a painless process). Silicon micro-needles will capture a small amount of interstitial fluid that is very good current conductor. The presence of glucose in the blood will let interstitial fluid change its conductor property rate. To different levels of glucose in bloods they will correspond different current potential differences. The first time the sensor will be inserted into the skin it will be calibrated using the traditional chemical method (take a drop of blood and sample), so the sensor could be instructed to further detect glucose level with electrochemical technique.

Glucose sampling will be executed every five minutes. This will let patient to have a better everyday scheme of glucose level and, at the same time, will not drain battery.

Once glucose level has been sampled, if its value is higher than normal, Life will proceed to calculate the optimal amount of insulin that must be injected (patients could also modify this amount) and it will inject automatically in patients skin.

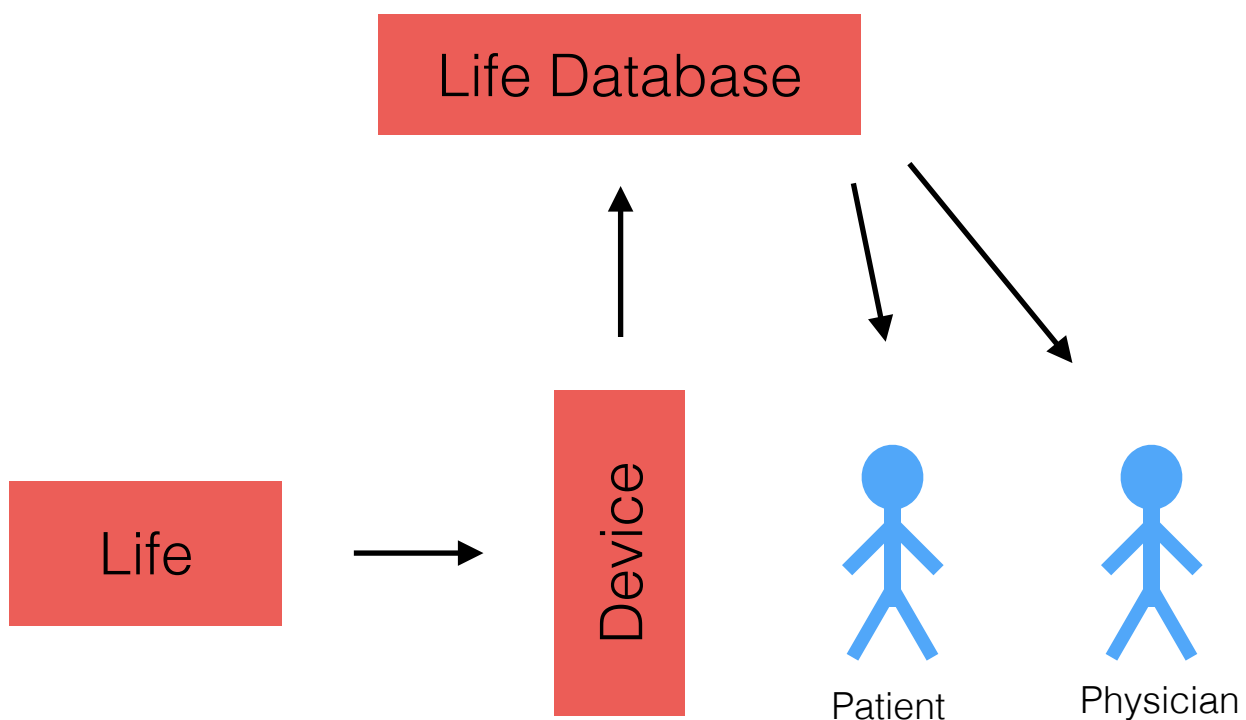
All detected data, not only glucose data and insulin injection data, but also movement and life monitoring data, will be communicate by Life to patient mobile device via wireless transmission. Mobile device, using its internet connection, will communicate

this data to Life database that will reorder and organize information to give a better visualization (front-end) to the final user. If mobile device doesn't work or it's not in Life's range, Life will be able to maintain normal and correct functions and will store data until the main device or another authorized device will be able to detect data and transmit to the database. Life will not erase data until it will receive uploaded data communication in Life databases.

Patients, thanks to cloud technology, will be able to visualize their data in every place with internet connection (if there is not an internet connection devices will grant a data storage for the last month data).

Database technology will let patients to have more organized data. In fact all insulin injections data will be compared to patient historical data in order to inject in the blood an ever more affordable quantity of insulin. Database will also let patients to monitor not only diabetic data but also movement and other "quality of life" data. This will let them to have a better understand of their organism and to help them to have a better sport activity and a better diet. This data will be also available to selected people such as physicians.

The database functions are summarized below.



Competitive comparison

In diabetes market there are two different type of players: big pharma companies and biomedical devices companies. Big pharma companies offer to patients not only insulin products but also devices as insulin pens. Biomedical devices companies offer to patients devices and usually they create partnership with big pharma companies in order to grant their customers device-insulin compatibility. There are only biomedical device firms that products an insulin pump with similar functions as Life.

Unique proposition summary

Life unique proposition is based on three key factors: micro-needle technology, database technology and brand identity.

Micro-needle technology let to have painless, more discreet and not invasive glucose sample and insulin injections.

Database technology let to transform simple data in usable data (for patient).

Armidal wants to take care of its patients in a different way compared to traditional pharma companies. Patients are customers for Armidal and satisfy their expectation in matter of health but also in quality of life is Armidal mission.

Future product development

Plans for future products include new version of Life product and development of database system. An opportunity is to create a team of selected physician that will help, but not substitute, the main patient physician, in everyday diabetes decisions throughout online suggestions starting from patients data.

Part 2.4 Market

Life customers are type I diabetes patients. Type I patients are by now 70 millions but in 2035 they will be over 100 millions. It has been demonstrated that in the next years type I patients number will raise with a 3% rate of growth every year. Data refer to people that are diagnosed under 20 years old.

Patient must control their glucose level to live better and this make them loyal customers, a feature that only diabetes market and few other present in biomedical industry.

Market segmentation

Geographical markets target, in the first years, are EU and USA . In fact, considering the diabetic market characteristics, only sales to these markets will generate sufficient profits to grant future successful R&D.

In order to reach this target must be considered more authorization and marketing costs.

Life target population is people with type I diabetes between 20 and 50 years. People who has Type I diabetes and has a dynamic life has ever shown interest for devices that could grant normal diabetic routine care with painless, non traumatic and discreet characteristics.

Market needs and current solutions

Type I diabetic is not a preventing disease. It means that people with diabetes could live a normal life even if they must control everyday (for many times) their glucose level, and manage their insulin injection in order to avoid hypoglycaemic attacks. Many of them have a dynamic life style or play sport everyday. Thus one of type 1 patients main need is to have a product that could help them to have a better management, have a more discrete and comfortable device to detect glucose levels in blood an inject insulin.

Actually there are not such developed solutions (only early adopters). Solutions are insulin pens and traditional insulin pumps.

Insulin pens are traumatic, painful and not discrete and require patients bring with him the pen and another device to sample glucose. Every injection must be operated in a different part of the body in order to avoid excessive traumas on the skin. It will be extremely painful do the same injection in the same place three or four time in a day.

Traditional insulin pumps have the same characteristics of insulin pens but are bigger, must be brought ever near the point of injection because they are connected with body via wires, and they are not good for dynamic lifestyles. They are used by a few number of patients due their discomfort and traumatic signs that remain on skin when removed. Young diabetes patients prefer insulin pens to more traumatic method.

Focus group analysis

In order to confirm market needs it has been conducted an interview with a focus group formed by 50 type 1 diabetics between 20 and 50 years old.

Three key questions have been placed (useful for this analysis) :

- How important to you is to have a painful glycemc sampling and insulin injection?
Scale from 1 to 3:
 - 1) I prefer pain. This make me feel better because i know i'm assuming a drug;
 - 2) It doesn't matter;
 - 3) I want painless glucose control and injection.
- Do you consider yourself a person with a dynamic lifestyle? (It has been explained to them that term "dynamic" refers to people who regularly play sport or have a particular life condition or work that push them to travel a lot or to have an animated lifestyle)
Scale from 1 to 3:
 - 1) I'm not a dynamic person;

2) Sometime i play sport but in general i'm a sedentary person

3) I'm a dynamic person (worker, student, traveller)

- In order to get closer to your needs, even if you have not a dynamic lifestyle, would you like a product that will let you to better manage your diabetes? This product can help you to build a database with your diabetics and movement data in order to let you analyze in a better way your daily diabetic life, and receive continue suggestions by your physician. It will be completely painless discreet and comfortable because it will stay on your upper arms. Consider also that it will be water proof, shock proof and dust proof.

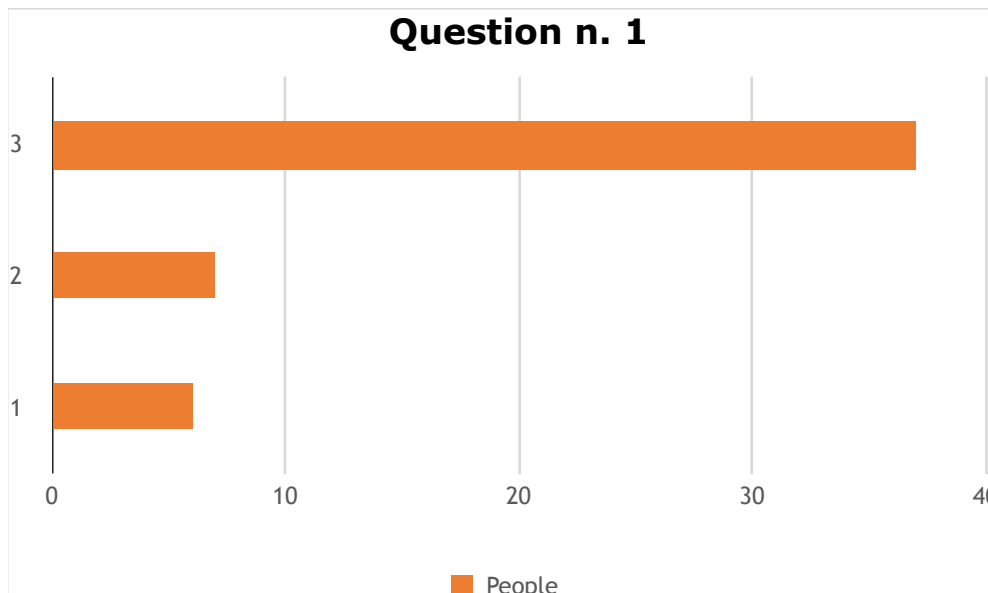
Scale from 1 to 3:

1) I'm good with my management instruments;

2) Indifferent

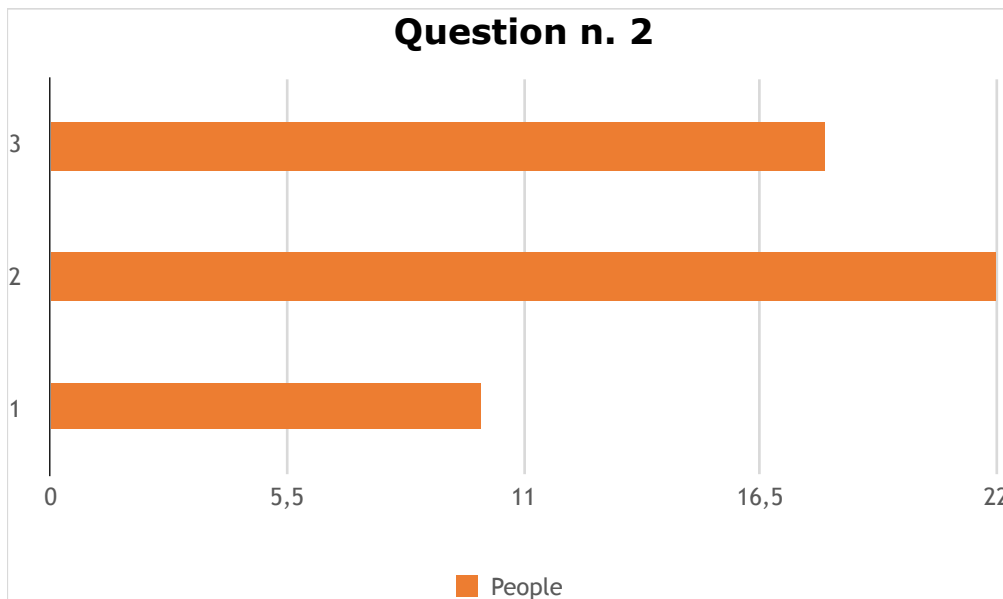
3) I need. I want a product that ill help manage better my diabetes

These graphs show their answers:

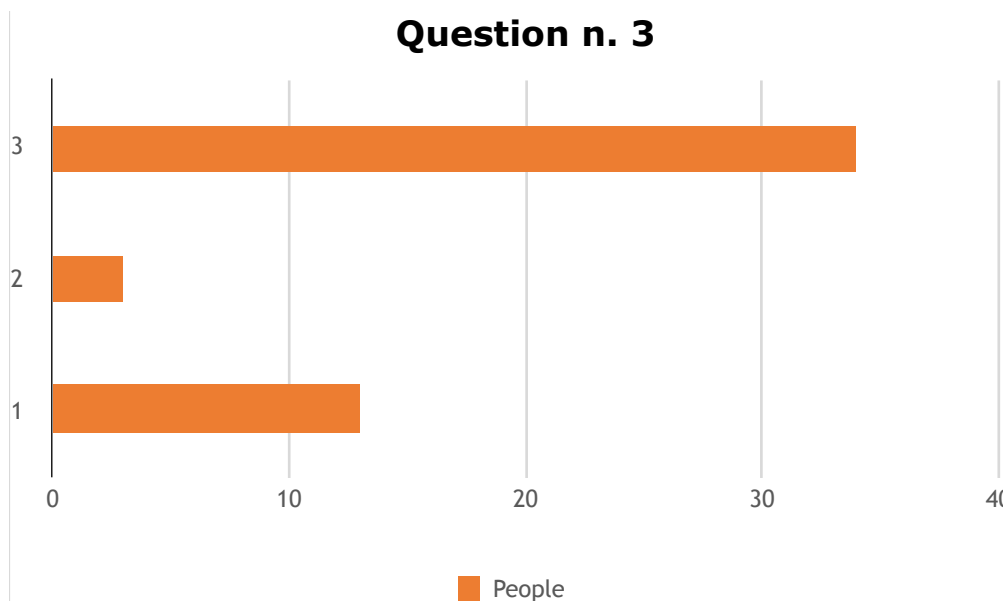


- 37/50 of interviewed retain that they would like painful glucose control and painful insulin injections (3)

- 7/50 of interviewed retain that it doesn't matter to have a painful or a painless glucose control and insulin injections (2)
- 6/50 of interviewed retain they want feel pain in order to be sure they are assuming a drug (it must considered placebo effect when drug is assumed) (1)



- 18/50 of interviewed retain themselves as dynamic people (15/18 were students or under 30; 3/18 were workers or over 30) (3)
- 22/50 of interviewed are medium dynamic lifestyle people (16/22 were students or under 30; 6 were workers or over 30) (2)
- 10/50 of interviewed don't consider themselves dynamic people (10/10 workers or over 30) (1)



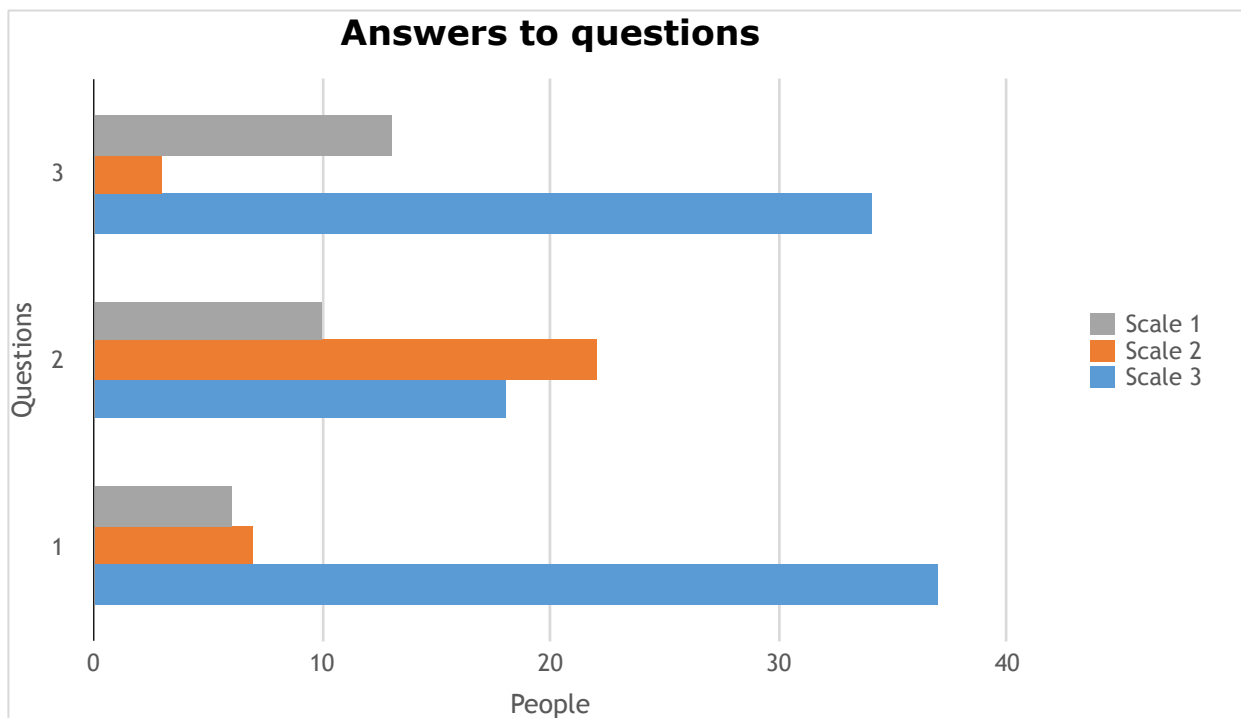
- 34/50 of interviewed say that they would like a product like the one proposed (29/34 were students or under 30; 5/34 were workers or over 30) (3)
- 3/50 are indifferent (2)
- 13/50 are good with their management system (1/13 were students or under 30; 12/13 were workers or over 30) (1)

As data show, young people, such students or people under 30, are more inclined to use the product.

This is a point in favor to start-up the company.

Data has been collected during the months of March, April, May and June 2014. Type I diabetes patients has been interviewed by face to face meeting and/or virtual meeting. Different diabetes organizations has been contacted to reach them.

In the next graph will be summarized three questions answers.



Part 2.5 Marketing strategy

Marketing will target especially specialized physicians and type I diabetic organizations in EU and USA. For each geographical segment will be selected different segments to set as targets (group of hospitals, diabetic centers, etc...).

In order to maintain desired brand identity and in order to have the best possible relationship with patients, Armidal will sell directly his products to final customers. This will maintain brand identity and will not let distributors conduct marketing strategy for Armidal products.

Brand identity will be also reinforced with YouTube video campaigns using as testimonial sport people.

Patients will be able to see products online on company website, and in the first year will be implemented an e-commerce store that will be able to manage insurance coverage for product payment.

Part 2.6 Pricing strategy

Life system will be priced in three parts:

- Life insulin pump system will be priced at 5500€
- Life micro-needles will be priced at 500€ (cost for 6 months, approximately 60 micro-needles).
- Life cloud access will be priced at 50€ (cost for 6 months subscription)

Armidal pricing strategy doesn't incorporate insulin cartridges costs.

Part 2.7 Sales strategy and forecast

Armidal plan is to begin to sell Life product in the second half of 2017 (at first only prototypes), after EMA and FDA approval in EU and USA. The number of sold units will grow during the other years thanks to a growing penetration rate that will let Armidal and Life to acquire new market shares.

During the last 6 months of 2018 and the first six months of 2019 marketing campaign will be able to let sales grow up. It has been assumed a 500 units for the first year of production, 3000 for the second year (production grow thanks to marketing job), and 10000 for the third year.

Considering diabetic market size they are on the average penetration data.

Sales forecast

Unit sales	2015	2016	2017	2018	2019
Life insulin pump system	0	0	500	3.000	10.000
Life micro-needles	0	0	500	7.000	27.000
Life cloud access	0	0	500	7.000	27.000
Total unit sales	0	0	1.500	17.000	64.000

Sales	2015	2016	2017	2018	2019
Life insulin pump system	€ 0,00	€ 0,00	€ 2.750.000,00	€ 16.500.000,00	€ 55.000.000,00
Life micro-needles	€ 0,00	€ 0,00	€ 250.000,00	€ 3.500.000,00	€ 13.500.000,00
Life cloud access	€ 0,00	€ 0,00	€ 25.000,00	€ 350.000,00	€ 1.350.000,00
Total sales	€ 0,00	€ 0,00	€ 3.025.000,00	€ 20.350.000,00	€ 69.850.000,00

Direct unit costs	2015	2016	2017	2018	2019
Life insulin pump system	€ 0,00	€ 0,00	€ 1.900,00	€ 1.700,00	€ 1.600,00
Life micro-needles (6 months set)	€ 0,00	€ 0,00	€ 180,00	€ 160,00	€ 140,00
Life cloud access (6 month sub.)	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00

Direct cost of sales	2015	2016	2017	2018	2019
Life insulin pump system	€ 0,00	€ 0,00	€ 950.000,00	€ 5.100.000,00	€ 16.000.000,00
Life micro-needles (6 months set)	€ 0,00	€ 0,00	€ 90.000,00	€ 1.120.000,00	€ 3.780.000,00
Life cloud access (6 month sub.)	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Subtotal direct cost of sales	€ 0,00	€ 0,00	€ 1.040.000,00	€ 6.220.000,00	€ 19.780.000,00

Pricing	
Life insulin pump system	€ 5.500,00
Life micro-needles (6 months set)	€ 500,00
Life cloud access (6 month sub.)	€ 50,00

Part 2.8 Personnel plan

Production will be completely outsourced as software development in the first five years and so will not be hire personnel for these activities. In order to grant human capital support to the growing company plans are to hire until the last year of forecast (2019) 20-25 employees.

Employees will be distribute in three categories:

- General and administrative
- R&D and engineering
- Sales and marketing

Personnel

	2015	2016	2017	2018	2019
General and administrative personnel					
CEO	€ 70.000,00	€ 140.000,00	€ 170.000,00	€ 200.000,00	€ 250.000,00
CFO	€ 45.000,00	€ 110.000,00	€ 150.000,00	€ 180.000,00	€ 230.000,00
Corporate development executive	€ 10.000,00	€ 70.000,00	€ 80.000,00	€ 90.000,00	€ 110.000,00
Executive assistant	€ 5.000,00	€ 15.000,00	€ 45.000,00	€ 75.000,00	€ 90.000,00
Administrative staff (3)	€ 0,00	€ 0,00	€ 75.000,00	€ 100.000,00	€ 130.000,00
Controller	€ 0,00	€ 0,00	€ 55.000,00	€ 68.000,00	€ 75.000,00
Other	€ 0,00	€ 0,00	€ 12.000,00	€ 24.000,00	€ 40.000,00
Subtotal	€ 130.000,00	€ 335.000,00	€ 587.000,00	€ 737.000,00	€ 925.000,00
R&D and engineering	2015	2016	2017	2018	2019
R&D executive	€ 40.000,00	€ 70.000,00	€ 90.000,00	€ 115.000,00	€ 130.000,00
Design engineer	€ 34.000,00	€ 60.000,00	€ 75.000,00	€ 90.000,00	€ 100.000,00
QC engineer	€ 0,00	€ 0,00	€ 70.000,00	€ 130.000,00	€ 150.000,00
R&D engineer (2)	€ 55.000,00	€ 90.000,00	€ 120.000,00	€ 140.000,00	€ 160.000,00
Other	€ 0,00	€ 0,00	€ 15.000,00	€ 30.000,00	€ 45.000,00
Subtotal	€ 129.000,00	€ 220.000,00	€ 370.000,00	€ 505.000,00	€ 585.000,00
Sales and marketing	2015	2016	2017	2018	2019
Sales and marketing executives	€ 0,00	€ 0,00	€ 60.000,00	€ 95.000,00	€ 120.000,00
Sales manager	€ 0,00	€ 0,00	€ 50.000,00	€ 90.000,00	€ 110.000,00
Product manager	€ 0,00	€ 0,00	€ 55.000,00	€ 85.000,00	€ 100.000,00
Sales administrator	€ 0,00	€ 0,00	€ 60.000,00	€ 85.000,00	€ 110.000,00
Other	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 50.000,00
Subtotal	€ 0,00	€ 0,00	€ 225.000,00	€ 355.000,00	€ 490.000,00
Total people	8	8	19	21	25
Total payroll	€ 259.000,00	€ 555.000,00	€ 1.182.000,00	€ 1.597.000,00	€ 2.000.000,00

Part 2.9 Financial plan

Capital raising

During start-up phase founders will finance the new company with €500.000. In order to proceed with R&D activities and, starting by the second half of 2017, of production, Armidal must be able to receive a seed investment for €5 millions within the first half of 2015 and to make an IPO in the second year (2016) in order to attract other investments to finance productions.

Seed investors will receive 40% of the shares.

Capital utilization

Seed investment (€5mln) will be used to obtain license of micro-needle technology patent, to acquire R&D centre and machinery and to acquire other assets useful for design and development stages.

IPO capital will be used to let the production start and let them be sustainable until the company will be able to sustain itself with net profit.

Exit strategies for seed investors are linked to acquisitions until the IPO or after the IPO with normal shares sell method.

Break even point analysis

Products will be sold in bundle so they have been considered together.

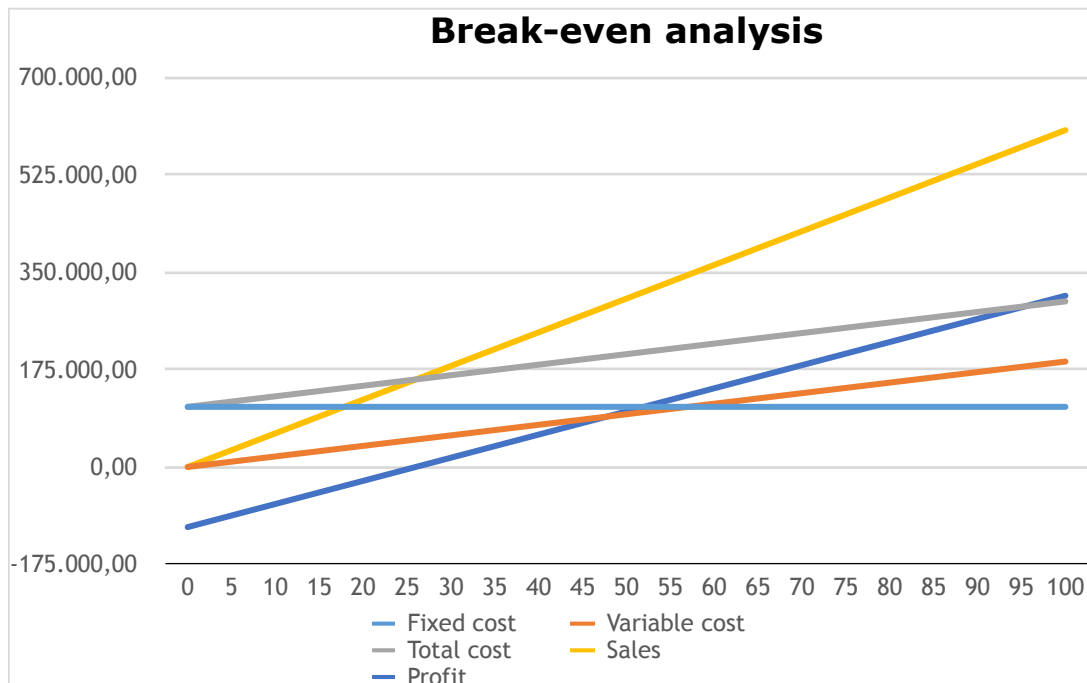
A single bundle is the minimum sellable unit (bundle composed by 1 insulin pump, 1 set of micro-needles and 1 cloud access subscription)

- Average per-unit revenue (it consider all types of units): €6.050
- Average per-unit variable cost (it consider all types of units): €1.894

- Estimated monthly fixed cost including payroll: €54.000 but we must consider €104.000 because in the first 30 month there is no production and costs must be divided starting from July 2017

In average Armidal must sell 25 units bundle every month in order to break-even or must to have sales for at least €151.395,57 every month.

In graph break-even point is visible where total cost meet sales (note that profit is €0 at this point).

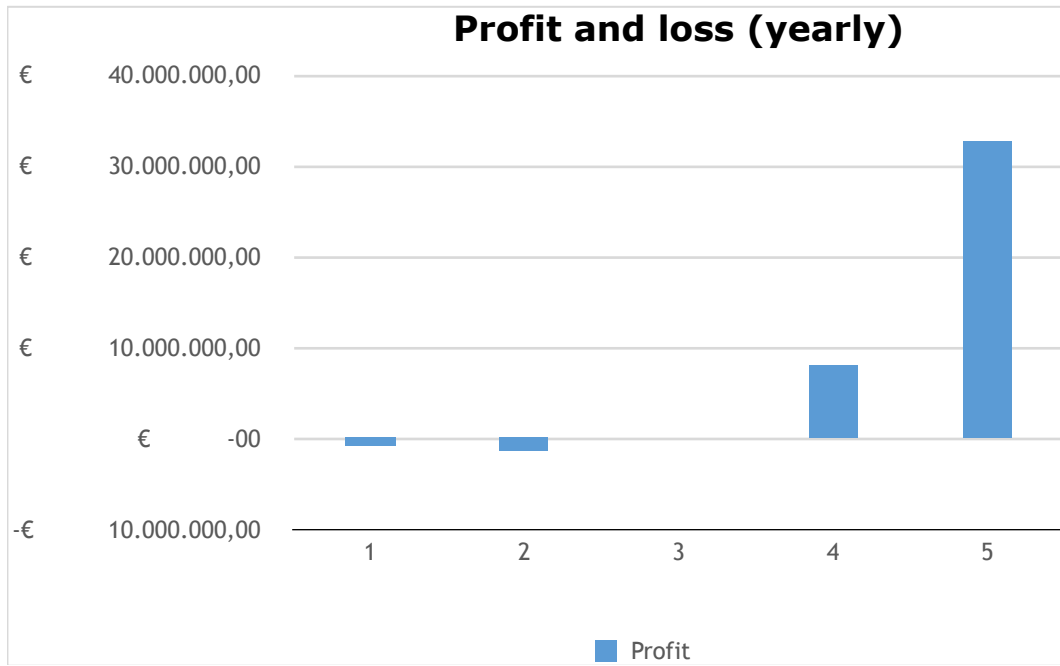


Profit and loss

Plans see Armidal to break-even at the beginning of the fourth year. In the first three years there will be losses (in first and second year there is no production and in the third year profit is not sufficient to cover expenses). Sales, in the first periods of production, will be addressed to private and public organizations and not directly to patients due to regulatory time constrains such as for specifically test and critical trials.

Pro forma profit and loss

	2015	2016	2017	2018	2019
Sales	€ 0,00	€ 0,00	€ 3.025.000,00	€ 20.350.000,00	€ 69.850.000,00
Direct cost of goods	€ 0,00	€ 0,00	€ 1.040.000,00	€ 6.220.000,00	€ 19.780.000,00
Production payroll	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Other	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Cost of goods sold	€ 0,00	€ 0,00	€ 1.040.000,00	€ 6.220.000,00	€ 19.780.000,00
Gross margin	€ 0,00	€ 0,00	€ 1.985.000,00	€ 14.130.000,00	€ 50.070.000,00
Gross margin %	/	/	65,62%	69,43%	71,68%
Operating expenses					
Sales and marketing expenses					
Sales and marketing payroll	€ 0,00	€ 0,00	€ 225.000,00	€ 355.000,00	€ 490.000,00
Promotion and advertising	€ 0,00	€ 0,00	€ 40.000,00	€ 50.000,00	€ 100.000,00
Travel	€ 0,00	€ 0,00	€ 30.000,00	€ 40.000,00	€ 40.000,00
Research	€ 0,00	€ 200.000,00	€ 20.000,00	€ 10.000,00	€ 10.000,00
Total sales and marketing expenses	€ 0,00	€ 200.000,00	€ 315.000,00	€ 455.000,00	€ 640.000,00
Sales and marketing %	/	/	10,41%	2,24%	0,92%
General and administrative expenses					
General and administrative payroll	€ 130.000,00	€ 335.000,00	€ 587.000,00	€ 737.000,00	€ 925.000,00
Leased equipment	€ 15.000,00	€ 15.000,00	€ 15.000,00	€ 15.000,00	€ 15.000,00
Depreciation	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Utilities	€ 10.000,00	€ 11.500,00	€ 11.500,00	€ 12.000,00	€ 13.000,00
Insurance	€ 40.000,00	€ 40.000,00	€ 40.000,00	€ 60.000,00	€ 60.000,00
Rent	€ 30.000,00	€ 30.000,00	€ 30.000,00	€ 30.000,00	€ 30.000,00
Payroll taxes	€ 108.780,00	€ 233.100,00	€ 496.440,00	€ 670.740,00	€ 840.000,00
Total gen. and adm. expenses	€ 333.780,00	€ 664.600,00	€ 1.179.940,00	€ 1.524.740,00	€ 1.883.000,00
General and administrative %	/	/	39,01%	7,49%	2,70%
R&D/engineering and other expenses					
R&D/engineering payroll	€ 129.000,00	€ 220.000,00	€ 370.000,00	€ 505.000,00	€ 585.000,00
Consultants	€ 30.000,00	€ 30.000,00	€ 30.000,00	€ 30.000,00	€ 30.000,00
Other	€ 25.000,00	€ 25.000,00	€ 30.000,00	€ 35.000,00	€ 40.000,00
Patent	€ 200.000,00	€ 200.000,00	€ 200.000,00	€ 200.000,00	€ 200.000,00
Total R&D/eng. and other expenses	€ 384.000,00	€ 475.000,00	€ 630.000,00	€ 770.000,00	€ 855.000,00
R&D/eng. and other %	/	/	20,83%	3,78%	1,22%
Total operating expenses	€ 717.780,00	€ 1.339.600,00	€ 2.124.940,00	€ 2.749.740,00	€ 3.378.000,00
EBIT	(€ 717.780,00)	(€ 1.339.600,00)	(€ 139.940,00)	€ 11.380.260,00	€ 46.692.000,00
Interest expenses	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Taxes incurred	€ 0,00	€ 0,00	€ 0,00	€ 3.414.078,00	€ 14.007.600,00
Net profit	(€ 717.780,00)	(€ 1.339.600,00)	(€ 139.940,00)	€ 7.966.182,00	€ 32.684.400,00
Net profit/sales	/	/	/	39,15%	46,79%



Armidal will start to make profit starting from year 4.

Part 3.0 Business model application and considerations

In the first part the biomedical industry has been analyzed as well as the role that patents and geography of innovation assume in such industry and especially into the biotechnological segment and the biomedical device segment.

In the second one a business plan for a new venture in the biomedical segment has been exposed. Company target is to create a new diabetes device product to help type I diabetes patients to have a better management of their disease, this has been presented considering not only financial data but also final customers considerations collected during interviews in order to project a new device that is able to meet patients needs and requirements.

In this chapter the business model will be analyzed taking in consideration not only patients needs and financial analysis (that shows project feasibility) but also industry and segment analysis made in part 1. It will be considered the important role that patents and geography of innovation have in this industry. They must be considered as key factors for success of a new company that wants to operate into the biomedical devices segment. The analysis will proceed taking into consideration first patents, and after geography of innovation. In the last part of the chapter conclusions will be presented as they will emerge during patents and geography of innovation analysis.

Part 3.1 The role of patents

In the biomedical devices segment patents are very important. As argued in previous chapters patents let companies to protect their innovations and obtain a competitive advantage on competitors. In Armidal case patents are important mainly for two reasons. The first is to create an innovative product that could be able to change the way in which patients manage type 1 diabetes and so to sell the innovative product. One of the most important point in managing type I diabetes is pain management. Data showed how is important for a certain category of patients to have a painless experience of

insulin injection, especially for those who have a dynamic lifestyle and those who play sport activities and require more discretion.

Thus, micro-needle technology patent will let Armidal to have an exclusive production of painless diabetes devices. This could help the new company to meet the needs of an huge number of type I diabetes patients.

The second reason is to protect its product from other companies that could be very interested in such qualities like painless injection or portability that make Life a wearable and comfortable device. In fact in order to protect in the best way the new product, Armidal will need to grant patent protection on its components creating a non replicable advantage.

As business plan has explained, initial investments in patents and new technologies will make able the company to have profit in the fourth year. This will make possible for Armidal to protect this technology for the incoming 20 years.

But, in order to take into consideration the real value of micro-needle technology patent and other patents that Armidal will register during its startup phase, it must be considered the value that this patents will have in the next years, and so how type 1 diabetes management will evolve.

There are two different factors that can represent a risk for the value of this patents. The first is the discovery of new products that could modify the way patients assume insulin, the second is the role of other tech companies that want to penetrate the biomedical devices market.

Actual technique lets insulin to be delivered only by injection. The main reason that justify only this type of assumption is related to the composition of insulin that is not able to resist to chemical agents of stomachs and so it is destroyed before being able to reach blood, losing its properties.

Biotech companies are trying to find new way to administer insulin. In the past decade some biotech companies have tried to develop a new way to dose insulin nasally but test has failed (as the case of Pfizer). Now biotech companies as Oramed are trying to develop a new method to let insulin be assumed by oral administration. This will let insulin resist to body chemical agents and reach the blood without losing its properties.

Research is at its upstream phase and now there are no possibilities to know in a certain way if in the next five, ten years insulin assumption methods will change. Obviously a new method that could let kids and people to assume insulin by oral could weak Armidal market power.

The second factor that could weak Armidal venture is the increasing role that tech companies begin to have in the biomedical device segment. Big companies as Apple and Google (and others) are very interested entering biomedical devices market and they are launching wearable devices able to detect users vital functions. Google has also in program to launch a new biomedical contact lens that will let diabetes patients monitoring their glucose level by tears. Glucose warning level will be notified with a red led light on the same contact lens.

Big tech companies due to a different market approach must be able to create partnerships with pharma companies in order to communicate with patients and customers with a different user approach if compared to their usual customers. Interested tech companies will not be pretty negative for pharma companies because partnerships will bring more revenues for both. In this scenario, a new venture company as Armidal could be extremely disadvantaged because its product will have more indirect competitors. As soon as Armidal will be able to make profit for its first Life prototype, the market will see other competitive products with same characteristics and more knowledge of market needs (thanks to partnerships between big pharma and tech companies) or, in the worst case, a completely new way to assume insulin that will make obsolete Armidal device and mechanical based insulin delivering.

Even if patents could represent an effective way to protect innovation, a new company must calculate patents future value in order to not risk to become obsolete in a short time. Due to high technological processes in this segment, and new comers from tech industry, Armidal could never be able to get over its startup-phase. This scenario, and how it will evolve, could be very disabling for a new company.

Part 3.2 The role of geography of innovation

In the first part has been analyzed how geographical proximity is important to help a new company develop strong competencies to produce a biomedical device, the role of clusters that exist when firms, universities and in general organizations are very close together and are able to influence each other with positive externalities. As argued, usually companies that are located into a cluster have a higher innovation rate if compared to similar companies not located into a cluster. This is due to geographical proximity.

The role of geographical proximity is very important during a company life, but it is fundamental in the startup phase. Industry with high diffusion rate, or internet industries, have the possibility to have an easier access to knowledge spillovers than biomedical companies. The main reason is that biomedical clusters are more geographically located in a physical space than technological clusters, and especially in the case of biotechnology and biomedical devices they need the transmission of tacit knowledge that require proximity and direct contact between sharers and receivers. Thus, while in the tech industry a big role is played by knowledge communication thank not only to direct contact but also remote contact, the biomedical industry need mostly tacit knowledge that could be only shared with close firms and people, and so when two organizations or two scientists are very close one to each other.

A new company that wants to project, develop and sell a new biomedical device must, in order to acquire knowledge and be able to have a good rate of development, be locally placed in a cluster and in proximity of other firms which operate in the same industry and near organizations that could help its project, design, development and testing processes (universities or public organizations). This can help the new company to validate results, acquire market knowledge and get in contact with early adopter customers.

Without such possibilities to have contact with early customers, organizations and same industry segment firms, without strong management support and partnerships with other companies, a firm has a high risk to fail, and in any case it will have a lower rate of

innovation if compared to firms located in a cluster. Thus, it's possible to conclude that geography of innovation (knowledge spillovers, positive externalities and geographical proximity of firms) is very important for the biomedical industry but it has a major role especially in the biotechnology and in the biomedical devices segments. It's also more important in new firms that have not a high number of expert managers or partnerships with important pharmaceutical firms, while has less importance in the case of startups with high value working management capital and that are able to acquire knowledge thanks to their partnerships.

In the case of Armidal, a new venture that in the first time of its life has no experienced managers or partnership with pharmaceutical industries, the role of geography of innovation is fundamental to assure survival and correct growth. Without access to a biomedical devices cluster or organizations that could help them to project and test the new biomedical device for type 1 diabetes, Armidal will not ever have the possibility to develop the product and sell it to the final customer.

In the case of biomedical devices and biotechnological companies there is one more step that bring the analysis to consider fundamental the role of geographical proximity. In such segments in fact a big role, as explained, is played by regulation authorities as EMA in Europe and FDA in USA that have the task to control new drugs and medical devices in order to grant that new products will not wound the final user, and that are useful to combat or manage a certain disease. Firms that operate in the biomedical industry must take into consideration to have relations with such organs, and must have a high knowledge on how to communicate with them for new products approval or how to react in case of product rejection.

Thus, it will be easier for a new company in cluster to access to this type of knowledge and to acquire more competent managers that could help the company to reach competitive advantage. An isolated firm will find more difficult undertaking this process and that could predetermine the success of the company itself.

Geography of innovation is fundamental to assure a company success in the biomedical devices industry either in the case of an established company or in the case of a new

company. In fact it let company to access in an easier way to knowledge and positive externalities in segments in which knowledge is specifically tacit and very difficult to share.

The diabetic segment, moreover, is one of the most particular segments in the biomedical industry and require a strong knowledge of final customers. In fact diabetes patients require drugs in every day of their life. They are loyal to a specific brand. This strong knowledge is held nowadays only by big pharma companies and biomedical companies that fabricate diabetes devices. Without partnerships or strong communication with this players in the market, it will be impossible for a new company to reach customers due also to the condition of oligopoly that characterize the segment.

Conclusion is that in a segment like the biomedical devices for diabetes a company that don't want to have partnerships with other players and it's not inserted into a geographical cluster will probably fail in the first year of activity due to lack of experience, tacit knowledge and the condition of oligopoly that characterize the segment.

So, a new company like Armidal necessarily must take into consideration these points and find a biomedical devices cluster in which the new diabetic device idea is sustainable.

Part 3.3 Final considerations

What could be finally considered is that patents and geography of innovation play an important role that could determine a new company success or failure.

It's clear, thus, that a new company that want to operate in the biomedical device segment must have access not only to money capital, and so communicate with private or public investors, but also qualified working capital that could help it in the startup phase and to avoid the risk of failure due to the high number of threats that could characterize a new biomedical device company. This bring to the consideration that a new company must pivot on knowledge accumulation property rights, especially

patents, and must be able to exploit all the positive externalities the environment provides.

In the case of patents a new company need to make R&D and register patents (or as in the case of Armidal licensing an existing one and implementing it with other patents), and try to maintain the patent value for the period of time required to make profit. In fact if new technology will emerge before the company will be able to break even, and so to make profit, the new company technology will be considered obsolete and not able to make the desired revenues. This consideration is not true for every industry. Not ever a new technology is able immediately to substitute an old technology especially for reasons due to final costs for customers. The new technology could be in fact very expensive if compared to the old one, and this might even justify new investments on the old technology before the new become disruptive.

In the biomedical industry, that as argued is characterized by a different relation between firms and customers (see part 1), the delay in the implementation of a new technology may not occur, and a new technology could immediately oust the old one mainly for two reasons: first the cost of drugs and devices are in the most of cases not supported directly by patients, second this could be an opportunity for the developing firm to test its new products. In the diabetics biomedical device segment this consideration could have greater influence because the new technology will be based on a different technological paradigm (from device to drug).

Consider that drug insulin is usually payed to patients by private or public assurance while in most case the cost of devices is supported directly by patients.

In the case of geography of innovation a new company must find its perfect cluster and try to locate its activities here. In fact in the cluster its chance of success will raise due to the high quantity of positive externalities which will be provided and, thank to geographical proximity, it will be able to acquire tacit knowledge that is fundamental in this segment to grant firm correct growth and success.

These two factors have such importance because the diabetes devices segment is one characterized by the oligopoly of a small number of mixed firms (diabetics devices management companies and big pharma companies) and an isolated behavior could have only a negative impact. A new company should enter in specialized cluster and try to create partnerships with major players in order to survive in the first years.

Thus, while it could be considered fundamental and as an assurance for success the new company cluster membership, patents patenting and/or licensing could not be immediately considered as key for success because new technologies could influence the industry, and new companies could exploit them nullifying all the previous new company investments and efforts. New technologies are able to revolutionize the way a drug product is delivered in specialized segment like the biomedical device one. They could seriously bring a new startup company to failure.

Conclusions

The analysis brings to an important reflection. Type 1 diabetes patients have a live need for a new diabetes management device and basic market analysis data has verified this need. In the process that could bring the new diabetes device to the market, patents and geography of innovation play a fundamental role and they must be considered as key factors for success and correct growth for new startup companies that want to acquire a competitive advantage. Thank to the analysis of the business plan of a new startup company in this industry it has been possible to measure how much important are these factors in the startup period (first 2-3 years of life), and how they can determine the success or the failure of such new company. The evidence shows that IPR protection systems has a more important role in the case of small firms and new startup companies rather than established firm in the industry or big pharma.

First, patents let new companies to better protect their innovation during their life and to develop and maintain a competitive advantage in order to avoid that competitors copy them. Second, thanks to geography of innovation firms could really develop knowledge and strong competencies that they wouldn't never acquired in the case of geographical isolation and so without a geographical proximity to public/private organizations and competitors.

Thus, clusters (a delimited geographical place in which there are positive externalities) acquire an important role in such situations and new companies must be able, as first decision, to choice the better location for their R&D activities. Usually R&D activities must be located in the place in which there is a high rate of specific firms that operate in the same segments. This location could be considered as rich of positive externalities, stimulant competitors and organization that could help the new company to better project, test and develop the new product (in the case of biomedical device) or the new drug (in the case of a biotechnological startup).

Patents and geography of innovation are fundamental but not the only factors a new company must consider. They could really help a new company to better develop a new

business in the industry but new companies must however consider other factors that could really influence business success.

This is the reason why in this paper has been considered the case of a new startup company in the diabetes device segment. The diabetes segment has very peculiar characteristics that let to consider different factors in the feasibility analysis of business plan. In fact there are two important characteristics that make it different to others.

The first is the rate of loyalty of the patient/customer, the second is the particular market composition.

The diabetes patient is very different if compared to other disease patients. He is in fact a loyalty customer because it must depend all the life from a certain drug or device. Other patients are not loyalty because they will use the drug or the device only for a specific period of time (the time of their disease), and this will bring them to a more objective consideration of the product used. That's the reason why is very important, for a diabetes company or a big pharma diabetes branch business, to develop strong relations with final patients/customers and with diabetes organizations that could influence diabetes patients to use a product (drug or device) instead of another.

Diabetes segment has also a very peculiar market composition compared to other pharma segments. Due to high loyalty of customers and due to high investments firms have supported to develop marketing channels to reach them, the diabetes segment is characterized by a small number of firms, especially big firms that work in the diabetes segment as Sanofi, Takeda, AstraZeneca and Novo Nordisk. Due to the small number of firms that characterize the diabetes market it could be considered an oligopoly in which a small amount of firms have the most part of market quotes.

Taking into account these considerations it's immediately obvious that a new startup company should be able through venture capitals investments or through IPO in a later time to build marketing channels that will let it to reach diabetes patients or to create partnerships with other companies that could provide their channel to the small firm. The role of partnerships is therefore fundamental. Without partnerships with big players it will be very difficult for a new company to acquire market shares and reach competitive advantage.

The diabetes segment, furthermore, have an important technological characteristic that bring to an important reflection. There are many small ventures that are working on new methods to deliver insulin, and in the last years these R&D processes have been successful. These new technologies could really mine the power of diabetes management devices because they will simplify the way in which a patient will assume insulin. Thus, what a new company must be able to understand in the biomedical industry and especially in the diabetes segment is the future value of its patents. A new technological paradigm could be established before the new company will be able to make profit from its innovation generating an immediate failure, or it will not justify the great amount of money invested.

Finally must be took into consideration that pharma industry will probably change in the next ten years. Big pharma will transform themselves in focused big companies. They will try to become monopolist in one segment rather than be powerful in many segments creating partnerships and acquiring small biotech firms in the segment they want to monopolize. First of all Bristol Myers-Squibb has decide to get rid of many not very profitable segments and focus its attention to cancer disease acquiring small biotech firms specialized in this segment.

We are not in very profitable years to undertake a new diabetes device venture.

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