Pre-MK: Technologies, their Genres and their Triumphs

Approaches for Nascent Technologies, Shelf Technologies, Technologies Composed in the pre-MK and Derivative Technologies

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Foreword

The book presents, in a didactic way, some practical and differentiated cases that were the subject of technology transfer negotiations in our unit. For these technologies the team developed preliminarily marketing plans (pre-Mks) of STIs (Science and Technology Institutions), for them to be used as a tool to value and insert these technologies in the market through licensing and know-how transfers.

Simple cases of licensing a technology, e.g. an equipment, were discussed at the start. Next were examined progressively more complex cases, involving different methodologies, partial licensing of intellectual property and licensing a group of various claims contained in intellectual properties of various documents.

The preparation of marketing plans is not a typical activity in the STI teams. Exercises, here referred to as pre-MKs, however, may, in the context of STIs be used as strategic tools. These exercises are simplifications and adaptations as compared to the patterns that have been recommended by Kotler (KOTLER; KELLER, 2005). In STIs, these exercises are developed in order to check and adjust alignment of technologies to the needs, potential licensees and to the demands of the production environment. The purpose of these pre-MKs, so it's not the same as marketing plans, whose typical feature is the inclusion of products manufactured in the company in a target market, as recommended by Kotler (Kotler and Keller, 2005). This is because, usually, STIs do not provide services, do not produce and do not sell to the end consumer. Therefore, it should be understood that the elaboration of pre-MKs, in the context of STIs, is an activity of institutional intelligence, different from what happens for marketing plans in the production environment.

This alternative approach is useful to STIs, but it can also be useful for universities and even for private companies interested in licensing its technologies. The method of pre-MKs is described with respect to the licensing and / or transfer of know-how, and additionally applications are suggested in relation to benchmarking of technologies and indications of possible enhancements and new research.

With a series of concatenated cases the theme is exposed in order to facilitate understanding. The usage of these cases was aimed at exposing the method of pre-MKs as a strategic tool for the STIs to insert their technologies in the production environment, through licensing for entrepreneurs.

The book is aimed at all those interested in alternatives to the inclusion of new methods, technologies or services, in the productive environment by licensing or know-how transfer. In short, the book can be useful to all those working in STIs and other structured companies that seek to succeed in the licensing of technologies described in intellectual property documents and know-how documents. The issues are not fully resolved because they are unfinished stories. They are ongoing real cases in progress, open to discussion and new directions and for which the book seeks to provide alternatives of thought and work, to encourage the development of local solutions.

The team responsible for this publication has participated in the licensing of several technologies and were therefore exposed to a number of interesting experiences that are concatenated in a methodical way. As a reference in similar situations experienced by different institutions, this publication is of special interest to all profiles of professionals who work in innovation.

João de Mendonça Naime
Director-General of Embrapa Instrumentação

Preface

Embrapa Instrumentation has made several efforts to make the results of their research available to society. The transfer of these research contributions of STIs for the productive environment presents particular difficulties, which are different from the observed ones at private companies that produce in order to meet a particular segment.

In recent years, in our unit for some technologies that have documents of intellectual property protection we seek to systematize experimentally actions leading to a greater success in technology transfer to the productive environment. This work is important because, in the area of technological innovation from STIs, there is not a consistent literature on evaluation, decision and presentation methods of these technologies for potential entrepreneurs.

Consulting the literature on innovation, we find valuable and detailed guidance on how private companies can place their products in target markets. These references are very interesting; however, they are geared towards companies that act directly in the production environment.

Paradoxically, for Science and Technology Institutions (STIs) that produced the major scientific advances, modernly available in the literature is scarce and inadequate. Most of the technologies - which we become used to have - was developed in STIs, but the historical path and the methods that were used for licensing and other types of trading for insertion into the market, were not described, making it difficult to infer about how these transfer methods, which were omitted, had contributed for these successful business experiences.

This work at Embrapa Instrumentation is a methodological adaptation to improve the communication between the Science and Technology Institution (STI) and the entrepreneurs in the production environment. The purpose is to strengthen the interaction, adherence and teamwork so that the technologies actually reach to the consumer market. It is developed after evaluation of strengths and vulnerabilities as well as from identification of possible companies that could benefit from the technologies, thus defining the target market and strategically directing the communication.

These communications tools were named pre-MKs. The comprehensibility to the businessman is a presumed characteristic of pre-MKs. Invitation letters, fast communications, demonstration of technologies and business roundtables are elaborated based on these pre-MKs. These dependent actions as a whole are considered successful when the licensing of the technology happens. The pre-MKs are also references for future consultation of the licensee, relating to definitions of industrial and commercial strategies, including in what concerns the establishment of specific marketing plans.

The pre-MKs described in this book have the purpose of being an alternative method clearly defined so that STIs determine the opportunity, the pertinence and the need to enter in the productive environment, with technologies described in intellectual property documents and Know-how documents, by licensing interactions with companies or entrepreneurs.

Authors

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Possibilities of the pre-MKs as guidance in the interactions between STIs and the productive environment.

In research and educational institutions, with decision-making systems having relatively circular leadership, responsibilities are better distributed and due to this reason the transference of technology between STIs and the productive environment might be easier for them. However, these technology transfers only get to be a triumph where there is the establishment - even if it is temporary or provisional - of groups of professionals who are engaged, motivated and with enough characteristics of energy, vigor, stamina and perseverance to face the challenges involved in the interactions with the productive environment.

There is a certain conformism or complacency, which makes promising technologies developed in STIs around the Earth, to be precociously, abandoned by their development teams, so that they become shelf technologies that are undervalued. To overcome this there is need for personal initiatives and continuous, coordinated and methodical institutional support, so that STIs achieve better success rates in licensing and in other actions of technology transfer to the production environment, which may be considered socially more effective and acceptable.

The consumer access to technologies that were developed by STIs occurs through interactions with production environment agents and it requires working methods that apparently are still not well understood and defined. For this purpose, we tried to adapt a method in this book to catalyze the interaction with the entrepreneurs who can produce and distribute the technologies developed in STIs. In the absence of other procedures, we chose to use what we call here: pre-marketing plan method (pre-MK). The approach is much more than methodically meeting some formal and standardized requirements that have been brilliantly developed by Professor Phillip Kotler (KOTLER; KELLER, 2005). In fact, nowadays the pre-MK for STIs can be understood as a tool for development or an institutional intelligence tool, besides of being an insertion tool and a market product positioning tool. About using pre-MK in the way that is described in this book we did not find methodological literature references.

The object worked in the pre marketing plan (pre-MK) is an intellectual property document or know-how document, with or without a prototype. The service, method or basic industrial product is developed by enterprises in the manufacturing environment and must meet the needs of consumers. This occurs even when the product is innovative enough to lead to new types of non-imagined needs. This method is an alternative to reduce the so-called 'non-consumption', which is a limitation to the introduction of new products into the market, pointed out by Christensen (1997). In fact, the pre-marketing plan has a simple essence created by Kotler (KOTLER; KELLER, 2005), but generates possibilities of use, which were often not explored. These pre-MK possibilities are well guided paths for the development of creative extrapolations, which need not be hampered by excessive formality.

The development of a pre-MKs is a competitive intelligence work, which involves generating premises about which has a greater expectation of success. This contrasts with the fact that the working teams naturally feel more comfortable in idealized conditions, on firm ground and provided with full knowledge about the product and market situations. This ideal availability of information, however, is only chimeras. Consequently, in fact, the pre-MK teams work in the shadow, with different kinds of uncertainties. However, victory and success can be achieved when the team gathers enough initiative, courage and persistence to precariously fill those gaps.

Normally the pre-MK team has the uncomfortable feeling that they will elaborate on a poorly known object, whose applications and respective markets are still a distant reality. Even when the technology involves incremental innovation, yet the teams do not have full knowledge about the additional benefits of the latest modifications, either to the performance of the product, or for the market perception. We hope that throughout this book the reader learns, through practical examples, the risks and the uncertainties that pre-MK teams face in making their decisions based on data and assumptions of work, hard drawn up in a process that involves creativity and caution. Of course these are special motivational environments because the teams know they will not be successful in all cases, and even imagine that they will not be successful in most cases.

In this line of thought in STI it is good to have clear answers to questions such as: What information is needed to put a new product on a competitive market, considering the consumer and supplier market? What are the interlocutors that will be the target audience of the work?

A STI when trying to introduce promising new technologies for irrigation, for example, seek to answer the above questions, which are very close to the types of questions demanded by the use of the method of the marketing plans in private companies. The STIs, for not selling directly to end consumers, have not used the methods of marketing plans frequently. However, it seems that in this initial effort it is very important to use the parameters contained in the marketing plan to increase the efficiency of the introduction of promising technologies in the production environment.

The main objective of this book was therefore show the development of pre-MKs as a working method that enables an alternative for the STIs to improve the insertion of new technologies in the market. These actions aim to increase the STI social visibility, through the introduction of products or innovations in the external environment on one hand, and to offer internal feedback guidance on the other hand. In case of the internal environment, it happens through the possibility of exposing perceptions of study opportunities for the application in new researches and technological developments. In theory, the business teams in STIs can benefit from the exercises with this method to become more active and more encouraging in the innovation processes in these institutions.

The chapters describing the specifications of pre-MKs technologies of different categories present a short introduction. These preambles contain the causes that induced the development of each pre-MK, whose aim was to draw the attention of entrepreneurs on the commercial relevance of the technologies developed by the STI.

Starting the development of a pre-MK

To begin the preparation of the pre-MK it is necessary, at least, a document in which the novelties claimed are properly described. The aforementioned description can be a patent document or a report describing the know-how involved. The information about the market and the definition of the preferred initial concretion of the product or

process, are additional aspects that should be organized by a team effort. In general, this initial information is far from the ideal one, but it is the basis for the generation of the premises and the establishment of strategic decisions, which are necessary to prepare the technology pre-MK. It is team work, which should not be developed only by a business expert, isolated in the STI. It should actually be prepared by a multi knowledge team that can effectively adjust the technology to the intended markets.

In general, structured knowledge of the markets based on research information related to consumers, suppliers and competitors is not available during the preparation of pre-MKs in the STIs. However, the pre-MK teams are exposed to the primary duty of making practical inferences on this subject, to support these technologies transference to the productive environment. To accomplish this step, the team should begin the process by interacting with the knowledge that the inventor is able to share. In most cases, this initial knowledge about the market is tenuous and was obtained by using unstructured and informal procedures for the analysis, evaluation and research, about the equipment and materials related to the technology development. Even in developed countries, knowledge on the target market, including relative size, is often precarious. Additionally, the inclusion of these new technologies in one or more market segments is only presumed and speculative, in the pre-MK preparation phase. So the teams of STIs need to work with realism and practicality, to fill the major gaps of knowledge with available information about the target market. This information, while scarce, should be obtained through simplified and pragmatic research, carried out with courage, critical sense and caution.

Starting from the pre-MK, decisions will be made about the destination and the preferred technology concretions. This elaborative method is a powerful tool because it involves a specialized technology review, which often demands comparative and detailed studies, which facilitate the development of practical and strategic solutions for the technological business. In this work an important aspect is to make an effort, a dedicated attempt to make the technology seductive to the entrepreneurs.

Methodology:

The pre-MK method used in this book is an adaptation of the marketing plans, as initially established by Phillip Kotler (KOTLER; KELLER, 2005), whose function is to define the preconditions of comparative feasibility of selling products and services. In the specific cases of technology developed in STIs, it is more accurate to think about pre-marketing plans (pre-MKs), as these technologies are not sold directly to the end consumer. In addition, STIs teams in general do not have, effectively, realistic conditions to assess or define costs and market positioning for the technologies. Despite these limitations the pre-MKs are an exercise, which in other respects have formal similarities with the procedure proposed by Kotler (KOTLER; KELLER, 2005). However, the expected result is quite different from a common marketing plan. It is mainly aimed at awakening the attention of entrepreneurs to one or more preferred concretion possibilities of the technology, which may be effective for the commercial efforts to make the innovation viable. In this consumer discovery process (BLANC, 2013) the entrepreneur probably will imagine different applications and niches from those previously imagined by the STI team. Therefore, the pre-MK is elaborated to give a strategic reference impulse, importantly, with which the STI will guide the initial communication steps with the productive environment.

As a tool for insertion of STI technologies in the production environment, the pre-MKs additionally are more simplified than the marketing plans proposed by Kotler (KOTLER; KELLER, 2005). In traditional marketing plans, the work does not necessarily begin on an intellectual property document or a know-how document, nor need necessarily the directed transfer to entrepreneurs. pre-MK is a more interactive process, as will be shown in detail, in the cases study, of different technologies genres.

As a communication tool, the so-called methods of pre-marketing plans (pre-MKs) were taken as documents for the initial interactions, used to set preliminary understanding about the subject with the entrepreneurs. Therefore, pre-MKs involve different issues despite using formal requirements, very similar to those developed in genial way, by Phillip Kotler (KOTLER; KELLER, 2005). In fact, pre-MKs are primarily an institutional intelligence and development tool for the STI,

rather than a tool for insertion and for the products positioning in the market. On the use of pre-MKs, in the sense described in this book, we did not find specific methodological references in the literature.

At least in Brazil, in STIs, we did not find reports of marketing plans use for the definition on the opportunity, or not, for the insertion of a new technology in the market. In this book, the method developed by Kotler (KOTLER; KELLER, 2005) is used as an auxiliary tool for the insertion of technology protected by intellectual property rights or not in the market, while the product is still only a proven concept.

In the experimental approach of pre-MKs, it is assumed that the preliminary marketing plans can be developed, comparing technological prototypes offered by STIs, with some products, which are available or not in the market. Preferably products that are used for comparison should be available in the market, but this is not always possible with innovative products. These selected products are suitable for purposes of rational and strategic comparison. These comparisons contained in the pre-MKs may guide the decision of entrepreneurs about the licensing, as well as on future investments needed to develop and put the technologies in the market. In each situation, treated in a preliminary way, the team determined that only the fact that the product be licensed would be taken as a case of triumph. This does not necessarily mean that the technology will be a market success. Triumph is a parameter, whose meaning is more restricted and more realistic, that commercial success parameter for the strategic work in STIs. Success is a possible occurrence, whose detection demand time horizons of industrial innovation, typically greater than 05 years. Additionally, we prefer the notion of triumph, because the criterion of commercial performance - success, occurs only for a small fraction of licensed products that actually become profitable. In this line, a problem to use the commercial success criterion is the fact that the development of the licensed product in the industry often take several years and the cases covered in this book are relatively recent. However, these method limitations do not decrease the proposal value, in the sense of being a tool to quantify the effectiveness of the STI in the clarification and the entrepreneurs' decision regarding the demonstrated technologies.

In addition, to obtain triumph in licensing to pre-MKs, a series of complementary actions is also necessary, among them: a survey of potentially interested companies, preparation of invitation letters, product demonstrations, negotiations of contract terms with the legal department and the work to publicize the performed acts. Only with the completion of all these additional steps, dependent on the clarity and strength of the inferences, based on pre-MK, is that one can achieve the defined triumph status. Just a good pre-MK, therefore, there is no guarantee for the STI that she really negotiates the technology with the productive environment. An effort of negotiation, strategic and well prepared, is also indispensable.

To achieve profitable marketing level, beyond the effectiveness of the proposed technologies, entrepreneurs need to work consistently, using good business models, aspects not directly controlled by STIs. Somehow STIs should take each technology licensing case as a new institution project. So, this could support entrepreneurs in technical and divulgation aspects, as co-responsible, interested in the success and technologies profitability.

The pre-MK must have a concise text, didactic, comparative and seductive, from the perspective of the entrepreneur. These features greatly facilitate the communication and business actions, which are formulated by using almost exclusively the excerpts of these texts. In order to overcome the difficulty of preparing concise and particularly understandable texts for entrepreneurs, we use the following method: the text was drafted and revised a few times, always after a reading aloud; to complete the development, in addition, we use an artificial intelligence tool. To clarify, the text was submitted to an automatic translation that uses the neural network method, with which the elaborated contents were tested with respect to the sufficiency and the concatenation. An almost perfect transposition of the agreed ideas between the Portuguese language and the English language was taken as clarity and comprehensibility indicator. Thus, it is assumed that if the automatic translation between two languages (round trip), is correct, then the text, although grammatically imperfect, in fact contains the messages that a careful businessman can interpret correctly and unambiguously. Therefore, the language of pre-MK should not be scientific, but should be an understandable language, at least for entrepreneurs who are currently envisaged as customers.

This auxiliary method that uses artificial intelligence, help the iterative construction of clear sentences, without words omissions such as articles, prepositions and verbs, so that there is no significant content loss for automatic translation between the two languages (round trip). Therefore, in a way, the method with artificial intelligence intervention served as if it were an interlocutor with which we try to communicate with clarity, removing words omissions and adding objectivity to the presented ideas. Clarity and objectivity are two essential qualities of pre-MKs, to facilitate communication and thus to enable the effectiveness for business.

As seen before, the method of pre-MKs - as recommended - can be applied in order to guide STI technology transfer interactions for the production environment. In this sense they can be used internally in STIs, to guide specific business relating to licensing and know-how transfer, and social actions of technology transfer.

The pre-MK is a review exercise whose main goal in the STI is to learn and to generate ex-ante ideas, or didactic information that are easier to understand. These frequent development results of pre-MKs, occur while the technologies are being addressed in order to provide understanding to an audience, not always specialized, whose interest must be aroused. For example, a manufacturer who is not a specialist in irrigation, but that may become interested in a business related to specialized irrigation management and control technologies through a didactic and well-directed presentation.

Technological genre

In this work we realize that the method of pre-MK can additionally be used as an important strategic tool for various orientations. The developments of STIs are very diverse and in the sense to improve the occurrence of triumphs in technology transfer, they were divided into some genres that require specialized care. The genre depends on the technology state, origin, unfolding, developments and business integrations proposed by the STI. Among the types of guidelines and definitions that seemed essential, are those relating to the state, to possible unfolding, integrations and business derivations of the STI technologies, as described below:

Nascent technology or genre 'a' technology - recently developed and promising technologies for transfer for the productive environment, for example, regarding to the Igstat Sensor, Dihedral Sensor and Turgormeter Sensor, at the time of pre-MK elaboration.

Shelf technology or genre 'b' technology- technologies with more than 18 months of intellectual protection filling for which effective measures have not been taken to implement the transfer. It should be clarified that 18 months is the typical time between the filing and the publication of patent documents (confidentiality phase), in the intellectual property databases. After this interval the secrecy phase ends - if there is any on the information on the patent - as it was the case when the Wiltmeter pre-MK was elaborated.

Technology composed in the pre-MK or genre 'c' technology - use of ideas contained in different documents of intellectual property and know-how documents (without intellectual property protection), integrated to improve the proposal for a technology, during the pre-MK development. E.g.:atmo-dripping technology, complemented by technical attributes introduced from the availability of the new Igstat Sensor.

Pre-MK Derivative technology or genre 'd' technology– New objects of technological or business development generated, to address shortcomings observed during the process of preparing the pre-MK. E.g.: Igstat Irrigation Stem and the Igstat sensor reading by reflectance.

All possibilities for the genre of the above technologies can be considered during the elaboration of pre-MK, which are typically performed on demand to handle specific cases.

Conceptual detailing about the genre of the Technologies

Nascent technologies

Technologies 'a' genre refers to nascent developments, that are, promising technologies recently developed for the transference to the production environment. To illustrate this concept, we present below some typical cases observed in our institution.

Nascent Technology - Dihedral Sensor Case -

After the triumph in licensing the Wiltmeter technology, whose procedure was a precursor of the method of pre-MKs, we had the opportunity to employ the method in the Dihedral Sensor technology, which had recently been protected (genre 'a' - Nascent Technology).

The Dihedral sensor technology, according to the patent document, represented a major challenge for the negotiation, since it contained various applications in: soil physics, plant physiology, and food technology and in monitoring relative humidity. We needed a well-defined marketing interest focus. Focusing was one of the hardest stages during the elaboration of the pre-MK. It was necessary to consider only about twenty percent of the original document, in the section on instruments for irrigation scheduling because - in this line - the team has had some preliminary experience. Additionally, this was considered to be an important market segment, inadequately serviced and valued.

We selected a specific market for the technology, but in this market the applications of the dihedral sensor were still diverse and it involved various types of prototypes: portable instruments, stationary instruments of visual reading and instruments for electronic data acquisition. These applications additionally are related to a market segmentation, which at the time were not included, and it involves a division between the agricultural market (which can be highly technified) and the domestic market (largely unexplored), which requires solutions that are interesting, creative and inexpensive. In the development work, strategic solutions obtained with the method of pre-MKs are very peculiar, because they depend on each technology and on the way the product can be inserted into the market, according to the vision established by the pre-MK team. The solutions obtained presumably are not the best, but these are necessary lines to provide a clear and didactic communication with the target business sector. As a result of this pre-MK, the preliminary communications for the technology licensing were mainly conducted for professionals working in companies that manufacture instruments for irrigation management, located in Brazil or abroad. An interesting aspect is that the letters based on the pre-MK text were well understood by Brazilian businessmen and as well by international entrepreneurs, even in cases of unsuccessful dealings.

The pre-MKs have also provided us an interesting international experience, which included cases of relevant triumphs for a small decentralized Embrapa unit, as the licensing for Irrometer Inc., a leader in the international market of sensors and irrigation management systems. In Brazil, in addition, the technology at that time was also licensed to Tecnicer Tecnologia Cerâmica, which was entering in the irrigation scheduling market.

In the Dihedral Sensor technology, the so-called triumph was obtained after an effective effort of the STI for including the technology in the market. The licenses were non-exclusive and other new licensing of the same technology may occur, based on this pre-MK guidelines. During the writing of this book the technology was on the industrial development phase. The team of pre-MK expects the technology to become a future market success.

Nascent Technology - Turgormeter Case

It was our first elaboration of pre-MK focused on cellular turgor pressure reading sensors in plants, for applications in irrigation scheduling, ecophysiology and postharvest. It was a newly developed technology, whose patent was filed, and that needed to be placed in a market still lacking practical tools based on the response of plants.

The first basic problem in the preparation of the pre-MK for the Turgormeter was similar to what had happened to the Dihedral Sensor. In the sense that the technology has many applications in plants, focused on post-harvest, for ecophysiology, irrigation scheduling and for automatic irrigation control. However, each of these applications is related to different market segments.

Initially the pre-MK team needed to take decisions regarding the markets' choice. To understand the insertion of technology, then a spreadsheet with the possible applications was elaborated. Several relevant opportunities for insertion in the market were observed. Some were familiar and simple while others brought great challenges for the negotiations establishment in areas where we had no experience.

For example, an instrument to meet the demand for post-harvest market would be simple, because it would require little industrial

development effort, for being very similar to that detail in the intellectual property document. But the entrance into the post-harvest market of fruits and vegetables was challenging in the sense of the difficulty in finding partners, with the potential to produce and sell our technologies. Instruments for assessing postharvest quality are produced mainly by a reduced number of small international companies. Thus, there was a small number of companies that produce simple equipment for the evaluation of post-harvest quality to whom perhaps we could offer the technology. Therefore, the easy part of manufacturing happened with a limitation which is the fact that instruments to evaluate postharvest quality constitute a small and displaced market.

Unlike the case of the Dihedral Sensor, however we preferred not to define only the simplest product, as would, for example, be the market for the Turgormeter in post-harvest of fruits and vegetables. Maybe we have discarded this option, during the preparation of pre-MK, because of our lack of experience with the post-harvest market. These products were usually difficult to find and were marketed by companies that offered a small variety of products for post-harvest. Typically, these devices were acquired in non-specialized companies, for example, from the market of instruments for ecophysiology or for chemical analysis.

At the time, we had some experience with instrument manufacturers for ecophysiology and irrigation management. The industrial development of instruments with Turgormeter technology to meet the demands of ecophysiology and irrigation management apparently would not be more difficult than for post-harvest, considered above. This market of instruments for ecophysiology was primarily intended for teaching and research, in which the demand for new technologies is frequent. This was a market that was serviced by numerous manufacturers located in different countries. Consequently, in theory, for this team, there was an area in which it was easier to identify potential partners. More broadly, the irrigation scheduling segment includes companies that primarily attend demands of the agricultural market and additionally the education and research market. The demand for new technologies in this segment was presumably less than in the ecophysiology market. Also for irrigation scheduling there were numerous manufacturers, distributed in various countries and therefore, it was an area in which some potential partners could be identified, with relative ease.

In the irrigation control segment, in particular, we had a greater challenge to propose a new automatic irrigation system controlled by cell turgor pressure sensors installed in the plant. The cell turgor pressure had the distinction of being a well understood variable among the plant physiologists. However, the challenge stemmed from the fact of being a radical innovation, because there was no other comparative irrigation control system based only on the use of a water state sensor, installed in the plant tissue. For the pre-MK teams, finding alternatives to overcome the non-consumption is known to be a very difficult task - for the introduction of radical innovations (CHRISTENSEN, 1997).

In contrast to what one would expect, the automatic control of irrigation was not a business involving large multinational companies. In fact, the big companies had worked mainly with irrigation projects without the application of automation methods based on sensor responses, installed in the soil or plants. The use of automated irrigation was unusual and if used, it was done, mainly controlled by time, in the PLC systems (programmable logic controller), sometimes with the use of water passage opening mediated by actuators connected to soil sensors, or atmospheric sensors. These technological supply constraints were at the same time an opportunity and a great challenge, related to the difficulty of overcoming the non-consumption, which affects not only small companies but also large companies. In the work involved in overcoming this difficulty it was thought that a necessary path was opening personal channels of communication within these companies. Of course, knowledge of strategic persons within companies is an ideal situation; however, this is usually not available at the beginning of the work. It was important to find special people, both in their ability to understand technology, as well as in their decision-making power in companies with which the institution intends to establish businesses. However, these two abilities are not necessarily related to positions or the functions exercised by the contacts within the company.

In the initial absence of this channel, an alternative that has a reasonable effectiveness is the use of invitation letters. Additionally, this is also an obligation, in the sense that public companies must give notice of their offered technologies, not only for private companies but also for society. These approaches, however, are only effective when mediated by the understanding, whose nature is eminently personal

and subjective. Consequently this effectiveness is usually facilitated by communication with qualified leaders that are open-minded to novelties.

The communication of the STI pre-MK team with small businesses in the regional market for irrigation is presumably similar. For small businesses the arguments also need to be simple and solid, but with the ease of having a simpler hierarchy. With small businesses an additional problem is that the prototypes of the technology, perhaps, should be closer to a commercial product, due to a presumed limitation of available industrial development capacity.

Thus, as noted, one of the hardest and most necessary activities that the team must face during the preparation of pre-MK, is to identify, even preliminarily, what are the potential partners. The frequent difficulty in prospecting partners, as described in this case demonstrates that the existence of an economically interesting potential market for a new product is not correlated to the presumed ease that STI would have for the licensing of technology. The implementation of partnerships is therefore a strategic communications activity, which is usually highly challenging.

Nascent technology - Igstat Sensor Case

The request for filing of the patent was carried out in 2013 and its pre-MK was also prepared in the same year, during the secrecy phase. The Igstat technology, was developed in partnership with a private company during the term of a technical cooperation agreement, and hence had theoretically an easy way out toward the market. Thus, as it is common in such cases, the partner company was the first to be licensed. In addition, there was a prior agreement for the occurrence of eventual new licenses without exclusivity, since the partner company was also interested in receiving future royalties.

At this point it is worth clarifying that a technical cooperation agreement of this kind, in fact, could exclusivity stipulate. In theory, depending on the negotiations, a partnership can simply prevent other technological business even when there is no expectation of commercial exploitation exclusivity. Indeed limitations could be partial and not explicit, since the transactions are dependent on the interest of the stakeholders.

Fortunately, in the case of Igstat Sensor the negotiations were in the sense that future negotiations without exclusivity would be beneficial to STI and to the partner company.

The availability of technical cooperation agreements may speed up some kinds of technological development, but can cause future negotiation restrictions. Thus, in technical cooperation negotiations, these possibilities for restrictions to future negotiations should be designed and adjusted before the contract is concluded. Decisions on technical cooperation must be carried out considering the synergy of the agreement, always taking care to avoid the favoring of private interests and even the possibility of eventual future misunderstandings about the cooperation.

From the perspective of triumph in licensing the Igstat Sensor technology proved to be attractive, as evidenced by other additional transfers to companies: Hidrosense, Acqua Vitta Floral, Irrometer and R4F. This attractiveness was possibly due to potential applications of the technology for the domestic and agricultural irrigation control, and interesting uses in agricultural irrigation scheduling. From the point of view of irrigation control, during the preparation of pre-MK, a new development has been designed, coherent with the perception of the market, which resulted in a complement to the intellectual property document, as it will be described now.

Nascent Technologies are cases ideally favorable for the preparation of pre-MKs. So when the intellectual property right was filed and it is in the secret stage, there is still available time for adding new matter within the same inventive concept, if these adjustments are considered important complements. This is the time when the work of pre-MK team has high creative possibility for the development, improvement of technology and the additions of new inventions, as occurred during the elaboration of the pre-MKs for the Irrigation Stem and the Igstat Sensor.

Shelf technology

Genre technology 'b' - shelf technology, refers to technologies with intellectual property deposit made at least one and half years before the pre-MK initiation, for which there has not been effective actions to

implement the transfer. To illustrate genre 'b' technologies, we present some rehabilitation cases of shelf technologies that occurred in our institution, as it is described in the sequence.

The shelf technologies, genre 'b', are the most common and those that would require more efforts to enable transfers to the productive environment. The state of 'shelf technology' is often seen in the sense that it refers to outdated or less valuable technologies. This is certainly not always true, because within the STIs there is often a lack of business culture, even in the most progressive institutions that are well open to the market. Among current cases taken as a model in this work the Wiltmeter and Atmo-dripping, for different historical reasons described, they were in the shelf technology state, when the development of activities of pre-MKs were initiated and gave support to the respective cases of negotiation triumph. In cases like these, the shelf technologies negotiations could perhaps become much more common.

To avoid reaching the shelf technology state, the ideal would be starting the preparation of pre-MKs immediately after the request for deposit of intellectual property or after writing a Know-how document or a trade secret. This could forward the transfer process, for a better use of the commitment and the enthusiasm that is still burning on the team that developed the technology. This would avoid the technology abandon by its developers, a factor that reduces the chance of business success. Additionally, the very novelty and enthusiasm are also positive factors and indicators that aggregate business value to a technology. The current national culture of valuing only the academic publications 'publish or perish', should be adjusted to a more objective practice of valuing innovation, so that the quality of the fruits of research are emphasized at the expense of 'papers' that in fact are not as favorably valued by society as a whole.

In the STIs, the protected and unlicensed shelf technologies are usually abundant. This abundance should preferably cause more open and general discussions aided by the establishment of pre-MK teams, given the possibility of integration of different technologies for the elaboration of 'improved products' by aggregation processes, update, development and also invention.

Shelf technology - Wiltmeter Case

The Wiltmeter technology in 2010 was a shelf technology. Despite some incipient efforts there was still no offering strategy for the technology negotiation, to the entrepreneurs of the productive environment. At the time, developers and business professionals have created a pre-MK team, in order to define the best alternatives for the STI to put its technology in the market.

In these initial actions to overcome the difficulty in entering into the market, we based our study on a little-known case (AGCalbo, personal communication), which took place at Embrapa Hortaliças, referring to the licensing of the technology now known as 'Irrigas'. For such technology Dr. Washington LC Silva, responsible for the business area of Embrapa Hortaliças, led the development of a marketing plan as if it were a private company technology. In addition to the marketing plan, the trademark Irrigas was registered by Embrapa Hortaliças to facilitate the identification and memorization. Next, invitation letters were produced for formal communications to some entrepreneurs, manufacturers of porous filter elements and soil tensiometers in Brazil. This action was complemented by phone calls.

In the preparation of what is now called Wiltmeter pre-MK, we knew the reason why the Embrapa Hortaliças had obtained triumph in the licensing of the Irrigas technology. It was a different known case at Embrapa Instrumentação at the time by the fact that the Embrapa Hortaliças team has not been requested, nor had direct access to the entrepreneurs in the area of instruments for irrigation scheduling. So, Embrapa Hortaliças had made a typical exercise of technology offering, not demanded by the productive environment. In that case, as in most other negotiation cases already made with triumph in different institutions, there was no description of its methodological aspects publicly documented. These documents could be reference and learning material for other negotiating teams in other STIs and even in private companies. This important information - not documented - is typically institutionally lost when the responsible for the triumph cases begin to perform other functions. In addition to this, there is a lack of international literature on these strategic experiences. This knowledge certainly would facilitate obtaining new negotiating triumphs.

Therefore, we begin to work towards removing the Wiltmeter technology from inconvenient situation of shelf technology, which at the time had left frustrated the researcher in charge. The main concern was to elaborate an attractive document containing the necessary strategic information in order to facilitate the marketing argument, aimed at entrepreneurs who produce instruments for research in ecophysiology. This work, which began in 2010, was named Marketing Plan and now within the STI context we are using a more realistic designation of pre-MK or STI pre-marketing plan.

The elaboration of pre-MK was thought as a conversion activity of technical documents, especially intellectual property, in more concise and understandable documents. We need to use a strategic language for business, unlike the PI document - which is more focused on the technical descriptions with legal consequences. These texts produced (chapter 02) were subsequently used as argument in a business roundtable in which the prototypes of the Wiltmeter technology were presented to entrepreneurs. A few months after the plan preparation, the result of the effort was the technology licensing. The methodology of pre-MK at the time was experimental, but we knew it had been used successfully in a previous licensing case, and that it actually seemed a realistic and effective procedure to subsidize technology negotiations produced in a STI.

The Wiltmeter technology could be considered easy to insert in the market, in the sense that professionals working with ecophysiology would like to have equipment with its functionality and additionally, many users are willing to pay this scientific equipment price. This business feature facilitated the participation of companies working with products for studies in ecophysiology and plant physiology. So, on that premise, the fact of the licensed companies achieve commercial success or not would depend mainly on the effort and expertise to develop a robust and reliable instrument that meets this potential demand, which in this case was well defined.

Other shelf technologies, unlike Wiltmeter, would cause greater difficulties for pre-MK teams, because they involve competitive barriers in addition to developing a product that properly meets the potential demand of the market. In addition, as many products consumers are less educated, they lack the minimum technical notions, and are willing to pay only values of the order of that is charged for the traditional technologies, to which they may be used to.

Technology composed in the pre-MK

The technologies composed in the pre-MK, technologies of genre 'c', refer to the use of contents from different documents, relating to intellectual property and other technical knowledge documented (without intellectual property protection) in a renewed proposal of technology. Some cases of technologies transfers composed in the pre-MK are approached in the sequence.

In order to illustrate business related to genre 'c', the use of concepts contained in different documents - technology composed in the pre-MK, we first considered what happened to the licensing of the Atmo-dripping technology which was a shelf technology, originally described in the intellectual property document 'Sistema de gotejamento para irrigação e arejamento com vazão controlada por fluxo de ar' ['Drip system for irrigation and aeration with water flow controlled by air flow'] that was filed by Embrapa in the National Intellectual Property Institute - INPI, on 11/09/2008 under the number PI0803322-6.

The Atmo-dripping technology as in its original description had practical limitations and some potentially strong differential characteristics for technological advancement of irrigation. Their potentials were: ease of flow control without the need for individual calibration of emitters and a high resistance to clogging. Not clogging and setting the water flows, including the very low ones, were two interesting features that were not adequately available in commercial products for drip irrigation.

If the technology was a breakthrough, then, what was the difficulty to its insertion in the production environment? This story is not new, it is repeated in different STIs and therefore the considerations of the genre 'c', technologies have valuable generality. The teams of STIs appear to face this problem for each new technology that is developed after years of research. It seems that the inclusion of a new technology is never easy. So it was with the Atmo-dripping technology that only came to be first licensed in 2013, after an interval of five years. The researcher had classified the technology as difficult to insert in the market due to the fact of demanding staking, fine control of water pressure and due to the use of an increased amount of tubes, compared to the conventional dripping systems. These additional complexities in some ways had

obscured the positive points of the atmo-dripping technology, already considered, as well as other possibilities for pneumatic irrigation control with the help of pneumatic irrigation sensors and irrigation controllers, which also demand additional investments. In other words, it would be a system with technical advantages, but expensive, more complicated, and completely different from the methods used by farmers.

In this context, the team sought to develop a technology composed in the pre-MK for atmo-dripping, initially focusing on mini-gardens and gardens irrigation. The beginning of this work was possible because a new pneumatic sensor called Igstat became available. This new pneumatic sensor could replace the use of specific and automatic irrigation controllers for individual plants, in the atmo-dripping. This possibility would make the atmo-dripping technology simpler and more competitive, at least in certain niche markets. Thus, the elaboration of a technology composed in the pre-MK was an encouraging experience. In this exercise we also found that the technology could be modified to dispense staking, which was one of the most important practical limitation. Therefore, this exercise provided unexpected lessons about the perspective for business models and of the integration between different related technologies available in the STI. After overcoming the initial obstacles to the improvement of atmo-dripping technology, the STI business team succeeded in obtaining a triumph, in the sense considered in this book, that a triumph equals a licensing.

A genre 'c' technology - Technology Composed in the pre-MK necessarily involves at least one shelf technology, which would be a genre 'b' technology, which requires enhancements or value aggregations to technically and commercially enable a technology transfer negotiation. In the specific case there was the aggregation between the atmo-dripping technology (genre 'b') and the Igstat technology (genre 'a'), that allowed simplifications and additional functionalities that made the atmo-dripping more interesting and competitive, at least in some niche markets. Therefore, elevating the genre of a technology from 'b' to 'c' is one of the available strategic solutions to the pre-MK teams in order to rehabilitate shelf technologies.

Pre-MK Derivative technology

Genre technologies'd' - pre-MK Derivative Technologies, refer to new objects of technology, science and business development, which is expected to meet market opportunities that were studied during the pre-MKs elaboration process, are described in the sequence. Genre technologies 'd' are developed to overcome market gaps identified in pre-MK works started within the genres 'a', 'b' or 'c'. In this sense we have some examples of pre-MK derivative technologies that were studied, which are briefly discussed in the sequence.

Comparing a genre technology 'd' and a genre 'c', we can verify that in the first one there is a clear need for something new, which is substantially more than the mere technologies combination such as in genre 'c'. The novelty in this case is analogous to the demanded in the applications for intellectual property filed, but less restrictive, because the pre-MK team can set a Know-how transfer to the new product, added or in substitution to the initial object from which it was derived.

The pre-MK derivative technology does not involve the absolute necessity of novelty in the sense of obtaining intellectual property, but it involves a substantial change in the studied object. The novelty that gave rise to technology genre 'd' sometimes is not strategic in the sense of requiring deposit of intellectual property. To raise the status of a technology to genre 'd' - Technological Derivatives, regardless of intellectual property protection, can be thought of as an intellectual and also commercial, distinct and valuable outcome.

Pre-MKs considerations on subsequent technology generations

The elaborations of pre-MK, are normally held on demand and aiming to provide knowledge and technologies that bring benefits to society. The experiences of a team with different technologies and different business partners may facilitate to a greater or lesser degree the pre-MK elaborations in order to transfer intellectual properties for the production environment, as described below.

From the atmo-dripping, which was a shelf technology - genre 'b', there was the aggregation of the Igstat Sensor, a nascent technology - genre 'a', which defines a technology composed in the pre-MK - genre 'c',

which allowed the automatic control of irrigation without the need for controllers, between the system and these new pneumatic sensors. The automated technology with Igstat Sensor in this application was used similarly to the simple and not automatic atmo-dripping, but with the economy of irrigation controllers. This particular use was framed as a typical case of technology composed in the pre-MK of genre 'c'.

During the preparation Igstat Sensor pre-MK, a nascent technology - genre 'a', we had also the opportunity to develop two genre technologies'd' - technological derivatives, which corresponded to two complements added to the intellectual property. This is certainly different from the case of technology composed in the pre-MK - genre technology 'c', whose practical effects are functionalities addition, which in itself without a new technical effect would not constitute an invention. New irrigation stems with different working mechanisms are breakthrough technologies, which were generated from the technologies atmo-dripping and Igstat sensor. Therefore, the pre-MK Derivative Technology refers to the development of these new intellect-negotiable products, which are not exactly the typical expected objects for the elaboration of a pre-MK.

The derivative technologies considered were the Irrigation Stem and the Igstat Sensor operated by reflection or transmission of light. Regarding to the Irrigation Stem, the team had been exposed to various parallel market demands, which could constitute new business opportunities for small manufacturers of non-automated products for watering gardens, vases and miniature gardens. For the Igstat Sensor operated by reflection or light transmission, in the same sense, the exposure to market demands pointed us to the fact that they would have greater use if an electrical response was also produced for reading and automation. The act of making these trade demands of the pre-MK explicit is that it made possible the efforts that generated the complements to intellectual property, here treated as pre-MK derivatives or genre 'd' technologies.

In the case of the irrigation Stem, the parallel demand that originated it, referred to the lack of low-cost irrigation control equipment that could be integrated into commercial products in order to aggregate value to the technology. The Irrigation Stem was a compact device that is easy to add to a water line for automatic control of irrigation, using pneumatic sensors of water tension in the soil without the need of using air compressors.

In the second derivative technology, that the pre-MK made possible, the Igstat sensor was obtained with response by light reflection or light transmission. Knowledge about the needs of the entrepreneurs, who labor in the area of irrigation scheduling and irrigation control, was also very helpful, because most of them, as well as farmers, are not accustomed to the use of pneumatic sensors of water status in soil or in the plant. This knowledge, referring to the industry and trade, gave rise to additional efforts to develop complements to a technology that was in the secrecy phase, these complements that we are here calling genre technology'd'.

Pre-MK - a strategy

The pre-MKs somehow are didactic documents for the organization of knowledge, specifically designated to focused applications in certain markets. Therefore, it is a technological prioritization method. So while the pre-MK is prepared, attention should be paid to the genre of the technology (a, b, c or d), in conjunction with the product stage in the life cycle, which can eventually be restarted by technological compositional changes.

In the elaboration of pre-MKs, regardless of their genre the teams always start from a central benefit. Thus, in newly developed technologies, the first product should add at least a basic benefit that is expected or not, by the consumer, preferably at an affordable price, even for a high-income niche initially. Internally in the STI, for these new products, we should also, imagine the future enlarged benefits at least, preferably in response to the presumed expectations of the interested public. This effort will be useful to forecast the expected life cycle and the most solid strategies for the technology.

As the market issues are determinants in the pre-MK, we can additionally evaluate for the most appropriate business models, perhaps new, which will be used by future partners. This, based on the debates about the technology features and its recommended placement market (four types of insert), aspects that make all the difference to the current sales occurrence (BLANK, 2013).

Genre technologies a, b, c or d, worked in these pre-MKs, started as an ex-post application, i.e. from a documented technology. Consequently,

this elaboration method tends to limit excessive abstractions in the team. Therefore, the initial documents are the know-how pages elaborated by researchers, who generally care more about academic aspects than about market aspects, even in STIs which are highly focused on technological development. Thus, in preparing the pre-MK, the researcher has a renewed opportunity to feel how the technology, presumably academic at first, can flow in the market that is certainly not defined by the mere sum of the consumers and researchers technological perceptions. Thus, in the pre-MKs we seek to establish viable initial links between STIs and the market for these technological documents. On the other hand, this work, carried out with caution, should avoid the objectivity excesses, not to harm the initial creativity that is needed in the STI as well as in the industry. It is known that disconcertingly interesting solutions for the creation of new markets can be reached at any time, whenever it happens a new critical eye, free and well concatenated.

'Sell' a technology is an important goal, but it is not the sole purpose of a pre-MK elaboration. In the STIs, other fruits of the method application are also valuable and among these, it can be mentioned: The generation of knowledge about the product market, and better understanding of latent needs for new solutions, that were not previously addressed in the technological development. These inductions of new ideas for research, based on technological needed solutions, determined in market interfaces and research, often occurs to overcome the lack of the consumer resources and to make possible the attendance of their innovation needs (GUPTA, 2012). However, it is reiterated that the pre-MK prepared in a STI has as main purpose to convince specific entrepreneurs about new opportunities.

These notions are considered without going so far as to advocate that the pre-MK should be prepared as a preliminary step to the development of a product or a technology. However, this possibility does not constitute a strategic absurd. In this sense, this adaptation, which is the STI pre-MK, nevertheless, would be a mismatch with the original procedures, developed by Kotler (KOTLER; KELLER, 2005), for application in conventional business marketing plans. A well elaborated pre-MK, preceding the development of a technology that also considers competition aspects and consumer needs would have a great chance to generate interesting hypotheses for technological

research - which as in this study - may change the way the technology is applied. Genre technology 'd' - technological derivative, somehow involves a type of precedence inversion between technology and market.

By the scope and by the consequences of a pre-MK, even if it is focused only on the immediate response to the entrepreneurs, it is still an exercise that – if possible – should not leave out those who worked on the early technology development. These elaborations are a rich opportunity to interpret and to adjust the knowledge raised on markets, their companies and their consumers. These are aspects that usually are not part of the academic background nor of the imaginary one, that guide the engineers, physicists and biologists work, among other professionals.

Elaborated by a strategic team in the STI, the pre-MK is a powerful tool for generating useful business and technological hypotheses for the R & D teams. This is because it involves culture interpretations, intellectual background and consumption patterns that require inferences that go beyond transitional situations, in order to achieve lasting adaptive effects, which are decisive for the level of commercial success of the products to be developed. Working with determination and relying on eventual creative moments during this job for the review and the technology improvement, often one can induce the generation of new intellectual properties and know-how documents for the STI. Thus, the pre-MK can be seen as a new option to review the technology. It is not merely a commercial exercise; it is an elaboration that can generate the demand for new scientific/technological research and also new important industrial developments for the innovations implementation.

In this study our impression is that the 'triumph' parameter to license a specific technology is likely, since this result was achieved in the described cases, perhaps because they refer to technologies with useful technical differences. To work with technologies that do not really have enough technical differentials seems an important cause of eventual lack of triumph in this type of work.

In these elaborations, the participation of each member of the pre-MK team was very important, including in what concerns the conscious

seek to avoid inconsistent consensus, which are often induced by the psychological phenomenon called 'Group thinking'. This problem occurs while the people that are seeking to collaborate, to some extent, become surprisingly accommodated or inhibited to set some benchmarks pieces for the 'puzzle'. This sometimes occurs due to the fatigue, when the work sessions are long, to avoid controversy, or by fear, not always substantiated, of counteracting prominent members. There was a significant understanding and also an effort to reduce these causes of Group thinking, which involve continuing consensus building that harm the generality, the richness and the validity of the perceptions aggregated in the pre-MK. Thus, it is recommended that all pre-MK teams' members feel prestigious, able, involved and important.

Develop technological objects in STIs is a leading responsibility for many current researchers. The fruits of these research works are most frequently directed to technical and scientific journals. However, for greater possibility of inclusion of these contributions in the production environment in general, researchers would need to make an extra effort for filing corresponding intellectual property documents or prepare descriptive know-how reports, to support negotiation actions. One way or another, holding the own know-how documents and intellectual property are essential requisites to enable effective actions to technology transfer. To facilitate interaction between STI and entrepreneurs of the productive means, one must, in sequence, develop communications and business rounds in which the technologies are presented in simple language and adapted to the businessman culture and perhaps even the potential future consumers. That is why the conversion of know-how documents and intellectual property rights, in an interesting read is here handled through applications of the pre-MK method for different technologies genres. This study method for use in STIs was primarily based on the methods of the marketing plan devised by Kotler (Kotler and Keller, 2005). However, the approach described here is freer and takes into account the fact that STIs generally do not manufacture products, do not provide services and have no direct commercial interaction with these technologies consumers. Thus, the pre-MKs method for STIs, as described in this study is a multiple tool, which also has strategic applications, which may vary between the insertion of shelf technologies in the production medium, to fine searches targeting the feedback applications and opportune development of new

technologies adapted by combination of different intellectual property and know-how documents. It is hoped that these concepts understanding contributes to the improvement of the level of success and innovational impact of STIs in the society.

Pre-MKs and Value Generation

According to Schumpeter (1961) the only way to create value for society is by introducing innovation. A country will only become rich in the case that it implements innovations in a very broad way, which needs not necessarily be restricted to the technological field. If a country innovates less than the others, it certainly will get a lower level of wealth and development. According to the notion stated in the Entrepreneurial State (MAZZUCATO, 2015), STIs have an important role to maintain the economy vitality in the Schumpeterian sense of value generation. Without innovation there is no value creation, there is no growth, the domestic enterprises only subsist.

From the operational level of a STI, these innovations can flow to the agents of the productive environment by educative publications action and in a more direct way through formal acts, mediated by negotiations for licensing of intellectual property and know-how transfer. These actions are mainly carried out with the intervention of STIs and in a complementary manner, with less intensity, also through pioneering actions of some companies from productive environment.

The methodology of pre-MKs, as described, facilitates the STIs interaction with early-stage companies, which are more often seen in the international literature, and with established companies, whether micro, small, medium or large enterprises, according to the genre, characteristics and strategies considered in the pre-MKs of each technology. In the reviewing of the literature, we have not found references to explain which methods were actually used to render the viable licensing procedures, possibly due to internal issues concerning the negotiation sigil. In these works on innovation, we have observed that STI often chooses to introduce technologies through startups, small and micro enterprises, due to the fact that rupture technologies generally only have potential or niche market and do not actually have measurable market. Additionally, large companies seek to work primarily with products that have some association with the magnitude

of the target market, consistent with the need of the company's revenue, i.e. those companies avoid expending energy to future products that represent just a few percentage points in its revenues. So usually, the STIs interaction with large companies has been predominantly in the form of incremental research partnerships and therefore, they have low innovational impact expectation.

In this book we regard as a unitary STI triumph each of the licensing of intellectual property or know-how transfer made to the production environment, so that each of the contracts traded was taken as a 'goal'. Additionally, it was not quantified as a greater triumph, when a technology was repeatedly licensed for the productive environment, even if this fact might conceal a relationship between triumph and the possible future commercial success for the technology.

To achieve this triumph, each of the studied technologies demanded a didactic argument for the negotiation that may or rather that must be extracted from the pre-MKs. These arguments need to be as simple as possible and preferably enchanting so that the entrepreneur assumes the hard decision of innovating. It is known that licensing a technology from a STI is a difficult and courageous attitude that should be propelled by internal strategies to create value for the company. Indeed, it is necessary idealistic and courageous entrepreneurs in order to assume the licensing of these technologies. This is because these technologies are usually embryonic and sometimes rupture technology such that they look a little more than academic inventions containing proven concepts and some demonstrative prototypes. On the one hand, the pre-MKs in Brazilian STIs, at least in non-exclusive negotiations should preferably be opened documents, due to a legal matter of publicity. On the other hand, in contrast, the inclusion of technology in production environment inevitably involves an additional effort to the direct interaction of the STI with few potential entrepreneurs who are identified as capable of carrying forward the industrial and commercial development process of the new technology which will be licensed. The publicity is intended to achieve the businessman, but it is actually received mainly the ordinary citizen, for which the information on the technology acquisition for commercial production, in general, is a curious, distant and little understood reality.

In works related to negotiations, as described in this book, we noticed that the STIs obtain triumph only when they make strategic efforts for

the technology offering, preferably directed to qualified and aligned receptors in target markets or in peripheral markets-niches. Locally, our cases that need to involve a wide publicity during the offering stage rarely cause spontaneous expressions of interest, generating contracts and innovations, because of this publicity, although this correlation is one preconized expectation. Thus, for each technology, in practice, so that the method of pre-MKs of STIs have a good chance to insert the technology in the production environment - the use of a survey of the potential innovators is critical. This is a work of innovation induction towards making efficient the models preconized by Schumpeter (1961) and Mazzucato (2015) through the establishment of communications of people belonging to different institutions.

Generate value is a notoriously laborious, costly activity and whose future outcome is uncertain. Strategic decisions of medium and long terms are necessary for enabling innovations, both in private companies, as well as in STIs. Notice that the development of an incremental product in industry - for example - typically involves a cycle of 02-03 years. However, Gupta (2012) considers a more realistic time frame to rupture products, a period of nearly 05 years. In our studies, in fact, we have not observed average speed greater than this.

During the products development, in their early life years, they are a cause of burdens for the innovative company that is forced to invest in human, financial and technical resources, to obtain future returns, although the success of the product, at this stage, is only a mere expectation. Thus, in addition to technological vision characteristics, for the product to be successful, it is important for the entrepreneur to save development resources, with prudence, but with vigor and perseverance, so as not to exhaust the company while developing the market and an initial product, for a small number of non-mainstream differentiated customers, as recommended by Blank (2013).

Perhaps, indeed, there is not a 'science', or at least a practice, effective and proven, of transferring new technologies of STIs to market. This is verifiable considering the very low licensing triumph rate, taken as a percentage of the number of patents in STIs, which is typically less than 6%, even in developed countries. With careful and methodical procedures use in this book, it is expected that the chances of STIs improve this indicator significantly increases. With traditional

procedures, and with few strategies, STIs will continue to have serious difficulties and its technologies will continue building up in the 'shelf'. So, they will not become composite technologies or derivative technologies, and they will not meet the society's needs, which were envisioned to justify the funding requested during the early stages of creation and subsequent intellectual protection.

The pre-MKs works for each new technology, keep an analogy with the applied research work, in the sense that each new development starts from the enthusiasm and vision (hypothesis) of the developers, who are the engine of the premise according to which STI has a new technology able to enter in the market. During the pre-MK elaboration, the problem that the technology solves in the market is compared to existing alternatives, which often are the dominant at the insertion niche. Therefore, the pre-MK is a result of institutional value and often refers to a signal that the STI must make efforts for the technology insertion. Another strategic outcome, not least and probably more common, is that the team could not glimpse a suitable insert for the technology, although in niche to justify an immediate transfer effort by the STI. If the team cannot glimpse immediate insertion viability, this does not mean that the technology is valueless, but it is an indication that, at present, the pre-MK team, which preferably includes the developers, do not see, momentarily, justifications to start in the STI, the technology offering, in its current state, to the productive environment. However, this does not obstruct that the technology is made available to society by non-commercial means or that it receives further support and enhancements that may justify future market insertion efforts.

Chapter 2
Pre-MK of the wiltmeter technology

Preamble: pre-MK of a previously shelf technology or a genre 'b' technology

The preparation of the pre-Marketing Plan (pre-MK) for the Wiltmeter was relatively simple because it was focused on the licensing of an instrument which involves the concepts of intellectual property of a document as a whole, without segmentation. It was a pre-MK focused on instrument applications to meet academic and scientific markets in plant physiology, ecophysiology and irrigation scheduling.

The pre-MK elaboration for the technology began in 2010. The fundamental plan concern was to provide an understandable, simple, attractive document and with strategic information required for business decision making. The pre-MK elaboration is a step in which the team has the opportunity to study, create and convert technical documents, elongated and without commercial appeal, in a strategic paper with a business language. This document is adapted to be useful in the negotiation phase and it may also be used in later stages of the technology demonstration, used with academic prototypes that are characteristic of the work in STIs.

In this chapter as well as in others, we sought to give a clear idea that the pre-MK preparation is an open strategic tool, a method of learning, less defined than it is generally thought, and that is not only useful for licensing. It is an intelligence work that seeks learning about the convenience or not of inserting the technology into the market in a particular, thoughtful and timely manner.

Backed in this pre-MK the Wiltmeter technology has been licensed for the commercial exploitation for the company *Marconi Equipamentos e Calibração para Laboratórios, from Piracicaba (SP)*, in 2010, and the company *Hidrosense Sistemas de Irrigação Ltda., from Jundiai (SP)* in 2013.

The Technology

The Wiltmeter is a portable and easy instrument to use. It is suitable for measuring the leaf cell turgor pressure - water pressure inside leaf

cells. This measure can be used in irrigation scheduling in vegetables, fruit trees, ornamental plants, so that the water stress does not affect the growth and the productivity of plants. Additionally it can be used in post-harvest to assess the commercial quality of leafy vegetables, flowers and ornamental plants. In the sector of ornamental plants and detached flowers, the instrument enables the creation of quantitative references on the useful life and the quality.

This technology is a tool that provides measurement of a basic variable of high relevance to studies on plant physiology and ecophysiology, necessary for the research and for the educational institutions. The Wiltmeter is used to measure quickly and easily, with great advantages over indirect methods for measuring in the field or on sophisticated methods that are used in a few specialized laboratories.

The technology aims to better meet the potential needs in ecophysiology, irrigation scheduling and post-harvest. In these markets, appropriate tools for measuring turgor pressure in the field and in the laboratory, were still missing. The Wiltmeter in ecophysiology market was a very important complement or substitute for instruments such as the Scholander Chamber.

While developing an instrument for this purpose, Embrapa Instrumentação, in São Carlos (SP), coined an international name for this tool which should be used in the future in several countries. In this way the Wiltmeter name used for this portable device was composed by the agglutination of the words 'Wilt' and 'meter'. The brand name was deposited in Brazil and the request of intellectual property of the instrument was deposited in Brazil and abroad.

The leaves turgescence is a key quality factor. It is related to the water content and is therefore decreased due to loss of water. This measure allows plants monitoring with regard to responses to the water availability and the climate variables such as temperature and air humidity.

*This pre-MK was initially elaborated and used in the year 2010. This is a dynamic document, which will require adaptations in accordance to the advancements in the technology and the new market possibilities and opportunities.

WILTMETER - pre-MK

a) Introduction

Wiltmeter is a portable instrument to measure leaf turgor pressure and leaves firmness and flat segments of plant organs, which was developed in Embrapa Agricultural Instrumentation. The invention [patent – US8656757 (B2)] is an adaptation of the external force technique for portable estimation of the cellular turgor pressure of leaves. The Wiltmeter, as a consequence, was designed for field uses and for postharvest applications. In the field this measurement is valuable for crop physiology, ecophysiology and for biological gauging of irrigation scheduling procedures that are, usually, dependent on meteorological techniques or on soil physics techniques, employed to keep the well irrigated plants. In postharvest applications leaf turgor pressure measurements is a new important alternative to characterize the quality of leaf vegetables, flowers and segmented organs, which quality and commercial value depends on tissue hydration and freshness.

b) Macro environmental analysis: relevant events and consequences

Wiltmeter was developed to offer a first easy instrumental alternative to measure leaf turgor pressure in the field. Historically, the development of new instrumental alternatives to evaluate plant water deficit has occurred slowly according to a long average time lapse (>10 years), between the available instruments used in this area. Altogether, this information is consistent with the fact that these new instruments come and stay in the market place for a long time, what is a strategic aspect for the investor. For technology diffusion it is also important to consider that the Wiltmeter is a valuable tool for researchers and educators, persons that are strongly involved in technological dissemination. This is a helpful factor for the adoption of new technologies, especially when it is also a relevant tool for plant growers. Additionally, water use is a crescent concern as water shortages are becoming a problem for agricultural sustainability and in this scenery the use of the Wiltmeter as an accessory instrument for irrigation scheduling is a considerable market value.

c) Brazilian market and enterprise competitors

The market exploration in Brazil could be started by the institutional segment of large cities from the Southeast, Central and South regions. In these regions there are numerous higher education, research and technology diffusion institutions, conveniently located close to strong agricultural segments.

As portable field instrument for leaf cell turgor measurement, the Wiltmeter does not have a direct competitor. By analogy, however, other instruments to measure plant water deficit could be considered as competitor products. Under this premise, the following instruments could be considered to be the main competitors: 'Scholander Pressure Chamber', such as the one made by Soilmoisture (currently there are no Brazilian makers); Dendrometer such as the Ecomatic Dendrometer, and the Cell Pressure Probe used to measure cell turgor pressure, of individual cells under the microscope, an instrument that was not available as ready to buy industrial product, because it is a very specialized laboratory instrument, used in a few laboratories across the world.

d) Key success elements – Competitive advantages

The exclusive Wiltmeter differential advantage is the capacity to estimate leaf turgor pressure with rapidity and portability in the field, using a small and robust instrument that is easily maintained and that does not damage the leaf surface.

The main success factors for the Wiltmeter, besides its capacity to measure leaf turgor in the field are: reliability, practicability and simple maintenance.

e) Commercial strategy – Focus and agreement

Patent licensing for the commercial exploration of the technology, which is useful in fields related to education, research and agriculture.

f) Communication strategy

- Operation manual and accessory divulgation folders prepared by the licensee, which could benefit from the complementary collaboration of an Embrapa counterpart;

- Embrapa and the licensee will develop actions to demonstrate the product in relevant technical and commercial events;
- Official product release of the licensed technology should be done as soon as the commercial instrument becomes commercially available.

g) Environmental analysis – Macro-environment

Environment	Characteristics and relevant events	Tendencies and projections	Expected marketing consequences
Economic	Need of new technological developments to improve agricultural sustainability is a current economic motivator.	Achievement of high agricultural productivity, while assuring food and the environmental security are goals whose achievement will require new tools and methods.	Increase of the demand for instruments and other suitable technological solutions in the agricultural segment.
Legal	Start of taxation for water use.		Increase of the demand for irrigation scheduling products.
Technological	Development of new instruments to study plant water deficit is not frequent, and it occurs, typically, within lapses of more than ten years.	A large progress of the information technology area is an expected trend that should not be followed by other areas such as in the interface between plant physiology and the development of instruments to evaluate plant water deficit.	Due to the market characteristics, there is the possibility of long-term planning.
Ecologic	Wiltmeter is an instrument aligned to studies of plant water deficit, plant physiology and plant ecology.	There is an increasing awareness about usage restrictions of land, water and energy set by the climate change in association with the fragile geophysiology of the Earth and ecology.	The increase of studies about ecology will demand new instruments.

h) Key success factors

Success factors	Weight	Comments
Rapid leaf turgor pressure measurement	40%	There are no other instruments to estimate leaf cell turgor pressure with rapidity.
Portability to enable field measurements	20%	It can be easily moved in rural and forest areas, allowing easy access for measurements of leaves in plants.
Does not damage the leaf	10%	Other instruments to measure water deficit variables, usually, require leaf detachment.
Robust and easy to maintain	10%	This is a valuable characteristic for instruments oriented for field usage.
Reliable	10%	Valuable characteristic for a quantitative instrument.
Easy to use and interpret	10%	The measuring procedure is simple and the result is physically well defined.

i) Competing products

A) Company: Soilmoisture Equipment Corporation
Competing product: Scholander Pressure Chamber
Country - United States of America

Some other commercialized products:
- Soil water samplers
- Moisture and water tension sensors for soil
- Porous ceramics plates and porous cups differing according to, shape size and critical water tension
- Soil penetrometer

B) Company: MMM Mosler Tech Support.
Competing product: Scholander Pressure Chamber
Country - Germany

Some other commercialized products:
- Standard soil tensiometer
- Watermark - a soil water tension sensor
- TDR - a soil moisture sensor
- Lisimeter
- Weather stations

C) Company: Ecomatik.

Competing product: Dendrometer
Country - Germany

Some other commercialized products:
- Data Logger
- Sap flow sensor
- Irrigation control system based on soil water tension
- EQ15 - electronic soil water sensor

D) Company: it does not apply to the Cell Pressure Probe, because this has not become a commercial product. The construction of such instrument is made by the user with the assistance of skilled artisans.
Competing product: Cell Pressure Probe

j) Potentialities and vulnerabilities - Competitors

Product	Potentialities (strengths)	Vulnerabilities (shortcomings)
Scholander pressure chamber	It is the unique portable instrument available for rapid estimation of plant water tension in the field.	Measurements are made in detached leaves. The estimation of leaf turgor is not as simple as to measure water tension and it involves a series of water tension measurements followed by calculations that usually involve mathematical fitting of data to leaf pressure/volume models. Such estimates are slow, toilsome and involve large errors. Measurements are made by using pressurized gas. It usually demands the transportation of a bulky N_2 gas cylinder.
Dendrometer	It has a sensing system that allows continuous measurement of the perimeter of stems and other organs. The measurement is valuable for plant growth studies and as an indication of short term water deficits.	The stem perimeter depends on two concurrent plant physiology processes: the plant growth and the elastic variations of volume according to the availability of water and the correspondent organ hydration status. Consequently, the result needs to be carefully interpreted to enable the separation of these concurrent long and short term components. Its use for irrigation scheduling is not straight forward. It is not a portable instrument.
Cell pressure probe	Reference instrument to measure individual cell turgor pressure.	It is not a readily available commercial product. It requires specialized skills and measurements needs to be done under the microscope.
Zimm Probe	Measures turgor variation directly on the leaf, in the field, in a continuous manner.	It measures only a quantitative parameter associated with cell turgor pressure.

k) Product ranking - Main competitive advantages

A - Exclusive competences

1- Portable equipment to measure leaf turgor pressure in the field.

B - Main advantages with relation to the Scholander Pressure Chamber

1 - Rapid and direct leaf turgor pressure estimation.
2 - It does not require N2 gas cylinder.

C - Main advantages in relation to the Dendrometer

1 - It measures leaf turgor pressure directly.
2 - Portability.

D - Main advantages in relation to the Cell Pressure Probe

1 - Portability.
2 - Easiness of use.
3 - Rapidity.

l) Product ranking - Competitive disadvantages

A - Chronic disadvantage
1 - It does not present known chronic disadvantages.

B - Main disadvantages in relation to the Scholander Pressure Chamber

1 - Wiltmeter has a more limited application; nowadays, it only measures leaf turgor, while the Scholander Pressure Chamber enables measurements of xylem water tension and estimations of water potential and water potential components.

C - Main disadvantages in relation to the Dendrometer

1 - Data collection over time is more difficult.

D - Main disadvantages in relation to the Cell Pressure Probe

1 - It is not a direct method as this competitor is.
2 - It does not work for very irregular, coriaceous or unusually thick leaves.
3 - The Cell Pressure Probe is a reference method.

m) Marketing plan presentation

Product: Wiltmeter

Period: 1st Semester 2010

Prepared by: Dr. Adonai G. Calbo and Carlos César Pusinhol

Date: January, 2010

1 - Objective: Technology transference, through licensing.

Reason of this objective: the instrument has industrial potential and should be useful for ecophysiological studies and for applications in irrigation scheduling and for postharvest leaf quality control.

2 - Goal: To carry out the technology licensing during the first semester of 2010 and thereafter.

Reason of this objective: Patented equipment suitable for transference commercialization.

3 - Strategies:

Product - Wiltmeter

a) Price (suggested): R$4,000.00 to R$6,000.00 (without peripherals and special utilities)

Justification: it is a small, portable instrument for which, initially, high cost components seem to be unnecessary.

b) Promotion / communication: participation in technical and scientific events and communication with potential clients, using Internet tools, technical journals and interactions with educational, research and extension institutions.

Justification: potential users are mainly from a public with high educational and cultural background, which accesses the suggested communication channels.

c) Selling channels / Distribution: stores, commercial representatives and e-commerce. For e-commerce the instrument portability eases the transport.

Justification: the selling cost for technical/scientific instruments can represent a large fraction of the total cost; consequently, a correct selling policy with proper focus can define the success of the instrument.

d) Sales: definition of fair prices and quality, respect to delivery closing dates and accessibility are the main complementary factors for the success and the sustainability of the instrument sales.

Chapter 3
Pre-MK of the dihedral sensor technology

Preamble: pre-MK of a nascent technology or a genre 'a' technology.

This case of pre-MK has focused in the licensing of only one application among others, which were described in the intellectual property document as a whole. The measurement of the water tension in soil and cultivating substrates was chosen because it has a greater possibility of being rapidly incorporated into the market. The water tension measurements in the plant, the water potential in the plant and the water activity in food and in the atmosphere were not considered. These latter applications were not included because they involve industrial development in companies focused on different niches - quite specialized - of scientific instruments for ecophysiology and food technology.

Embrapa Instrumentação - after the triumph in the licensing of the Wiltmeter technology in Brazil - employed a flow of similar actions to license the Dihedral Sensor technology.

The purpose of the pre-MK for the Dihedral Sensor, to measure the water tension in the soil, was to introduce it in the sensors segment for irrigation control and irrigation scheduling. Aspects related to the application of the technology in plants and in the atmospheric air - claimed in the patent - were not treated due to focus reasons.

The pre-MK is a guiding document in negotiations with specific customers and because of this; the points that would make the document excessively generic were removed. Still, during the early stages of the pre-MK development, the work was started with a broad coverage, because we did not have clarity on the best target audience to be set. Therefore, this pre-MK was directed to meet the specialty for which we glimpse most successful commercial potential, according to the available information on the companies that potentially would be interested in the technology.

After the pre-MK elaboration, this was used as a basis for a Business Event, in which in addition to issues relating to the market, a demonstration of the dihedral sensor technology was presented.

The Dihedral Sensor technology has been licensed to the US Company Irrometer Inc. and for the Tecnicer Tecnologia Cerâmica Ltda., settled in the city of São Carlos/ SP -Brazil. The reason for the American company interest of was the possibility of introducing this Embrapa's technology as a factor to add value to their commercial products. As for the Tecnicer, the interest was the entry into the agricultural market not yet explored by the company, which lacked technological solutions for the rational use of water.

During the preparation of this pre-MK there were some questions like those related to market segmentation. In this particular case there was no differentiated approach for applications in domestic and agricultural irrigation markets, given that we had not been exposed, more intensely, to the demands of business people working with the domestic irrigation market. This kind of concern will appear in other pre-MKs, for sensors with applications in different market segments.

*This pre-MK was initially elaborated and used in the year 2010. This is a dynamic document, which requires adaptations in accordance to the advancement in technology and the new market possibilities and opportunities.

Pre-MK – Dihedral Sensor

a) Introduction

Embrapa developed the Dihedral Sensor, a low cost sensor to measure soil water tension. It uses a new method based on the evaluation water meniscus position within plates mounted with a contact edge dihedral angle. The Dihedral Sensor is a system application *'Sensor diédrico para avaliar tensão, potencial e atividade de líquidos' [Dihedral sensor for evaluating tension, potential and activity of liquids]* (BR2010PI00060, EP 2522214), which was designed for field, green-house and gardening use. Its continuous measurements in a wide range of soil water tensions are ideal to verify the correct time for irrigation. This irrigation time definition based on the concept of crop critical soil water tension, now can be done with less maintenance and within a more suitable range.

The Dihedral Sensor can be used by farmers, professors, researchers and by the general public, as a low cost sensor, with simple adjustments that is suitable for different irrigation scheduling, manual and automatic procedures, in many crops.

b) Macro environmental analysis: relevant events and consequences

The technology has potential in comparison to other systems. It could be adapted for automation of the irrigation and for the construction of portable instruments. The sensor is distinguished by stability, by the measurement in a wide range of water tensions and it does not require external power source for operation.

The average time for the emergence of new sensors for the measurement of water tension in soil is longer than ten years, an aspect that is strategic for the investor. Such temporal aspect related to the emergence of new methods is one of the strategic strengths of this sensor for the investor.

The Dihedral Sensor is a simple sensor that enables the management of irrigation directly, without requiring advanced technical knowledge, because it uses soil water critical tensions, for the plant - soil – atmosphere systems, already established in previous irrigation studies. Another favorable point is the growing concern with the rational use of freshwater, of which about 70% is used for agricultural irrigation. In this scenario, the Dihedral Sensor is an instrument that will bring benefits to the rationalization of the water use.

c) Brazilian market and enterprise competitors

Market exploration in Brazil could be started at the regions with the largest marketing potential, for example in the Southeast, Central and South regions. The marketing focus will be in fairs and direct contact with growers, clients from higher education, research and for technology diffusion institutions, considering the synergy involved for the formation of opinions about the new technologies.

The Dihedral Sensor has direct competitors to measure the soil water tension, which will be considered in this market analysis. These instrumental sensors are the common tensiometer, the Watermark and the Irrigas to measure water tension and the TDR is a volumetric soil moisture sensor.

d) Key success elements – Competitive advantages

The exclusive Dihedral Sensor differential advantage is the direct reading in a wide water tension range, in an inverse scale, which attends strict and very diverse grower demands, such as setting very low water tensions of protected crops, or setting very high water tension ranges, while applying irrigation deficit techniques in the field.

In this sensor the meniscus position, under visual or electronic detection, is the measurement of the soil water tension, without the need of accessories such as vacuum gauges or calibration curves.

Different from the common tensiometer the Dihedral Sensor can work unattended both in manual and automatic application modes.
The Dihedral Sensor is a reliable, ease to use sensor.

e) Commercial strategy – Focus and agreement

Technology transfer through licensing for the patent exploitation, focused on companies operating in the sensor industry and equipment for irrigation scheduling.

f) Communication strategy

- Operation manual and accessory divulgation folders are prepared by the licensee, which could benefit from the complementary collaboration of an Embrapa counterpart;
- Embrapa and the licensee will develop actions to demonstrate the product in relevant technical and commercial events;
- The official launch of the licensed product of the technology must be done as soon as it becomes commercially available.

g) Environmental analysis – Macro-environment

Environment	Characteristics and relevant events	Tendencies and projections	Expected marketing consequences
Economic	Compatibility of sustainability, productivity and quality for agriculture is one of the economical motivators for new technologies.	Increase in the use of new technologies in agriculture.	Increase in the demand for new technologies for irrigation scheduling
Legal	Water use taxation.	Measurement of farmers' water consumption.	Market increase for irrigation scheduling sensors.
Technological	Development of new methods for soil water tension measurement occurs with time lapses longer than ten years.	The projection for the following years is that advances will be mainly related to; geospatial data use for irrigation scheduling.	Suitable product for immediate and long term commercial marketing actions.
Ecologic	It is a sensor to ease the rational use of water, which will be increasingly valuable in the current climatic change scenario.	Increased awareness about ecological issues.	Increased demand for sensors and systems to improve the water use.

h) Key success factors

Success factors	Weight	Comments
A simple sensor that measures a wide range of soil water tension values.	30%	It can be developed to attend general applications and to attend very specific and demanding conditions in the low or in the high water tension ranges.
Reliable, works unattended and it is also suitable for automatic irrigation control.	30%	Strength derived from the construction and the physical fundamentals of the technology. This sensor can be used for automatic irrigation control using electric or pneumatic connections.
It uses critical soil water tension already available in the literature for many crops.	20%	It benefits from established irrigation studies made by using soil tensiometers.
The sensor has an intrinsic visual reading interface.	10%	It allows direct visualization on the sensor and allows the construction of portable and stationary instruments
It does not require an external energy source.	10%	Ease and independence in using.

i) Competing products

A) Company: Soilmoisture e Equipment Corp.
Competing product: Tensiometer and TDR
Country: United States of America

Some related commercialized products:
- Soil moisture and salinity sensors
- Soil tensiometers
- TDR (Time-domain reflectometer) to determine soil moisture
- Soil penetrometers
- Soil water extractors

B) Company: MMM Mosler Tech Support.
Competing product: Watermark; TDR; Tensiometer
Country: Germany

Some related commercialized products:
- Soil tensiometer
- Watermark – Soil water tension sensor
- TDR (Time-domain reflectometer) to determine soil moisture
- Lisimeters
- Weather stations
- Conductivimeters

C) Company: Hidrosense.
Competing product: Irrigas
Country: Brazil

Some related commercialized products:
- Irrigas sensors for irrigation control and for soil water tension measurement
- Blumat sensors for irrigation control
- Soil water extractors
- Digital tensiometers

D) Company: MESA Systems Co
Competing product: TDR
Country: United States of America

Some related commercialized products:
- TDR (Time-domain reflectometer) to determine soil moisture
- System to measure seed moisture

E) Company: Soil Control - EPP
Competing product: Tensiometer
Country: Brazil

Some related commercialized products:

- Tensiometers
- Weather stations
- Evaporimeters

j) Potentialities and vulnerabilities - Competitors

Product	Potentialities (strengths)	Vulnerabilities (shortcomings)
Tensiometer	Reference instrument to measure soil water tension.	Cavitation and consequent need of water recharge; demand of frequent attention makes automatic irrigation control difficult; it requires correction for pending water column height at the vacuum gauge.
Irrigas	Soil water tension sensor that works unattended; suitable manual and automatic irrigation control; it presents a linear response to the soil water tension.	It requires a specialized pneumatic system to continuously read the soil water tension.
Watermark	Soil water tension sensor that does not require maintenance; it has a wide working range; it eases data acquisition and can be used in manual and automatic irrigation control procedures.	It requires an external electric source; it demands calibration for each particular soil or substrate; it has low sensitivity to measure water tension in the range between 0 and 10 kPa.
TDR	Soil moisture sensor that works unattended; suitable manual and automatic irrigation control; it eases data acquisition.	It requires an external electric source; demands calibration for each particular soil or substrate; it measures soil moisture, with precision, in a narrow volumetric moisture band; It needs external power source.

k) Product ranking – Main competitive advantages

A - Exclusive competences

1 - The sensor has an intrinsic visual reading interface, which enables reading without the use of any accessory in a wide range of soil water tensions.

B - Main advantages with relation to the common tensiometer

1 - It is not susceptible to cavitation.
2 - It works unattended.
3 - It has a larger soil water tension range.

C - Main advantages with relation to the Irrigas

1 - It measures soil water tension without the use of pneumatic energy.
2 - Electric control of irrigation is easier.

D - Main advantages with relation to the Watermark granular matrix sensor

1 - It measures water tension even without an external energy sources.
2 - It does not require calibrations for specific substrates.
3 - More sensitive to low soil water tensions and enable reading of higher water tension than the Watermark sensor.
4- It enables pneumatic irrigation control.

E - Main advantages with relation to the TDR

1 - It measures water tension even without an external energy source.
2 - It has a work water tension range, corresponding to a wide range of water available for the plant in the soil.
3 - It does not require calibration to measure the water tension in different soils and substrates.
4 - It enables pneumatic irrigation control.

i) Product ranking - Competitive disadvantages

A - Chronic disadvantages

Not detected.

B - Main disadvantages in relation to the common tensiometer

Unknown equipment

C - Main disadvantages in relation to the Irrigas

It may require reading corrections due to the difference in water column heights between the sensitive region and the reading region in models using elongated porous element conducting water.

D - Main disadvantages in relation to the Watermark granular matrix sensor

It may require reading corrections due to the difference in water column heights between the sensitive region and the reading region in models using elongated porous element conducting water.

E - Main disadvantages in relation to the TDR

It may require reading corrections due to the difference in water column heights between the sensitive region and the reading region in models using elongated porous element conducting water.

m) Model for the pre-MK presentation

Product: Dihedral Tensiometer

Period: 2nd Semester 2010

Prepared by: Dr. Adonai G. Calbo and Carlos C. Pusinhol

Date: September, 2010

1 - Objective: Technology transference, through licensing.

Reason of this objective: the system presents technical differentials and competitive advantages, which will help in the marketing insertion.

2 - Goal: To carry out the technology licensing after the second semester of 2010.

Reason of this objective: Patented system suitable for transference and commercialization.

3 - Strategies:
Product - Dihedral Tensiometer

a) Price (suggested): R$50.00 to R$250.00
Justification: It is a sensor made with readily available components.

b) Promotion / communication: Participation in technical and scientific events and communication with potential clients, using Internet tools, technical journals and interactions with educational, research and extension personal.

Justification: Potential users are mainly from a public with high educational and cultural background, which accesses the suggested communication channels.

c) Selling channels / Distribution: Stores, commercial representatives and e-commerce. For e-commerce the instrument dimensions eases the transport.

Justification: The selling cost for technical/scientific instruments can represent a large fraction of the total cost; consequently, a correct selling policy with proper focus can define the success of the product.

d) Sales: definition of fair prices and quality, respect to delivery closing dates and accessibility are the main complementary factors for the success and the sustainability of the instrument sales.

Chapter 4
Pre-MK of the turgormeter technology

Preamble: pre-MK of a nascent technology or a genre 'a' technology.

The pre-MK of the Turgormeter technology had the characteristic of approaching applications of different methods - which the technology enables - for the irrigation scheduling, irrigation control, ecophysiology and evaluation of post-harvest of fruits and vegetables. These different applications and possibilities were organized in a two-way table, with some instruments and some markets. In this way we were able to address the different possibilities contained in the intellectual property document. For each type of application, the competing products were defined, in the specified markets, for the elaboration of comparative analysis in order to enable the technology insertion.

The base document contained a number of promising applications, so it was considered better to use a comprehensive approach to enable options for future creativity, while generating products, in the licensed companies. It was a risky decision in the pre-MK team. This decision did not release us of the hard work of defining what technology configurations that would be presented to the entrepreneurs, so that in the industry these prototypes would be the starting points for commercial products.

Basically all applications provided for in intellectual property document involved novel products, subject to the barrier of non-consumption. Our biggest challenge was to analyze the potential needs and develop strategies to create demand and introduce the product to the target audience, with support from the industry. This pre-MK - which was directed toward potential markets - was different from the pre-MK for the dihedral sensor technology, which was developed to overcome technical difficulties in other commercially available systems. These are conceptual differences, which teams that draw up the pre-MK face in practice.

This pre-MK sought to address ecophysiology and irrigation scheduling markets, which were known by the staff and on which it was more feasible the development of the hypotheses that guided the document. This was done in spite of the fact that the technology had been most studied and presumably easier to apply in the field of post-harvest of fruits and vegetables.

Results:

After the prospection of companies, there was a business event, to which companies with technological alignment in the equipment segment for ecophysiology and irrigation scheduling were invited. The event aimed also to make public the offer to license the technology Turgormeter sensor, using as a basis the pre-MK.

The technology was licensed to Hidrosense Comércio de Sistemas para Irrigação Ltda, which wanted to develop tools for irrigation scheduling and to evaluate postharvest quality.

In the same negotiation the Wiltmeter technology - to measure the cell turgor pressure in the leaf - was also licensed again. Since these are complementary technologies, the purpose of this dual licensing was to expand the company's operations in the segment of instruments for irrigation scheduling and start a line of instruments for the ecophysiology market.

*This pre-MK was initially elaborated and used in the year 2012. This is a dynamic document, which requires adaptations in accordance to the advancement in technology and to the new market possibilities and opportunities.

Turgormeter - pre-MK

a) Introduction

The Turgormeter System is a new invention to measure turgor pressure in soft plant organs, with applications in post-harvest, ecophysiology and irrigation. This sensor measures the cell turgor pressure that is a function of the hydration status and the development of stems, fruits and vegetables.

This sensor's applications are in laboratory, quality assessment by checking the hydration status or ripening in fruits and vegetables, through turgor readings; in the field studies of ecophysiology through readings of cell turgor pressure, and in irrigation, the automatic watering in response to the plant hydration state.

b) Macro environmental analysis: relevant events and consequences

There is a lack of practical methods for determining the hydration status of the plants, and more particularly methods for measuring cell turgor pressure, which is one important measure of the plant water status.

For ecophysiology: the main instruments for continuous reading of variables from the hydration status of the plant are the dendrometer, which measures stem diameter changes, and the Zim-probe, which provides a reading roughly related to the leaf cell turgor pressure. For measurement of turgor pressure in the stem, in the fruit or in the root there is no available continuous reading instrument.

To post-harvest: for reading the turgidity in the leaves there is only one commercial instrument - the Wiltmeter developed in Embrapa. To read the turgidity in fruits and vegetables, with regular external surface, the only instrument used is the turgor flattener, which is not yet commercially available.

For irrigation: there are no water emitters driven directly by the plant water status. Currently the irrigation scheduling systems are based on readings of soil water status and of the air evaporative power.

c) Market competitors

For ecophysiology: small and medium enterprises that operate nationally or globally, offering portable equipment for field and stationary equipment for laboratory use. The public is primarily academic.

For post-harvest: there are no companies that manufacture equipment for measuring cell turgor pressure in fruits and vegetables.

For irrigation:

- Drip in the field: mainly large companies that sell non automated drip systems in different countries, offering customized projects.
- In household and gardening: small companies.

d) Key success elements - Competitive advantages

Turgormeter Fruit and Turgormeter Plant:

The exclusive advantages of the Turgormeter Sensor, relative to competing products are:
- Measure the cell turgor pressure of soft organs, such as stems (trunks, haulms, bulbs and tubers), fleshy fruits and roots.
- Continuous measurement - with sensors fixed in the plants.
- Rapid measurement - stationary and portable instruments.

Turgordropper:

The exclusive advantage of the Turgordropper, relative to competing products, is: Irrigate in an automated manner as a function of the plant cell turgor pressure. It is the first irrigation automatization directly controlled by the plant water status.

e) Commercial strategy - Focus, agreement modality and suggested price

Turgormeter Plant and Turgormeter Fruit:

The main focus will be on companies working with instruments for ecophysiology and post-harvest.

The type of contract involved will be patent licensing exploitation, without exclusivity.

Turgordropper:

The main focus will be companies working with irrigation equipment and irrigation scheduling, as follows:
For field drip irrigation: medium and large companies.
In household and gardening: micro and small companies.

Price:

Turgormeter Fruit (Portable) - for use in the field and laboratory

Suggested price: R$1,500.00 to R$2,000.00

Justification: it is equipment made of small and relatively inexpensive components.

Turgormeter Fruit (stationary) - for laboratory use

Suggested price: R$ 4,000.00

Justification: it is precise and robust equipment.

Turgormeter Plant - Sensors with pressure transducer for clamping on the stem and other organs, the reading is obtained with a data collector.

Suggested price: sensor - R$ 300.00 / data collector - R$1,500.00 to R$2,000.00

Justification:

Sensor, data collector (dedicated acquisition system) and means for clamping on the stem or other organs.

Turgordropper - Water emitter with sensor and means of attachment to the stem or other organs.

Suggested price: R$50.00

Justification: the attachment means to the stem is a significant part of the cost, dependent on the diameter.

f) Communication strategy

The product launch will be held after the commercial product development made by the licensee.

Operation manual will be prepared by the licensee, which could benefit from the complementary collaboration of an Embrapa counterpart.

Embrapa and the licensee will develop actions to demonstrate the product in relevant technical and commercial events.

g) Environmental analysis - Macro-environment

Environment	Characteristics and relevant events	Tendencies and projections	Expected marketing consequences
Economy	Innovation is essential for the occupation of new markets and for the maintenance of the existing ones.	In agriculture innovative products that provide sustainability, productivity and quality attract great interest.	Increased demand for technology.
Law	Beginning of the charging for water usage.	Measurement of water volume used in farms.	Increased market of instruments for irrigation control and irrigation scheduling.
Technological	New instruments for irrigation scheduling, irrigation control and automatic measurement of turgor pressure are much needed, but its development with commercial qualities is uncommon.	In the coming years it is expected that there will only be incremental advances in methods for irrigation, post-harvest and ecophysiology based on measurements of turgor pressure.	Inserting these new sensors meet potential demands in the markets for irrigation, post-harvest and ecophysiology.
Ecology	They are Instruments aligned to the studies of climate change and ecophysiology.	Increased awareness about ecological issues, specifically on the necessity of water bodies preservation.	The product will meet the demands of ecological studies and will facilitate the rational water application.

h) Key success factors for Turgormeter Plant and Turgormeter Fruit

Success factors	Reasons and comments
It performs turgor pressure measurements in soft organs	The absence of other devices that perform measurements quickly and precisely, in stems (trunks, haulms, bulbs and tubers), fleshy fruits and roots. The methods for measuring the turgor pressure are cumbersome and more geared towards laboratory. The available field methods apply only to leaves.
It performs continuous measurements	Using sensors fixed on the plants for reading turgor pressure for ecophysiology and irrigation scheduling.
It performs nondestructive measurements	It allows repeated measurements in the same organ and site over time with portable and stationary instruments.
It makes quick measurements	It uses a procedure of superficial applanation of the organ.

Turgordropper

Success factors	Reasons and comments
It performs automatic irrigation control in accordance to the plant response.	There are no other methods based on plant responses for automating irrigation.

i) Segmentation of markets according to the uses for the Turgormeter Sensors

Usage	Product	Purpose	Potential user demands	Available technologies for the demand	Innovation (product that best meets the demand)	Market
Perennial farming	Perennial Plant (*e.g.* coffee tree)	Farming	Automation of localized irrigation	Timer	Turgordropper	Research / Agriculture
			Irrigation scheduling	Dendrometer, Scholander chamber, Zim-probe, and Wiltmeter	Turgormeter Plant	Research / Agriculture
Horticulture (fruit crops)	Fruits	Field	Automation of localized irrigation	Timer	Turgordropper	Research / Agriculture
		Field	Irrigation scheduling	Dendrometer, Scholander chamber and Zim-probe	Turgormeter Plant	Research / Agriculture
		Fresh product, minimally processed and industrialized	Quality assessment	Turgor flattener (for smooth and soft convex vegetables)	Turgormeter Fruit	Industry / Logistics / Research
Horticulture (vegetables)	Seedlings and vegetables	Experimental field and greenhouse	Localized irrigation	Timer	Turgordropper	Research
		Experimental field and greenhouse	Irrigation scheduling	Dendrometer, Scholander chamber, Zim-probe and Wiltmeter	Turgormeter Plant	Research
		Fresh product, minimally processed and industrialized	Quality assessment	Wiltmeter (for leaves) Turgor flattener (for smooth and soft convex vegetables)	Turgormeter Fruit	Industry / Logistics / Research
Agriculture of annual and bi-annual plants	Annual plants (*e.g.* Sugarcane)	Production	Automation of localized irrigation	None	Turgordropper	Research
			Irrigation scheduling	Dendrometer, Scholander chamber, Zim-probe and Wiltmeter	Turgormeter Plant	Research
Note: Horticulture (ornamental plants), nurseries and gardening were not addressed in this table, although possible target markets.						

j) Competing companies

Regarding to the Turgormeter Plant and the Turgormeter Fruit

In post-harvest equipment:

There are no companies that manufacture equipment for measuring cell turgor pressure in fruits and vegetables, for evaluations of firmness, hydration, maturation and / or quality.

In ecophysiology equipment:

Competing product: Scholander Pressure Chamber
Company: Soilmoisture Equipment Corporation
Country: United States of America
Some related commercialized products: Scholander pressure chamber, Richards pressure chamber, soil moisture and soil tension sensors.

Competing product: Dendrometer
Company: ICT International
Country: Australia
Some related commercialized products: Dendrometer, porometer, equipment for agrometeorology.

Competing product: Cell pressure probe
Company: Not found

Competing product: Zim-probe
Company: Zim-Plant-Technology
Country: Germany
Some related commercialized products: Zim-probe and associated accessory telemetry.

Competing product: Wiltmeter
Company: Marconi Equipment for Laboratory
Country: Brazil
Some related commercialized products: Wiltmeter, agrometeorology sensors, soil water sensors, dendrometers.

Note: Wiltmeter technology was developed and licensed by Embrapa Instrumentation

Competing product: Turgor Flattener
Company: Not found

Regarding to Turgordropper (Irrigation):

As a household irrigation competitor:

Competing product: the Blumat system
Company: Hidrosense.
Country: Brazil
Some related commercialized products: Blumat sensors for irrigation control, Irrigas sensors for irrigation control and for soil water tension measurement, soil water extractors and digital tensiometers.

As a competitor for field use:

There is no available plant sensor in the market to automate individual water emitters in agriculture.

k) Potentialities and Vulnerabilities of the Competing Products

Turgormeter Plant and Turgormeter Fruit

Product	Potentialities (strengths)	Vulnerabilities (shortcomings)
Scholander Pressure Chamber: instrument to measure the tension with which water is retained in plant tissue (water tension).	Unique portable equipment to measure water tension in plants. It enables indirect and approximate estimation of the turgor pressure and of the osmotic pressure.	It needs a N_2 cylinder. Destructive measurement. Suitable only for leaves and small branches. Turgor pressure determination is dependent on a mathematical model and a pressure/volume curve.
Dendrometer: tool for monitoring changes in the diameter or in the perimeter of stems.	Continuous measurement.	Growth and hydration status of the plant are confounded in a single reading, whose interpretation becomes difficult.
Cell Pressure Probe: a pressure transducer for measuring cell pressure after puncture with oil filled capillary tube.	Reference instrument for measuring cell turgor pressure.	It is not commercial equipment. It requires skilled work done under the microscope.
Zim-probe: Instrument for monitoring the leaf turgidity variation.	Equipment that continuously monitors changes in cell turgor pressure in leaves.	Reading is related to the turgor pressure in an approximate manner by means of a transfer function. Slow response.
Wiltmeter: Equipment for measuring the turgor pressure in leaves.	Rapid and nondestructive method for measuring turgor pressure in leaves.	It does not measure turgor in bulky plant organs.
Turgor Flattener: technique for measuring the organ hydration dependent firmness.	Reference method.	Noncommercial.

Turgordropper

Product	Potential (Strength)	Vulnerability (weakness)
Blumat Sensor: promotes irrigation when the water tension exceeds a certain adjustment in a pinch valve.	Household irrigation sensor. Provides simple local and automatic irrigation.	Irrigation is set in a subjective manner. Suitable only for domestic use.

I) Product ranking – Main competitive advantages

Regarding to the Turgormeter Plant and the Turgormeter Fruit:

Exclusive competences

Equipment to measure stem's cell turgor pressure directly and continuously.

Portable equipment for rapid measurement of cell turgor pressure in fruits and other organs.

Main advantages over the Scholander Pressure Chamber:

It measures the turgor pressure directly and continuously.

It does not require N2 cylinder or gas under high pressure.

It has a calibrator.

Main advantages in relation to the dendrometer

It measures cell turgor pressure.

Main advantages in relation to the cell pressure probe:

It carries out measurements quickly and easily by simple contact with the plant.

It performs continuous reading in the field.

Main advantages over the Zim-probe:

It makes direct readout of the cell turgor pressure.

It makes readings that are less sensitive to the rapid variations of the solar radiation, temperature and wind speed.

Main advantages over the Wiltmeter:

It performs measurements in bulky plant organs.

It performs continuous readings of the cell turgor pressure in the field.

Main advantages over the Turgor Flattener:

Portable equipment.

Regarding to the Turgordropper:

Exclusive competences

Water emitter triggered directly by the plant cell turgor pressure.

Main advantages in relation to the Blumat sensor

Automatic irrigation scheduling triggered by plant water status.
It serves for household and agricultural applications.

m) Product ranking – Competitive disadvantages

Turgormeter Plant and Turgormeter Fruit:

Chronic disadvantages

It does not work for sclerified plant organs.

Main disadvantages in relation to the Scholander pressure chamber

It does not work for sclerified plant organs.

Main disadvantages in relation to the Dendrometer

It does not work for sclerified plant organs.

Main disadvantages in relation to the Cell Pressure Probe

Cell Pressure Probe is reference equipment.
The reading of the cell turgor pressure is slightly less than the effective value measured with the cell pressure probe.

Main disadvantages in relation to the Zim-probe:

It is not specified for measuring leaf turgor pressure.

Main disadvantages in relation to the Wiltmeter:

It is not specified for measuring leaf turgor pressure.

Main disadvantages in relation to the Turgor Flattener:

The Turgor Flattener is reference equipment in relation to the expected responses a Turgormeter sensor should have.

Turgordropper:

Competitor for domestic use: Blumat sensor.
Competitor for use in the field: none.

Chronic disadvantages

It does not work for sclerified stems.

Main disadvantages in relation to the Blumat sensor system

It requires means for fixing the sensor in the plant.

n) Marketing plan presentation

Product: Turgormeter Plant, Turgormeter Fruit and Turgordropper

Period: 2nd Semester 2012

Prepared by: Dr. Adonai G. Calbo and Carlos C. Pusinhol

Date: September, 2012

Objective: Technology transfer, through licensing.

Reason of this objective: the system presents technical differentials and competitive advantages, which will help in the marketing insertion.

Turgormeter Plant - instrument attached to the plant, with applications in studies of ecophysiology;

Turgormeter Fruit - portable equipment for studies in post-harvest and ecophysiology;

Turgordropper - sensor and water emitter fixed in the plant to control irrigation.

Goal: To carry out non-exclusive technology licensing after the 2nd semester of 2012.

Reason of this Goal: The technology has patent deposit and it presents commercial potential.

Strategies:

Product - Turgormeter Plant and Turgormeter Fruit

Promotion / communication: Participation in technical and scientific events and communication with potential clients, using internet tools, technical journals and interactions with educational, research and extension institutions.

Justification: Potential users are mainly a public with good educational and cultural background that accesses the suggested communication channels.

Distribution: commercial representatives and E-commerce.

Sales: definition of fair prices and quality, respect to delivery closing dates and accessibility are the main complementary factors for the success and the sustainability of the sales.

Chapter 5
Pre-MK of the igstat sensor technology

Preamble pre-MK of a nascent technology or a genre 'a' technology

The pre-MK of the Igstat Sensor technology considers different applications involving some of the claims, which are described in the intellectual property document as a whole. The technological document, on which this pre-MK was based, was developed in partnership with the company Tecnicer Tecnologia Ceramica Ltda. As a result, even before the drafting of the pre-MK the technology was licensed to the partner company Tecnicer. Additionally, since this company also had interest in licensing to third parties and to earn royalties relating to the technology transfer, we elaborate a pre-MK, to promote new non-exclusive technology licensing.

The patent document shows several interesting applications, but in this pre-MK we seek to define only the applications of water tension sensors, which are currently, demanded objects for the companies that produce instruments for irrigation scheduling. Accessory instruments for particular irrigation applications, whose profile has more grips to other niche markets, were not approached.

This pre-MK approaches a sensor that enables the use in the pneumatic or electrical modes. Consequently, at first, the technology has two application niches, companies working with the pneumatic irrigation scheduling systems and companies that work with electro/electronics irrigation scheduling systems. These sensors are objects to be incorporated into instruments that even may involve telemetry. Furthermore, because it is a sensor, the most common business model is the type B to B (business to business), i.e. from the licensed company that manufactures sensors to other companies that manufacture the instruments in which the sensors will be incorporated.

Descriptions about components of the intellectual property document concerning to instruments of soil water tension reading and about instruments for direct irrigation, such as the irrigation stems were not considered. Even with such a scope limitation, this is a relatively complex pre-MK because it deals with the Igstat sensor in two action lines, one for companies with product platforms compatible with pneumatic sensors and one for companies with platforms supported by electrical sensors.

As result of this elaboration, the technology - up to now - in addition, was licensed for the following companies: Acqua Vitta Floral, which initially would use the sensor in the pneumatic mode for domestic applications; the US company Irrometer that produces systems for irrigation scheduling; the Hidrosense company, which manufactures pneumatic irrigation scheduling systems and that has additional interest in the development of new electrical systems, compatible with the use of telemetry; and more recently for the R4F company, which also has an interest in the use of the sensor associated to telemetry.
*This pre-MK was initially elaborated and used in the year 2013. This is a dynamic document, which requires adaptations in accordance to the advancement in technology and to the new market possibilities and opportunities.

Igstat Sensor – pre-MK

a) Introduction

The Igstat Sensor is a sensor to measure soil water tension, stable, low-cost and with simple construction. It is easily integrated into instruments for irrigation scheduling and irrigation control. It is a suitable sensor to monitor soil water tension by pneumatic or electrical procedures. The reading of the water tension in the soil is not affected by factors such as salinity, temperature, or density of the soil / substrate.

It operates according to the movement of air and water within the nucleus of the Igstat Sensor contained into a porous capsule. The modulation of air flow through the Igstat Sensor enables pneumatic operation while the variation of light reflection over the nucleus allows electrical readings.

The technology patent was filed on co-ownership by Embrapa and the Tecnicer Ceramic Technology Ltda., in April 22nd, 2013, under the number Br1020130097721.

The sensor working range (critical soil water tension) is easily set according to the size of the particles packed inside the porous sensor body. For example, glass beads particles. Additionally, it is a technology that has the convenience of using critical values of soil water tension, available in the literature for different crops, soils and climates.

The Igstat Sensor can be used in the field, in greenhouses and gardening, as it has been done by the use of common soil tensiometers, but with the advantages of low maintenance, and better suitability for automation procedures.

b) Analysis of macro environment: relevant events and consequences for the agribusiness

The technology has potential in competition with other existing systems. The Igstat Sensor stands for stability, low cost and ease of manufacture, besides the compatibility of use with pneumatic and electric instruments for soil water tension reading and control.

The Igstat Sensor is a simple sensor that enables irrigation management directly, without the need of advanced technical knowledge, because it uses critical soil water tensions already established in previous studies of irrigation.

Another favorable point is the growing concern with the rational use of fresh water, from which about 70% is used for crops irrigation. In this scenario, the Igstat Sensor is a sensor for irrigation control and management that can be useful as an affordable and practical technology for agricultural and domestic use.

c) Market and Business Competitors

The market focus will be in areas with higher demand in irrigation management and irrigation control for the vases, gardens and the agricultural environment.

d) Competitors Business Profile

Drip irrigation in the field: particularly companies that sell sensors in different countries.

In vases and gardening: for small businesses that operate regionally offering a great products' diversity.

The Igstat Sensor has direct competitors to measure soil water tension, which will be taken to a market analysis. Among these sensors the

most relevant are: the common soil Tensiometer, the Watermark, the Irrigas Sensor and the Dihedral Sensor, for measuring soil water tension, besides TDR - which is a sensor for volumetric soil moisture.

e) Key Success Factors - Competitive Advantages

The exclusive Igstat Sensor advantage compared to competitor products is the fabrication simplicity in which the use of unsintered particles provides for adjusting the working range of the sensor. The requirements for irrigation scheduling and irrigation control in accordance to soil water tension can be met through the use of appropriate particle sizes.

Unlike the reference Tensiometer Sensor, the Igstat Sensor is suitable for use in automatic irrigation control because it does not depend on frequent maintenance for operation. It can also be used in domestic negative pressure waterers, without the electricity need and without cumulative performance loss. In these applications it can be used in the pneumatic mode and the electric mode, for reading and automation.

The key success factors of the Igstat Sensor in addition to the features mentioned above are: the stability and easiness for use in irrigation management instruments and in instruments for irrigation control.

f) Marketing Strategy - Focus and Contract Modality

Technology transfer through licensing to patent exploitation for companies working in the field of sensors and equipment for irrigation management and irrigation control of environments such as: agriculture, pots and gardening.

g) Communication Strategy

The licensed company shall prepare the instruction manual, with the collaboration of a technician indicated by Embrapa;

Embrapa and/or the licensed company will hold actions in order to show the product in events such as trade fairs and congresses;

The commercial launch of the product will be conducted by the licensed company, with Embrapa's participation;

The product exposure may be held jointly or separately by the companies.

h) Analysis of the macro environment elements

Environment	Features and relevant events	Trends and projections	Possible consequences for the product marketing
Economic	For vases and gardening as an alternative for irrigation management and irrigation control. In agriculture it is a practical and affordable sensor for irrigation management and irrigation control.	Growing use of new technologies for irrigation management and irrigation control.	Leverage of the sales for instruments designed for irrigation.
Legal	Collection of fees for water use in agriculture.	Measuring the volume of water used in farms.	Increase in sensors sales, readers and control systems for irrigation.
Technological	Simple technology, suitable for irrigation scheduling and irrigation control.	Simple and affordable products whose performance is technically satisfactory to do the job enable the creation of new markets.	Emergence of lower cost products and the opening of new markets for water management and irrigation control.
Ecological	It is a sensor to facilitate the sustainable use of water.	Growing concern with the proper use of water.	Increased demand for systems for irrigation scheduling and irrigation control.

i) Key Success Factors - For irrigation in the field

Key Success Factors	Reasons and Comments
Stable and low cost sensor, suitable for integration into different instruments for managing irrigation and irrigation control.	Stability, low cost and simplicity for use in the instruments development are required commercial and industrial characteristics to meet specific demands for irrigation management and irrigation control.
Pneumatic or electric (optical) readings.	It enables the development of a variety of instruments for irrigation management and irrigation control using pneumatic and electric platforms.
It uses critical values of soil water tension, available in the literature for different crops, soils and climates.	It benefits from the standards established by studies for irrigation management with the aid of soil tensiometers.
Easy to manufacture.	The requirements for irrigation scheduling and irrigation control in accordance to soil water tension can be met through the use of appropriate particle sizes.
Response is not affected by salinity, soil density, temperature or ferromagnetic substances.	It can be applied in any type of soil or substrate without the need of specific calibration.
It does not lose performance over time.	The water filtered through the external porous element does not dirty the unsintered inner nucleus. Even in the case where the sensor is more prone to performance loss, that is, when operated under partial vacuum.
The ease of defining the working range.	The definition of the working range is obtained in accordance to the size of packed particles in the nucleus, for example glass beads.
The dripping control is autonomous	Due to its pneumatic operation.

j) Competing products

Competing product for irrigation in the field:

- Conventional soil Tensiometer: It is a sensor composed of a porous capsule filled with water and attached to a manometric device, which continuously measures the water tension in the soil.
  Manufacturing companies: Irrometer Inc. - USA; Soilmoisture and Equipment Corp - USA
  Dealer Company: Hidrosense - Brazil

- Watermark: It is a sensor that measures the electrical resistance in a porous body, in a manner correlated to the soil water tension.
  Manufacturing company: Irrometer Inc. - USA

- TDR (Time-Domain Reflectometer): It is an instrument to measure soil moisture, according to a time response for electromagnetic wave propagation by means of metallic rods installed in the soil.
  Manufacturing companies: Soilmoisture Corp - USA; ICT International - Australia

- Irrigas Sensor: It is an instrument to measure the water tension in the soil composed by a porous capsule connected to a tube filled with air and without water. In this kind of tensiometer the porous capsule becomes permeable to the air passage, when the soil water tension exceeds a certain critical value, which depends on the sensor porosity. It can read water tensions continually and linearly, from zero to a critical tension/bubbling pressure.
  Manufacturing company: Hidrosense - Brazil

k) Potentials and Vulnerabilities of the Competitor Products for Irrigation in the Field

Products	Potentials (strengths)	Vulnerability (weaknesses)
Soil tensiometer	Reference equipment to measure soil water tension.	Suffers cavitation and therefore requires manual reload with water. Recharge of the porous capsule with water causes difficulties for the irrigation automation.
Irrigas Tensiometer	Sensor suitable for irrigation management and automatic irrigation control. It shows a linear response according to the water tension in the soil.	It requires pneumatic system to measure the water tension in the soil between 0 and a maximum value. The sensors fabrication with prior definition of critical water tension in the soil (maximum value) demands individual gauging.

Products	Potentials (strengths)	Vulnerability (weaknesses)
Watermark	It has a wide working range. It presents ease data acquisition. It can be used for irrigation management and automatic irrigation control.	It requires calibration for different soil types or substrates. It has low sensitivity to the soil water tension measurement in the range from 0 to 10 kPa. It presents a problematic sensitivity to the soil salts.
TDR	It can be used for irrigation management. It presents ease data acquisition.	It requires calibration for different types of soil or substrate. It measures the soil moisture accurately on a narrow range. It presents a problematic sensitivity to the soil salts, soil density and ferromagnetic substances.

I) Competitive Position of the product - main advantages Competing product for irrigation in the field

A - Exclusive competences

Easier manufacture.

B - Main advantages over the Soil Tensiometer

1 - It does not suffer cavitation.
2 - Practicality and simplicity to obtain electrical signal.
3 - It can be easily automated by pneumatic system.
4 - It does not require frequent maintenance.

C - Major advantages over the Irrigas Sensor

1 - It can be used to obtain continuous electrical signal with simplicity.
2 - Sensor that provides greater facility to its industrial production.

D - Main advantages over the Watermark (granular matrix sensor)

1 - Not sensitive to salinity.
2 - It enables automation by pneumatic method.
3 - It is sensitive to measure soil water tension value lower than 10kPa.
4 - It does not require specific calibration for different soils and substrates.
5 - It has a linear response in the pneumatic mode.

E - Main advantages over the TDR

1 - Not sensitive to salinity, soil density and ferromagnetic substances.

2 - It enables automation by pneumatic method.

3 - It does not require specific calibration to different types of soils and substrates.

4 - It has a linear response in the Pneumatic mode.

5 - It is a sensor that measures the water tension in the soil.

6 - It requires simple electronics for automation and for reading water tension.

m) Competitive Position of the product - main disadvantages Competing product for field irrigation

A - Chronic disadvantage

Not detected.

B - Main disadvantages compared to the Soil Tensiometer

1 - It requires a special system for monitoring soil water tension, in the pneumatic mode.

C - Main disadvantages compared to the Irrigas Sensor

1 - Not detected.

D - Main disadvantages compared to the Watermark

1 - Not detected.

E - Main disadvantages compared to the TDR

1 - It is a sensor that measures the water tension in the soil instead of being a soil moisture sensor.

n) Model for the presentation of a simple marketing plan

Product: Igstat Sensor - technology with a patent filed in co-ownership with the company Tecnicer Tecnologia Cerâmica Ltda.

Period: 2nd Semester 2013.

Prepared by: Dr. G. Adonai Calbo and Carlos C. Pusinhol.

Date: November 2013.

1 - Objectives

Objective: Technology transfer through licensing.

Reasons that support the goal - sensors and instruments have differentials such as: it is easy to manufacture; it uses critical values of soil water tension; it presents the possibility of pneumatic control and electrical control; it is stable and low cost; it is weakly influenced by salinity and temperature. These are significant attributes that facilitate the market insertion.

2 - Goals: to accomplish the non-exclusive licensing of the technology after the first semester of 2014.

Reasons that support the goals:

a) Sensor patent and its equipment was deposited.
b) Technology ready for transfer.

3 – Strategies: the easiness for the products acquisition, quality and the definition of a fair price, in addition to meeting delivery deadlines, are key complementary factors to the business success.

a - Igstat Sensor - Pneumatic R$ 20.00 to R$ 40.00.

Rationale: It is a simple sensor, with few components and low manufacturing cost.

Equipment associated with:

- Immersion cuvet (entry level product): R$ 10.00 to R$ 20.00.

Rationale: It is just a cuvet to fit into the pneumatic tube of the sensor.

- Portable pneumatic instrument for irrigation management: R$ 200.00 to R$ 300.00.

Rationale: It is a simple electromechanical device with a micro air compressor.

- Portable Pneumatic soil Tensiometer: R$ 300.00 to R$ 500.00.

Rationale: It is a device with electronic pressure transducer, air flow restrictions and a micro air compressor.

- Automatic irrigation controller (pneumatic): R$ 500.00 to R$ 1,000.00.

Rationale: It is a device that contains an electronic pressure transducer, air flow restrictions, micro air compressor and electronic relay for activating a temporized solenoid valve.

b - Igstat Sensor - Electric/Stationary: R$ 100.00 to R$ 200.00.

Rationale: It is a tensiometer with a light source and a light sensor.

Equipment associated with:

- Electronic instrument to read soil water tension in stationary sensors installed in the field: R$ 300.00 to R$ 600.00.

Rationale: It is a digital device to read the soil water tension using Igstat sensor installed in the soil.

- Portable electronic system for reading the water tension in the soil (subsurface): R$ 300.00 to R$ 600.00.

Rationale: It is a device for gardening and plant propagation, aiming at a subsurface soil water tension reading.

- Automatic irrigation controller (electronic): R$ 500.00 to R$ 2,000.00

Rationale: It is an electronic device for activating a temporized solenoid valve.

Promotion / Communication

Focus on sensors manufacturers applied to irrigation management:

Promotion is an activity to boost sales by communicating with customers in different environments as in the participation in fairs, specialized conferences, the Internet (English, Spanish and Portuguese) and technical journals. In communication with the target audience personal interaction with researchers, teachers and professionals from agricultural extension is particularly valuable. Additionally, new markets for the sensor can also be achieved through innovative actions of corporate sales. These sales would be focused on niche transversal value chains, for irrigation in the agricultural environment and for the gardens and vases irrigation.

Rationale: the licensee will benefit from the simplicity with which it can add the new technology to their products. The aggregation of the new sensor will provide a performance improvement for the licensee. All of this, without the need of sophisticated technological development or a new productive structure creation.

Place / Distribution

Physical store, sales representatives and E-commerce. In the E-commerce, the equipment has easiness to dispatch by postal and logistics companies.

Rationale: It is necessary to observe that the cost of selling the product does not represent a large portion of the total value of the sale, consequently a proper sales strategy can facilitate the product success.

Chapter 6
Pre-MK of the atmo-dripper technology

Preamble technology composed in the pre-MK or genre 'c' technology

The pre-MK of the Atmo-dripper technology can be considered relatively complex. Atmo-dripping was a shelf technology with intellectual property protection, which was subjected to an aggregative process for trade insertion by removing the weaknesses identified during the necessary discussions for the elaboration of the pre-MK and also in connection with the recent availability of new aligned technologies, which were aggregated. The patent claims were not changed, but the final concretion of the technology considered in the pre-MK, has become more practical and with higher market potential.

This chapter introduces the novelty of an integrated approach for parts of two intellectual property documents, which form a unique genre 'c' technology, with market potential.

In fact, the elaboration of this pre-MK can be considered as a work to develop a better commercial product, by aggregating available methods and concepts in different documents. This is a very important facet, even in conventional Marketing Plans, which is usually not explicitly considered in the literature. The three main reasons for the development of the Atmo-dripping were: applying water under reduced flow rates, enabling the automation of irrigation in the pneumatic mode and enabling the use of simpler systems of water filtration.

According to Gilaad (1972), author of a classic publication on the drip irrigation theme, an ideal dripper should: a) provide a low and uniform water outflow; b) not be susceptible to clogging, even without the use of sophisticated systems for water filtration; and c) have small dimensions to facilitate transport and assembly.

The recommended specifications above are not adequately met by the currently available drip systems, which emit water at relatively high outflow rates (to prevent clogging) and that need sophisticated water filtration systems. The only recommended specification by Gilaad (1975) that are met by the current drip systems is the emitters' small size, coupled sometimes with a certain simplicity on the transport and assembly.

There are numerous studies and developments dealing with localized irrigation through drip for water application, but there is still lack of suitable products for the irrigation automation under low water flow. For the atmo-dripping system it is easy to meet the first two demands of Gilaad (1975). Providing low water outflow and having low susceptibility to clogging are important features of the atmo-dripping system, performed easily by the system. The greatest difficulty for this new drip system is about its production in the form of small units, to facilitate the transportation and installation of these emitters in the field.

The development of the Igstat Sensor (chapter 05), enabled the automation of the atmo-dripping systems even without using accessory miniature valves, whose use was described in the original intellectual property document of the atmo-dripping technology. Additionally, the combination of these technologies made easier the optional use of atmo-dripping in the form of small units that are easy to transport, suitable for the application of small water outflows, without increasing the clogging risk.

The introduction of these innovations defined the object of this pre-MK, in order to better meet different needs of drip irrigation products in the market segments for pots, gardens, and agricultural irrigation.

Results:

This technology has been licensed for the company Acqua Vitta Floral, who imagined using the system for the automatic watering in mini-gardens and gardens, with the aid of Igstat Sensor.

*This pre-MK was initially elaborated and used in the year 2014. This is a dynamic document, which requires adaptations in accordance to the advancement in technology and to the new market possibilities and opportunities.

Atmo-dripper – pre-MK

a) Introduction

Problem that resolves:

The Atmo-dripper technology is a difficult system to clog, which enables adjustment of water flow from very small values. It is an ideal

system for automatic irrigation based on the Igstat Sensor response, without the explicit need for specific information on soil types, timing to apply calculated irrigation water depths (mm) and about the evapotranspiration.

The patent technology *'Sistema de gotejamento para irrigação e arejamento com vazão controlada por fluxo de ar' ['Drip system for irrigation and aeration with water flow controlled by air flow']* was filed by Embrapa at the National Institute of Intellectual Property - INPI, on 11/09/2008, under the number PI0803322-6.

The atmo-dripping irrigation system is durable (some years) and the rate of water flow can be controlled over a wide range of values which is generally from 5 ml/hour to 3000 ml/h. It is suitable for traditional irrigation and fertigation.

It enables electricity savings, because it works with reduced pressures and can operate with simple water filtration systems, involving low water head loss in pumping.

Functioning:

The joint conveyance of water and air in a duct is a differential of the present system; the water flow can be adjusted from small values and may be interrupted pneumatically. It operates with the introduction of air bubbles into the base (or half) of the control drip duct and the water seeps on the top of this water floating duct. The low air density - applied in continuous flow - drives the water movement and defines the water outflow.

The mechanism of system operation makes it compatible with pneumatic sensors for soil water tension, using critical values of this variable already established in the literature. For example, it is compatible with Igstat sensors to control irrigation without the use of accessory instruments. Additionally, the system can be automatically triggered by pneumatic sensors of plant hydration status. The compatible sensor is the Turgormeter plant, pneumatically operated.

The ability to apply reduced water flow allows the irrigation automation, with the sensors help and eliminates the explicit need to know the water depth (mm) to be applied. The effective water depth of irrigation (mm) is a function of the type of soil, the depth of the root system and the soil water tension in which the irrigation is applied.

Motivation:

It provides a new concept to society, ideal for drip irrigation, defined by pneumatic sensors of water status, in the soil or in the plant. This objective will be pursued through the technology licensing contained in the document PI0803322-6, entitled 'Sistema de gotejamento para irrigação e arejamento com vazão controlada por fluxo de ar' ['Drip system for irrigation and aeration with water flow controlled by air flow'].

Use:

The Atmo-dripper technology is suitable for irrigation located in agricultural environments, particularly staked plants and small trees - in gardening, particularly for vertical gardens and mini-gardens. It can be powered by a network of water supply or water reservoir. For automatic irrigation control, with recommended sensors, it requires no adjustments, as the system irrigates in accordance to the values of critical water status, in the soil or in the plant.

b) Analysis of the macro environment: relevant events and consequences for the agribusiness

The Atmo-dripper stands out for providing adjustments of water outflow, starting with extremely low values. Under reduced water flow, regulated by the system, there is no explicit need for the use of irrigation timing or knowledge of the characteristic curve of water retention in the soil, for the automatic watering with sensors assistance. It enables the drip irrigation with the use of soil water tension sensors or with turgor pressure sensors installed in the plant. It is compatible with pneumatic Igstat Sensors for irrigation, which can control the watering without the use of electricity or additional instruments.

The rigorous water level adjustment and the trellising system needed for the atmo-dripping may optionally be exempted with the help of mini valves to control the water pressure, fed by a water supply or a water reservoir. The air supply for the atmo-dripping occurs through a restrictor placed on the top. With the use of mini-valves the atmo-dripping system enables the emitters' miniaturization and the free vases and plants disposal, according to the project, in its aspects of automation and topography.

Another favorable macro environment factor is the growing concern on the rational use of fresh water, from which about 70% are used for crops irrigation. In this scenario the atmo-dripping is an irrigation system that promotes water saving by the possibility of use of reduced water flows and automatic control, to achieve precision irrigation.

c) Market and Competing Companies

The market focus will be on the companies that are requiring irrigation control systems for vertical gardens, mini-gardens and agricultural environment, staked plants and small trees.

d) Competing Enterprise Profile

Drip irrigation in the field, especially companies that produce drip irrigation systems in different countries.

Irrigation for vertical gardening and mini-gardens: small businesses that produce irrigation systems for automatic dripping or not.

e) Key Success Factors - Competitive Advantages

The exclusive advantages of the Atmo-dripper system are:

A) Dripper whose water flow is pneumatically controllable from very low values. *[For irrigation control the ability to apply very low water flows simplifies the automation. This avoids the need of use of watering times, for the process of applying a given water depth (mm), specified in accordance to the soil water retention curve. In this condition the responses of the sensors regarding the arrival of the wetting front, is sufficient to ensure proper watering, without risk of run-off water and percolation.]*

B) Easy site-specific irrigation control with pneumatic sensors of water status in the soil.

C) Reduced possibility of clogging up the emitters. *[This drip system has no restrictions to adjust the water flow; however, the pressure controller should be selected according to the application, since this*

component can also clog. The pressure control system is a technical component, which may require special development, in cases of water application with larger amounts of impurities.]

D) The system enables pneumatic closing, which provides smooth reduction in water flow and reduce the ram pressure increase effect.

Other success factors for atmo-dripping, in addition to the features mentioned above are:

A) Reduced demand for water pumping capacity.

B) Reduced energy consumption. *[It uses simple filters, that operates with small pressure differences]*

C) The interruption and activation of irrigation can also be along a line atmo-dripping mediated by activation and interruption of the air flow.

D) Durable dripping system (a few years).

f) Marketing Strategy - Focus and Business Modality

Technology transfer through licensing for patent exploitation by companies working in the equipment area for irrigation and irrigation control in environments such as: agriculture, vases and gardening.

g) Communication Strategy

The licensed company shall prepare the manual, with the assistance of a technician indicated by Embrapa.

Embrapa and/or the licensed company will hold actions for the product demonstration in events such as trade shows and conferences.

The commercial launch of the product will be conducted by the licensed company, with Embrapa's participation.

The product exhibition can be held jointly or separately by the companies.

h) Analysis of the elements for the macro environment

Environment	Characteristics and relevant events	Trends and projections	Possible consequences for the product marketing
Economic	For vertical gardening and mini-gardens as an alternative to irrigation control. In agriculture it is a practical and accessible system for irrigation control, using the Igstat Sensor.	Growing use of new technologies for irrigation control.	Increased marketing of new instruments and technologies designed for irrigation.
Legal	Charging for the use of water in agriculture.	Measurement of water consumption in agriculture.	Increased sales of automatic control systems for irrigation.
Technological	Simple and suitable technology for irrigation control.	Simple, accessible and innovative technologies enable the creation of new markets.	Development of lower cost products and the creation of new markets for automatic irrigation control.
Ecologic	It is an automatable irrigation system that enables the sustainable use of water.	Growing concern over the use of water.	Increased demand for systems for automatic irrigation control.

i) Key success factors - For Irrigation of vertical gardens and mini-gardens, as a watering system

The system enables automatic control of dripping with the aid of Igstat Sensor without other accessories.

Water flow can be controlled over a wide range, starting from very low values that are important to prevent water leakage at the base of vertical gardens and mini-gardens.

j) Key success factors - For application to irrigation in agriculture

Individualized plants dripping using only the Igstat Sensor (precision irrigation).

Dripper whose outflow is controllable from very low flows. *(The ability to apply reduced water flows enables irrigation automation procedures with the aid of Igstat sensors without the need for arbitrary definition of irrigation depths (mm), depending on the types of soils and substrates)*.

Dripper whose water flow is linearly controllable from low values (5 to 1000 ml/h).

The water flow begin, interruption and adjustment can be pneumatic. It demands lower water pumping capacity.

It enables lower power consumption.

k) Competing products

Competing product for Irrigation of vertical gardens and mini-gardens:

- Blumat Sensor: The system consists of a porous capsule, which is surmounted by a diaphragm, a flexible tube and a button for additional grip. It triggers the watering in a specified soil water tension. The tightening of the flexible tube interrupts the passage of water when the soil is sufficiently moist.
    Dealer Company: Hidrosense.
    Country: Brazil.

- Blumat Jr: is an instrument of domestic automatic watering consisting of a porous capsule installed in the vase substrate. The porous capsule contains a water-filled internal hermetic chamber, which is connected by a tube to a water reservoir. The dry substrate absorbs water from the wet porous capsule. The water in the lower reservoir flows by suction to the internal hermetic chamber in the porous cup, providing automatic watering of the substrate.
    Dealer Company: Hidrosense.
    Country: Brazil.

- Petgotta: It is an irrigator for vases containing a reservoir of water - PET bottle with a hole opening at the top - and an adjustable dripper.
Manufacturing company: Acqua Vitta Floral.
    Country: Brazil.

Competing products for field irrigation:

- Traditional Dripping: there are numerous manufacturers of drip irrigation systems, some occupy only local markets and others are large companies with transnational action.

l) Potentialities and vulnerabilities of competing products to irrigate vertical gardens and mini-gardens

Products	Potentialities (strengths)	Vulnerability (weaknesses)
Blumat Sensor	Tensiometric equipment for automatic irrigation control. It uses water from the adduction network.	It suffers cavitation and therefore it requires manual recharging of the porous cup with water. The adjustment of the critical soil water tension is arbitrary. It uses a manual control knob, which interrupts the passage of water through the flexible tube strangulation, The user does not know the value that was set.
Blumat Jr	Simple automatic watering system.	It requires a water container near and below the plant vase. It moistens substrates just around the porous capsule. Substrates with coarse textures are insufficiently moistened It suffers cavitation and it needs manual recharging of the porous capsule with water.
Petgotta	It is a low cost irrigator for vases containing a water reservoir.	It is not sensitive to soil moisture. It requires manual water recharge.

m) Potentialities and vulnerabilities of competing products for field irrigation

Products	Potentialities (strengths)	Vulnerability (weaknesses)
Traditional dripping	Low cost system.	It easily clogs. Irrigation control requires sophisticated instruments. Timed irrigation with specified demanded water quantity (mm). It requires sophisticated filtration systems, which require high energy consumption. Flow strongly influenced by temperature.

n) Competitive Position of the product - the main disadvantages

Competing product to irrigate vertical gardens and mini-gardens:

A – Chronic disadvantages:

1 – It demands tubes for the air passage. The system when automated by Igstat sensor can work without the air passage tubes.

2 – It needs air compressor to operate.

B - Blumat Sensor:
Not detected.

C - Blumat Jr:
Not detected.

D - Petgotta:
Not detected.

Competitive product for field irrigation:

A - Chronic disadvantages:
It needs air compressor for operation, with or without automation.

B - Main disadvantages compared to the conventional dripping:
1 - It needs compressed air for operation.
2 - It requires additional tubing for conducting air.
3 - It requires stakes to support the tubes.
4 - It demands restrictions for adjusting the air flow.

o) Model for the presentation of a simple marketing plan

Product: Atmo-dripper.

Period: 2nd semester 2013.

Prepared by: Dr. G. Adonai Calbo and Carlos C. Pusinhol

Date: November 2013.

1 - Objectives:

Objective: technology transfer through licensing.

Reasons that support the objective - irrigation system with relevant technical advantages such as: it is easy to manufacture and resistant to clogging; it presents the possibility of pneumatic control and electrical control; it is weakly influenced by temperature. It enables irrigation automation with the use of Igstat Sensor by the simple use of additional

piping. It promotes power savings by the use of water filtration systems that require less pressurization. These are significant attributes that facilitate the insertion into the market.

2 - Goals: To perform non-exclusive technology licensing after the first semester of 2014.

Reasons that support the goals:

a) Patent filed.
b) Technology ready for licensing.

3 - Strategies: The ease of buying, fair price, quality, compliance with deadlines and alternative support for system installation are important complementary factors for the business success.

Product: Atmo-dripper.

Price (suggested):

Products to irrigate vertical gardens and mini-gardens: R$50.00 (Brazilian currency).

Products for field irrigation: R$30.00 (Brazilian currency).

Promotion / communication:

Focused on makers of irrigation systems:

Promotion is an activity to boost sales by communicating with customers in different environments, such as participation in fairs, specialized conferences, Internet (English, Spanish and Portuguese) and technical journals. Interactions with professionals from the landscaping, gardening and architecture, besides the consumer itself, are important for the insertion of technologies in these markets.

Rationale: the licensee will benefit from the simplicity of technology aggregation in their products. For automatic irrigation control, it only uses the Igstat Sensor. The operation itself does not demand other components.

Points of Sale / Distribution:

The business model possibly will involve store, sales website and sales representatives (B to B). The projects' customization for customers with related provision for support and maintenance is an important niche.

Rationale: It is a new technology that requires alternative business models in specialized channels for dissemination and sale.

Preamble: derivative technology or genre'd' technology

Igstat Watering Stem - this is a pre-MK case focused on an instrument that involves the concepts related to some claims of the intellectual property document. The particular object of this plan, more specifically, was a consequence of the development of the pre-MK of the Igstat sensor. In a window of opportunity, it was observed that the first watering stem claimed in the intellectual property document did not meet the practicality that was demanded by entrepreneurs, for watering vases.

The technologies are not fixed objects, they are intellectual productions, subject to adjustments and the pre-MK team, working directly with developers, can bring the market demands for the technology. If technologies are not fixed or final objects, then the pre-MK made about them, only for that reason, is not supposed to be a fixed and complete object. On the other hand, the pre-MK also needs to seek understanding about the market that is usually dynamic, poorly known and voluble. Consequently the pre-MK, as a STI product, must contain strategic intelligence and reorientation possibilities in the development being done in industry and in the STI itself.

The claims about the watering stem were approached differently given that were more attuned to a niche of entrepreneurs, who might not have interest in the manufacture of sensors, which was the main object of the patent document.

The preparation of the pre-MK is a team learning process on market aspects and on aspects of the technology itself. For example in this case that the learning team enabled the technology improvement that received the inclusion of a new intellectual property content. This content addition during the secrecy period allowed by law for inventors, defined, for the pre-MK team, a derivative technology or genre technology 'd'.

This demonstrates that the pre-MK preparation work, made in a timely manner, allows the filling of marketing and technology gaps, related to the development of new products to the market. Other examples of

cases where the pre-MK influences final product development are described in chapter 6. This achievement is an indication that the work in collaboration with the researcher feeds back the objects initially set out in the pre-MK.

Results:

This technology has been licensed for the company Acqua Vitta Floral, which initially would use for domestic applications, irrigation of gardens and vases. Despite the fact that the patent has been licensed as a whole, the particular interest of the entrepreneur was in this application.

*This pre-MK was initially elaborated and used in the year 2014. This is a dynamic document, which requires adaptations in accordance to the advancement in technology and with the new market possibilities and opportunities.

Igstat Watering Stem – pre-MK

a) Introduction

The Igstat Watering Stem is a new rupture technology and therefore its initial insertion is easier in markets that do not have attractive, simple, efficient and cost effective products yet. Due to this reason, this plan does not address the application of it as an agricultural product. Manufacturers will possibly be encouraged to serve the profitable agricultural market, after the establishment of favorable consumer experiences in this smaller and simpler market. Therefore, this plan will focus on irrigation for vases and gardens, because it is an underserved niche in need of technological solutions.

Problem that resolves:

The Igstat Watering Stem is a miniature device for automatic irrigation that enables technical dripping at low cost. Their small size units are easily transported and are simple to assemble. It can be connected to the water supply network or to a water reservoir.

It is an ideal system for automatic irrigation based on the pneumatic response of the Igstat sensor, without the explicit need for specific information on soil types, watering time, water quantity that is required for irrigation or technical information about evapotranspiration.

Operation:

It is an automatic emitter that is controlled by a pneumatic sensor of soil water tension and able to apply reduced water flows. In the Igstat Watering Stem the water passage in a valve is interrupted when a water column is accumulated in the tensioning tube. The accumulation of this column of water occurs when the sensor Igstat in moist soil prevents the air entry into the tensioning tube, which suspends watering at the outlet. In the condition of dry soil the sensor becomes permeable to air, which is sorbed into the tensioning tube and as a consequence the water moves downward at an adjusted flow and drips while moistens the soil again in the sensor vicinity.

The Igstat Sensor is also a special type of actuator, suitable to trigger or stop dripping through the Igstat Watering Stem. This system keeps the soil moist, because irrigation is applied when the soil water tension exceeds a specified technical value.

Motivation:

Licensing of the technology entitled *'Sensor de tensão de água, sistema para caracterização e medições contínuas de água no solo, sistema de indicação de tensão crítica no solo e haste de irrigação' - [Water tension sensor, system for characterization and continuous measurements of soil water, indication system for critical tension in the soil and irrigation stem]'*, patent BR 1020130097721. The goal is to provide to the society an automatic irrigation device, of low cost, which is controlled by sensors of water tension in the soil.

Applications:

The Igstat Watering Stem is suitable for localized irrigation of potted plants, gardens and fruit trees. It is powered by a pressurized inlet water supply or water tank, and does not depend on electrical components for its perfect functioning. It does not require manual adjustments, since it irrigates according to critical values of soil water tension.

b) Analysis of macro environment: relevant events and consequences for agribusiness

For irrigation in pots, gardens and home environments:

Currently there is a massive urbanization and verticalization of the dwellings. This has led to a growing lack of contact with the nature and people have come to value the plants cultivation at home environment. Watering plants is the most laborious operation and one that generates the greatest concerns for gardens and household plants.

The Igstat Watering Stem has potential for domestic irrigation. This is a relatively unexplored niche, perhaps for lack of inexpensive, uncomplicated and efficient technologies.

The domestic market of plants might not be smaller than the conventional agricultural market, for the control of irrigation. This latent market needs new technologies to meet the modern urban dwellers.

In this segment the Igstat Watering Stem allows the modern citizen to take care of their plants, without losing the freedom of taking a few days of their habitat.

c) Market and Business Competitors

The target market will be the automatic watering of pots and gardens.

d) Profile of the Competing Enterprises

In pots and gardening: small businesses.

e) Key Success Factors - Competitive Advantages

Exclusive advantage of the Igstat Watering Stem, for the market of pots and gardening.

Small Automatic dripper, which can be the size of a chestnut, to be installed even in pots and presenting ease of use, so that eliminating manual adjustments to meet the plant water needs.

Other advantages to the market for pots and gardens:

Keep the soil moist with irrigation determined by a sensor of soil water tension *(critical water tension specified in the Igstat Sensor, which uses technical values available on the literature about the water tension in the soil or substrate)*.

It is robust.

It does not require external power source other than water pressure.

It does not require electrical components for correct operation.

Disadvantage for market of gardening and pots: Not detected.

f) Commercialization Strategy - Focus and Type of Contract

Technology transfer through licensing for patent exploitation for companies that work in the irrigation field for pots and gardening.

g) Communication Strategy

The licensee shall draw up the guidelines for the use of Igstat Watering Stem, in collaboration with a technician defined by Embrapa.

The commercial launch of the product will be held by the licensee, with Embrapa's participation.

Demonstrations and exhibitions can be performed together or separately by companies.

h) Analysis of macro-environmental elements

Environment	Features and Relevant events	Trends and Projections	Possible consequences for the product marketing
Economic	Low cost alternative to the irrigation automation. High cost of water in urban areas.	Increased demand for new technologies for the irrigation control.	Leverage of sales for irrigation-oriented instruments.
Technological	Simple technology for irrigation control.	Development of lower-cost products and the opening of new markets for the irrigation automation.	Simple and affordable products with satisfactory technical performance that enable the creation of new markets.
Ecological	It is a device to facilitate the sustainable use of water.	Growing concern with the good use of water.	Increased demand for irrigation control systems.
Habitat	Massive urbanization and verticalization, besides the increasing lack of contact with nature.	Appreciation of plants as an element of hobby and ambience.	Increased demand for more pleasurable and comfortable environments, with the use of ornamental plants.

i) Key success factors

Key success factors	Reasons and comments
Automatic dripper inexpensive and easy to install.	It has small dimensions, which facilitate transport, installation and use.
System powered by a water supply network or a water reservoir.	It is adaptable to use in different environments.
Easy manufacturing and low-cost components.	It uses a simple diaphragm valve or float to control irrigation.
It does not require manual adjustment to work correctly.	The irrigation control is done through the Igstat Sensor, according to the critical values of soil water tension, available in the literature for different crops, soils and climates.
It does not require electrical components.	The water pressure is the only external source of energy that is required for proper operation.

j) Competing products

- Blumat Sensor: The system consists of a porous capsule, which is surmounted by a diaphragm, a flexible tube and a knob for additional grip adjustment. It triggers the watering in a specified soil water tension. The tightening of the flexible tube interrupts the water passage when the soil is sufficiently moist.

Dealer Company: Hidrosense.
Country: Brazil.

- Blumat Jr: It is an instrument of domestic automatic watering consisting of a porous capsule installed in substrate of the vase. The porous capsule contains a water-filled internal hermetic chamber, which is connected by a tube to a water reservoir. The dry substrate absorbs water from the water-filled internal hermetic chamber in the porous capsule. The water in the lower reservoir flows by suction to the porous cup, providing automatic watering of the substrate.

Dealer Company: Hidrosense.
Country: Brazil.

- Petgotta: It is an irrigator for vases containing a reservoir of water - PET bottle with an opening on the top - and a tap adjustable dripper.
Manufacturing company: Acqua Vitta Floral.
Country: Brazil.

k) Potentialities and vulnerabilities of competing products

Products	Potentialities (strengths)	Vulnerability (weaknesses)
Blumat Sensor	Tensiometric equipment for automatic irrigation control. It uses water from the adduction network.	It suffers cavitation and therefore it requires manual recharging porous cup with water. The adjustment of the critical soil water tension is arbitrary. It uses a manual control knob, which interrupts the passage of water through the flexible tube strangulation. The adjustment is laborious, visual and interactive. The user does not know the water tension in which watering is applied.
Blumat Jr	Simple automatic watering system.	It requires a water container near and below the plant vase. It moistens substrates just around the porous capsule. Substrates with coarse textures are insufficiently moistened It suffers cavitation and it needs manual recharging of the porous capsule with water.
Petgotta	It is a low cost irrigator for vases containing a reservoir of water.	It is not sensitive to soil moisture. It requires manual water recharge.

l) Competitive Position of the product - the main advantages

A - Exclusives Competences

The Igstat Watering Stem automatically irrigates depending on the state of water in the soil without iterative manual adjustments.

B-Main advantages over the Blumat Sensor:

It has an easy use that does not require way adjustments by the user in order to respond technically to the plant water requirements.

The sensor does not require manual water refilling in the porous capsule.

C - Main advantages over the Blumat Jr:

It enables the choice of sensor to meet the plants' water needs.
The sensor requires no manual refill of water in porous capsule.
It provides more adjustable water distribution in the vase.
It requires no water reservoir to operate.

D - Main advantages over the Petgotta:

It responds to the soil water tension.
It does not require water reservoir for its operation.

m) Competitive Position of the product - the main disadvantages

A - Chronic Disadvantage
Undetected.

B - Blumat Sensor:
Undetected.

C - Blumat Jr:
It is more likely to cause water leakage in the bottom of the vessel.

D - Petgotta:
Undetected.

n) Model for the presentation of a simple Marketing Plan

Product: Igstat Watering Stem - technology patent filed in co-ownership with the company Tecnicer Tecnologia Cerâmica Ltda.

Period: 1st Semester 2014

Prepared by: Dr. G. Adonai Calbo and Carlos C. Pusinhol

Date: June 2014

1 - Objectives:

Purpose: Technology transfer through licensing means.

Reasons that support the goal - the Igstat Watering Stem is a device that is easy to use and requires no electrical components. One just needs to insert the instrument into the soil and connect it to the water supply network or a water reservoir. It does not require manual adjustments because it waters, according to the soil water tension value established in the Igstat Sensor. Consequently, this instrument has important quality attributes for entering in the market.

2 - Goals: perform non-exclusive licensing of the technology starting in 2014.

Reasons that support the goals:

a) The patent was filed.
b) Technology ready for transfer.

3 - Strategies: fair price, quality, fast delivery and easy purchase are important to the business success factors.

Product: - Igstat Watering Stem

Price (suggested): Product for the irrigation of pots and gardens: R$ 15.00 and R$ 30.00.

Rationale: simple instrument, which is small, easy to manufacture and without electronic.

Promotion / communication: Focus on manufacturers of irrigators for vases and gardens:

Promotion is an activity to boost sales by communicating with customers in different environments. For example, through fairs, internet (English, Spanish and Portuguese) and specialized magazines. Interactions with landscaping, gardening and architecture professionals, besides the consumers themselves, are important for the technology integration in this market.

Rationale: It is an automatic instrument, simple and requires no electricity. Efficient, the Igstat Watering Stem supplies the demand of a market that misses more practical watering solutions.

Points of Sale / Distribution:

The business model can involve physical store, e-commerce and trade with other businesses (B to B). For e-commerce, the small dimensions of the Igstat Watering Stem small size facilitate the sending through postal service and logistics companies.

Rationale: It is a new technology that requires alternative business models in specialized channels to promote and sell.

Segmentation of the markets according to the applications of Igstat Watering Stem connected to a pneumatic sensor, of water tension in the soil or of cell turgor pressure in the plant.			
Niche	**Applications**	**Competing Technologies**	**Compatible Sensors**
Agriculture	Staked plants	Dripping	Igstat Sensor and bifacial Irrigas
	Trees and shrubs	Dripping	Igstat Sensor, Pneumatic Turgormeter Plant and bifacial Irrigas
Vases	Ornamental plants	Waterer with reservoir and restriction (PetGotta) Waterer with water reservoir and a porous suction capsule (Blumat Jr.) Waterer of the tensiostat type (Blumat sensor)	Igstat Sensor and bifacial Irrigas
Gardens	Ornamental plants	Waterer of the tensiostat type (Blumat sensor)	Igstat Sensor, Pneumatic Turgormeter Plant and bifacial Irrigas
Protected cultivation	General	Waterer of the tensiostat type (Blumat sensor)	Igstat Sensor, Pneumatic Turgormeter Plant and bifacial Irrigas
Research and teaching	General	All above mentioned	Igstat Sensor, Pneumatic Turgormeter Plant and bifacial Irrigas

Chapter 8
Conclusion

The elaboration of this book was possible by the need of publicity, under Brazilian law, which is involved in each of STI technology licensing work in Brazil. This allowed us to report cases of technology licensing, with a level of detail that is unusual in the literature. So we had the freedom to expose these recent cases, because they were made without exclusivity and without other aspects of confidentiality, other than those determined by the law governing intellectual property. These licensing were made with pre-MKs aid elaborated for potentially marketable STI technologies, in order to make available the research results to the society.

A pre-MK is a didactic communication object, destined to entrepreneurs, within which an intellectual property document or know-how document is presented in an attractive, simple and commercial way. In fact it is the result of hard work that involves learning and institutional intelligence, comprising communication improvements and reinventions of complex original documents. Pre-MKs should not exactly follow a previously established model. The preparation should be flexible and well thought out, case by case. The pre-MK is not focused on the product final costumer and, therefore, this approach aims to arouse the interest of entrepreneurs who will put the technology in the market.

The pre-MK of a STI needs to convince and persuade the businessman to conduct the innovation and make it viable. To this end, the text should be agreeable, simple, technically correct and innovative. The pre-MK for STI is a way of offering the technology, which is intended to raise awareness among entrepreneurs about the expected potentialities, through an objective and stimulating prose. If the entrepreneur does not get enthusiastic about the described idea, there is no business.

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Embrapa
Instrumentação

Pre-MK: Technologies, their Genres and Triumphs

Approaches for Nascent Technologies, Shelf Technologies, Technologies Composed in the pre-MK and Derivative Technologies.

Science and technology institutions (STIs) have the mission of developing technologies for the productive environment. These institutions, however, do not market, do not manufacture nor provide services. This causes difficulties for the generation of social benefits that can be addressed, among other forms, through the licensing of technologies.

This strategy can be used when STIs have intellectual properties and know-how documents for conducting business and partnerships. With these documents and through licensing for companies, ICTs reach additional probabilities of converting technologies into innovation and social benefits.

The subject triumph in technology licensing is addressed in this book, through the preparation of pre-marketing plans (pre-Mks) to guide the negotiations of nascent technologies, shelf technologies and the generation of new technologies composed in the pre-MK and new derivative technologies, which represent possible aggregation of values enabled by the developed method.

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