The management of technological "horizontality": the Vaelsys example[1]

La gestión de la "horizontalidad" tecnológica: el caso Vaelsys.

A gestão de "horizontalidade" tecnológica: o exemplo de Vaelsys

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Summary

Several different aspects of the enterprise phenomenon recommend themselves for study and analysis: skills, motivation, technology, finance, risk management, etc. All of these are important challenges in the process of consolidating innovative projects. Entrepreneurs as a group have strategic importance to society, and within this context, the new technology-based companies, (which can be described as "R&D as business"), have a clearly central role.

Key aspects in this business approach are thus centred on the management framework which must accompany the scientific-technological know-how context that differentiates these projects. However, despite the specialisation which is required to give the new technology-based companies added value, non-technological organisational realities frequently arise having the fundamental characteristic of horizontality or transversality, in terms of opportunity and management requirements.

These concepts can therefore be applied to multiple sectors, markets, segments and realities. For all these areas to be handled appropriately, it is necessary to have both a systemic vision and a specific vision of each of the quadrants in which the product/service can be placed.

Vaelsys, working in the technical area of video-surveillance, is a perfect example of this. A significant layer of strategy and management is required in order to adapt the company's offering for each specific application to the wide spectrum of possible applications of this technology. This case study aims at examining this added value, and demonstrating the way in which its precepts can be transferred to other entrepreneurial enterprises.

Key words: Entrepreneurship, new technology-based companies, strategy, knowledge, R&D, video-surveillance, image analysis, video analytics, image recognition, detection, pattern recognition

Resumen

El fenómeno emprendedor presenta diferentes facetas sobre las que se centran los estudios y análisis, a saber, habilidades, motivaciones, tecnología, financiación, riesgo, etc., todas ellas importantes retos para el proceso de consolidación de los proyectos innovadores. Desde este punto de vista las nuevas empresas de base tecnológica caracterizadas por el lema "el I+D como negocio" revisten un claro

Resumo

O fenômeno empreendedor apresenta diferentes facetas sobre as quais se centram os estudos e análises, tais como, habilidades, motivações, tecnologia, financiamento, riscos, etc., todas estes importantes retos para o processo de consolidação dos projetos inovadores. Desde este ponto de vista, as novas empresas de base tecnológica caracterizadas pelo lema "o I+D como negócio"

papel protagonista dentro del interés estratégico que ostenta el colectivo de emprendedores.

Así, aspectos clave en esta aproximación empresarial giran alrededor del marco de la gestión que debe acompañar el contexto de *know how* científico-tecnológico que poseen de forma diferenciada estos proyectos. No obstante, a pesar de esta especialización necesaria para dotar de valor añadido a las nuevas empresas de base tecnológica surgen a veces determinadas realidades organizativas que cuentan con una característica fundamental por oportunidad y por requerimientos de gestión, que en este caso se concreta en la horizontalidad o transversalidad que posee la oferta.

De esta forma, su aplicación se posibilita a múltiples sectores, mercados, segmentos o realidades, cuyo apropiado tratamiento necesita de la mezcla de visión sistémica y particular de cada uno de los cuadrantes en los que ubicar el producto/servicio.

Este es el caso de la empresa Vaelsys, enmarcada en el contexto tecnológico de la videovigilancia cuyo amplio espectro de aplicaciones evidencia una importante capa de estrategia y gestión para adecuar la oferta en cada caso de aplicación, contenido clave de valor añadido para la transferencia de conocimiento a otros emprendedores a modo de caso de estudio.

Palabras clave. Emprendimiento, nuevas empresas de base tecnológica, estrategia, conocimiento, I+D, videovigilancia, análisis de imagen, *video analytics, image recognition, detection, pattern recognition.*

assumem um claro papel protagonista dentro do interesse estratégico que ostenta o coletivo de empreendedores.

Desta forma, aspectos chave nesta aproximação empresarial giram ao redor do marco da gestão que deve acompanhar o contexto de *know how* científico-tecnológico que possuem, de forma diferenciada, estes projetos. Não obstante, apesar desta especialização necessária para proporcionar às novas empresas de base tecnológica valor agregado, surgem, às vezes, determinadas realidades organizativas que contam com uma característica fundamental por oportunidade e por requerimentos de gestão que, neste caso, concreta-se na horizontalidade ou transversalidade que possui a oferta.

Desta forma, é possível sua aplicação a múltiplos setores, mercados, segmentos ou realidades, cujo tratamento apropriado precisa da mistura da visão sistêmica e particular de cada um dos quadrantes em que se vai localizar o produto/serviço.

Este é o caso da empresa Vaelsys, emoldurada no contexto tecnológico da CCTV (videovigilância), cujo amplo espectro de aplicações evidencia uma importante camada de estratégia e gestão para adequar a oferta em cada caso de aplicação, conteúdo chave de valor agregado para a transferência de conhecimento a outros empreendedores como caso de estudo.

Palavras-chave: Empreendimento, novas empresas de base tecnológica, estratégia, conhecimento, I+D, videovigilância, análise de imagem, *video analytics, image recognition, detection, pattern recognition.*

Introduction.

The Europe of Knowledge for innovation not only requires scientific research and production but also exercises in knowledge transfer related to the entrepreneurial activity. In both national and supra-national public agendas, this is, without doubt, a strategic schema at the highest level[1] This general thesis is promoted by the agencies which set strategies and financing. Their main aim is to make the competitive scenario more dynamic by providing resources to support new enterprises. They specifically aim to support those companies which have the characteristics associated with exponentially-increasing competitiveness, and whose impact on society (employment and quality of life) will be significant.

It is obviously necessary to specify or segment the new companies created in a region, in order that the appropriate conditions and resources for these projects can be generated. Using this general approach, the core of new technology-based companies (NTBCs) emerge as the sophisticated spearhead of the entrepreneur-

ship phenomenon[2] These NTBCs should therefore be given special and preferential conditions for both public and private investment, which should however be based on the credibility and expectations of success in each case.

Given the influence of entrepreneurship on competitiveness for them, many regions include an analysis of this phenomenon in their strategic approach[3] In this case, the search for entrepreneurs who have the greatest impact on competiveness has identified these technology-based companies as an entrepreneurial group which is especially interesting, since their growth and competitiveness are expected to be very significant.

In this respect, creating companies, entrepreneurship and the development of self-employment are generally beneficial to a region's economy. However, different lines of action have different degrees of

1. Comisión Europea Putting knowledge into practice. A broad based innovation strategy for the EU, European Innovation, Special, Nov.,2006, pp.1-24 (COM(2006) 502 final).

2. Storey, D.J. y Tether, B.S. "New technology-based firms in the European Union: an introduction". Research Policy (26),1998, pp. 933-946

3. GEM. Global Entrepreneurship Monitor, London Business School y Babson College.1999.

impact on regional development, competitiveness and social well-being[4] A search for these high levels of return leads the researcher to those businesses which exactly fit the "R&D as business" description and in which the innovative spirit drives all the company's functions and activities[5] However, this group is not well-represented within the overall scenario of creating new businesses[6]

Support for NTBCs is therefore very important and is, in fact, expanding, as is shown by the initial results of several business incubators which have been set up with their associated infrastructures. This shows the significance of appropriately locating the service offerings[7] aimed at supporting this strategic group of companies. These services should go beyond the general aspects of providing space, utilities and supplies, and be focussed on providing legal advice, technology monitoring, knowledge management, the management of industrial and intellectual property, marketing, financing, etc. This approach must also take into account the phase of a company's development: the idea phase, the business plan, the start-up phase and the consolidation phase. This is fundamental when devising the strategies, policies and programmes which are appropriate for the broad range of cases presented by these new business projects. These phases have different characteristics in different sectors of business activity.

In recent years, the growth of nanotechnology, biotechnology and ICTs has merited special attention. Several analyses have been made of innovation and the creation of NTBCs (understood as those companies which require that scientific or technological knowledge is generated or used intensively in order to create new products, processes or services).[8]

According to Hidalgo[9]: "*Although this type of company represents just a small percentage of the total number of companies created in a country over a given period of time, its relative importance for technological innovation is very high. These are the ones which, by taking larger risks, accelerate technological maturity and feed technological innovation. But they also have another important function: They increase business competitiveness by forcing other companies to accelerate their own transformations, the growth of their network of strategic alliances, and the renovation of their products and services*". The NTBCs therefore fulfil a function which complements the effect of those large companies with which they co-exist in the areas of technological development and innovation. From this perspective, it should be emphasised that the said orientation to "R&D as business" which characterises most of these entrepreneurial projects is very significant. This profile is a basic strategic identifier, since it is combined with the following considerations[10].

› Generating and developing knowledge are the key processes within the organisation.

› The R&D must be on-going.

› The product should always seek to be cutting edge.

› Entering the market place often generates stress between the commercial framework and the technical framework (see figure 1).
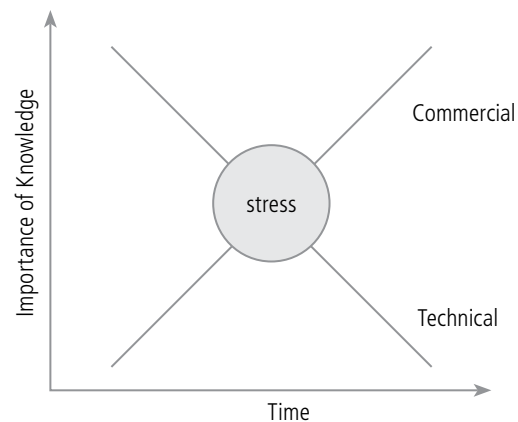

Figure 1. Adaptive stress.
Source: Author

Listing these aspects highlights the importance of a company's human capital, i.e. the importance of the values, aptitudes and abilities of not only the founders but also the rest of the staff and the external collaborators. In this respect, a differentiating aspect of the orientation to "R&D as business" lies in recognising the complexity and breadth of knowledge required for innovation. It is therefore imperative to create a powerful framework of relationships in which infor-

4. Ministry of Trade and Industry MTI "High growth SME support Initiatives in nine countries: Analisys, Categorization and Recommendations". Finnish Ministry of Trade and Industry. 2007.

5. ACREA Project "Análisis de los Factores de Éxito y Fracaso en el Proceso de Creación de Empresas de Base Tecnológica", 2006 Dir. Dr. D. Eduardo Bueno Campos.

6. GEM, Op. Cit. 1999.

7. Mateu, X. "Servicios en los parques tecnológicos". Alta Dirección. Nº 214, 2000, pp. 393-399.

8. Fariñas and López (2006), March (1999), Palacios, Del Val and Casanueva (2005), Simon (2003) and Storey and Tether (1998).

9. Hidalgo, A. Las nuevas empresas de base tecnológica en los procesos de innovación. Disponible en: http://www.madrimasd. org/revista/revista21/tribuna/tribuna3.asp 2004.

10. ACREA, op. Cit. 2006.

mation and knowledge flow freely, in line with the concept of intellectual capital[11]

Moreover, the organisation must be structured and have a business schema of defined roles and responsibilities, formalised processes, the protection of research results, etc. This will ensure the right management dynamics for the company's functional areas.

The video-surveillance scenario.

The evolution of social paradigms shows that those aspects which provide "protection" are growing in importance. This arises in a context of increased demographic and financial pressures which lead to higher levels of conflict, divisiveness and insecurity[12]). However, the technological advances principally aimed at providing solutions to the security sector, also lead to other applications which are useful in diverse situations, in which the concept of "protection" and "monitoring" extend to the environmental, retail and logistics sectors, amongst others.

This consideration has had an impact on the mindset of entrepreneurial projects in the area of "recognition" technologies. These technologies have evolved from text recognition, through voice recognition, to image recognition. Data, sound and image traffic have also changed the way in which the various entrepreneurial projects which are focussed on these technologies now understand their target markets (see figure 2).
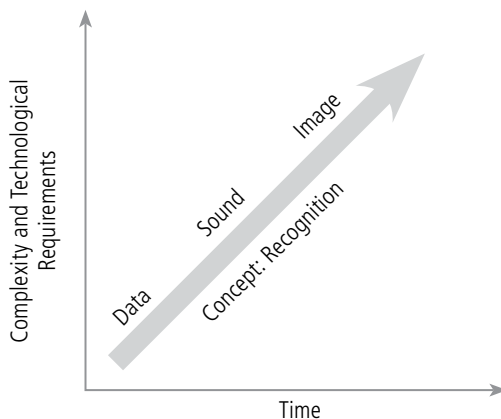

Figure 2. The evolution of the concept of recognition. Source: Author.

In this respect, day by day so-called "intelligent video" systems[13] or products replacing motion detection by intelligent motion detection are becoming more and more common. The word "intelligent" today is an almost unavoidable feature for any system that prides itself of being innovative. The basic and general concept lies in the use of a system that does not film continuously, but only according to certain criteria.

According to this definition there are multiple elements: programme-, sensor activation-, video analysis filming, etc. Therefore, we should differentiate between the technologies used in every case.

› Programmed filming enables a system to film following a certain schedule. This function, which was already common in tape recorders has been notably enhanced with systems that make *date video revision* (DVR) possible, saving recording and searching time. The intelligence of this type of products is, at least, limited.

› Recording through sensor activation enables a system to record only when a certain device, like a volumetric detector or an infrared barrier, generates a warning.

› Depending on the quality of the sensors and the activity of the environments, the quantity and relevance of recorded videos will be higher or lower. Again, the intelligence of these systems can be called into question.

› Recording through motion detection and intelligent motion detection enables recording when the scene captured by the camera undergoes certain changes. Currently there is a significant gap between the motion detection that most of DVRs incorporate and a professional video analysis system. In this space we find multiple variants offering a slightly higher capacity than the ones of a traditional motion detector, but they are normally far from having exterior perimeter security installation features.

In order to evaluate the difference between motion detection systems the key is the rate of non-detection and false alarm. A non-intelligent motion detection system will generate a warning every time there is a change in the picture, because it does simple pixel comparisons. Unfortunately, these changes can occur due to slight movements of plants, the passing of clouds, small animals etc. In order to discriminate, there are motion detection systems with the

11. Itami and Roehl, 1987; Stewart, 1997; Bontis, 2001; Peña, 2002 and IADE, 2003.

12. Peissl, W. "Surveillance and Security: A Dodgy Relationship". Institute of Technology Assessment. Working Paper nº ITA-02-02. 2002.

13. Van-Thinh, V. "Automatic Video Interpretation: A Novel Algorithm for temporal scenario Recognition", International Joint Conference on Artificial Intelligence, 18th International Joint Conference on Artificial Intelligence, Mexico. 2003.

option of configuring their sensitivity. It is important to think carefully about the fact that diminishing sensitivity increases no-detection rates, reducing the installation's reliability[14].

An intelligent video system should be capable of reducing the rate of false alarms without putting the installation's reliability at risk. The more intelligent the system, the more criteria it will enable us to introduce so that the alarms the systems generates will be reduced as far as possible. With new video analytic systems (NVAS) persons can be distinguished from vehicles, persons staying in one area can be detected exclusively or vehicles in a certain area during a certain time moving in a specific direction[15]. The more detection criteria are introduced, the more relevant the information generated by the system will be, reducing the needs of storage space, bandwidth, and, on top of it, optimizing the cameras' surveillance.

We must differentiate between analysis parameters and detection criteria. Parameters permit the internal algorithms of video analysers to be adjusted in order to enhance their performance in filtering noise or detecting harsh environments. Some video analysis products in the market cannot be configured by a non-expert in signal processing. On the other hand, the detection criteria are information entered by the user to make the system respond as is wished, thus adapting itself to the requirements of each installation. NVAS are designed to maximize the automation of parameters so that the installer does not have to deal with such tasks and can be focused on what is really important: defining the adequate criteria regarding detection.

The majority of DVRs in the market don't incorporate truly "intelligent" motion detection systems. It seems complicated to theoretically compare two motion detection systems because on the fact sheet we will find exactly the same description. Nevertheless, in practice it turns out to be easier. A comparison between detection systems needs to take into account to be aware of the following factors:

› Systems have to function in a parallel manner, which means, with the same videos captured by the same camera in the same environment and during the same days.

› The equipment has to be configured by an expert in every type or by another person with equivalent knowledge.

› In order to make tests more representative it is convenient to make several of them, in different environments and with different events, because some systems filter certain elements better than others.

A good video analysis system should enable to reduce time of recording in average at least 99.9% compared to continuous recording. That means, of the 1440 minutes of a day only 2 minutes should be recorded, if no events happen in this camera. In NVAS' case the average of false alarm recording per day and camera is less than 30 seconds, that is equivalent to a reduction of 99.98%.

The advantages relating to the above argument is as follows:

› **Reliability:** video analysis systems offer very important advantages compared to other type of technologies. Being based on video, they offer a liability level high above any other system. The key is surveillance. A blind technology cannot be supervised with all this implies. In case of alarm it is necessary to be moved for its surveillance. Most probably it is a false alarm lacking of available information to determine the fault's origin. Systems based on video are much more difficult to sabotage. A common practice of sabotage of a big perimeter protected by sensors is to generate various false alarms so that the security personnel thinks there is an alarm and seize the opportunity to access a protected area easily. With NVAS this is not possible because the system records each of the detected events so that the generation of alarms would remain reflected having the opportunity to act accordingly.

NVAS offers, furthermore, the advantage of being able to analyse in real time what is happening in the camera's field of vision, generating alarms and enabling the security personnel to do an intelligent supervision of the security cameras. The efficacy of the traditional control centres based on static matrixes or programmed tele-rounds is drastically increased, where it seems humanly impossible to guarantee a 24/365 supervision of dozens of cameras.

› **Installation:** the installation of a video analysis system offers numerous advantages compared to other based on barriers and detectors. NVAS enables to create "virtual barriers" instead of physical barriers (infrared or PIR, microwaves,

14. Ansari, A., et al "Implementation of a Motion Detection System". International Journal of Computer Science. Real-Time Imaging, vol. 9, issue 5, October, 2008,pp. 321-346.

15. Junlin, J. y Sameer, S. "Video Analysis of Human Dynamics –A Survey". International Journal of Computer Science, 2003, 3, 1.

volumetrics…). A virtual barrier is a zone defined by the NVAS user inside the vision field of a camera. This zone can have any size or polygonal form. In each camera the user can defines an unlimited number of zones. Virtual barriers are undetectable by intruders; therefore, they cannot be jumped, dodged, nor sabotaged. Another advantage is related to cover any type of field, avoiding the need of other technologies like clean, plane fields, without vegetation, rocks… Finally, it is interesting to see how virtual barriers can easily be modified. This is especially useful if users find a security hole in the initial design of the installation or if users detect that, under certain unexpected conditions, the initial zone definition generates false alarms. Virtual barriers offer an absolute flexibility saving costs of building work, material and time.

› **Time of reaction:** Currently, the monitoring center receives a warning and, in the majority of cases, this alarm comes from a blind device (volumetric, barrier, etc.) so that the operator has to contact with the client to corroborate the warning's veracity. This process can last some minutes and even fail (when you cannot reach the client).

Even complementing the installation with DVRs and cameras (with the associated extra charges), time of response will be too long due to the monitoring center operator; once he receives a warning from a blind device, it first has to be connected to the client's DVR, then the operator will have to register, watch the cameras and look for the alarm's "cause".

On the other hand, a warning generated by NVAS can be supervised from such monitoring center in only 10 seconds, so that time of reaction is reduced to the minimum, false alarm notifications to State Security Corps and Forces minimized and disturbances towards the client reduced drastically.

However there are several problems of video analysis systems. Firstly related to technological limitations; the biggest enemy of intelligent video systems is their own name. The adjective "intelligent" generates in many users and even many installers expectations above and beyond technology's status. As emphasized before, a professional team like NVAS can reduce a camera's time of recording more than 99.8%. The percentage is impressive, but this cannot prevent us from remembering that this 0.02% represents 30 daily seconds in average, that means, less than a daily false alarm. In an installation with 20 cameras the number of false alarm oscillates between 10 and 15 per day. It is essential to take into account this fact when selecting a

video analysis system for an installation, considering the importance of being provided of a surveillance service. Thanks to NVAS advanced surveillance system a single monitoring center operator can supervise more than 2000 cameras in an efficient way.

Secondly, price; to this moment, leading video intelligence systems have been offered with high prices, being the main reason the cost for specialised companies the necessary R&D to implement reliable analysis systems. Nevertheless, the grow and popularization of this type of systems is lowering prices, so that in a few years installing a video analysis system should be more economic than the current installations based on barriers. Furthermore, it cannot be forgotten the saving in building work and materials this involves.

And finally, technological jump; video analysis is probably the major innovation of the last 10 years in Closed-Circuit Television (CCTV) technologies. The possibility to develop an automatic system, at least in a great part, security cameras surveillance increases the efficacy of video analysis systems drastically. But, like any other change, it demands an equally important effort in training and popularization.

In order to complete the analysis of the general scenario, this introduction to the technological and functional aspects must include the realities of the market. The complexities arising from the power of computers, processors and networks require that scientific and technological knowledge evolves. This knowledge level is already mature enough to provide a foundation for constructing an approach in which there are multiple possible contingencies to suit different sector realities.

There are five initial applications for the product: retail, operations management, maintenance, monitoring and the environment. These are in addition to other specific application options, including some which, as of this moment, have not been consolidated. (Figure 3).

Functional perspective	Sector perspective
› Marketing	› Banking
› Logistics	› Environment
› Maintenance	› Transport
› Monitoring	› Hospitality
› Protection	› Energy
	› Military
	› Health

Figure 3. Functional perspective vs. sector perspective.
Source: Author.

This functional perspective extends to a wide range of sector realities which can also be initially taken into account: banking, environment, transport, hospitality, energy, military and health.

Obviously, given this discussion of the market, whichever market is under consideration, the key approach for success in the entrepreneurial movement, as in all movements, is determined by suitably transferring the added value arising from the scenario of returns which are limited by the financial argument for prevention, to a new schema in which even greater returns can be obtained from the investment in resources e.g. cameras, guards, etc, which are intended to detect an event at a specific time and place.

The Vaelsys Project.

Vaelsys was founded in 2004 and since 2005 has been based in the Madrid Scientific Park. The company specialises in artificial vision solutions. Its technology covers the different branches of knowledge which are related to image analysis: handling, recognition and classification. The company's experience and specialist knowledge is focussed on the detection and recognition of images and video (intruders, suspicious packages, head counts, etc.).

The value of Vaelsys lies in both its experience and its technological platform. Its team of R&D engineers has been working on the problems of pattern recognition, image improvement and classification algorithms for several years. This knowledge enables them to evaluate and define the optimum solutions.

The work done by Vaelsys in introducing the latest advances in Artificial Intelligence, and continuing to improve its products, has been recognised on many occasions by diverse bodies, which have awarded the company prizes such as *the Best Technology-based Company 2006 and 2007* and the prize for the most innovative company in the SIMO International IT Trade Fair, for its presentation of the "ViFence" product.

The company has significant financial support, which was not only used for the start-up phase, but also made it possible to implement a strategy based on technical innovation. Its principal strategic partners, the Caixa and the Autonomous University of Madrid (UAM), guarantee financial solvency, technical reliability and excellence in research.

In the framework of the previous section's exposition, the technology developed by Vaelsys enables IT systems, which are connected to image capture devices such as surveillance cameras or scanners, to interpret the data collected. By combining knowledge from different areas of computation, it is possible to implement advanced solutions for multiple sectors, including security, defence, traffic, etc.

Image analysis is fundamental to any solution designed for outside use. The infinite variety of natural environments and conditions presents a formidable challenge to any detection or recognition system. The first task for these systems is to filter the images and highlight or extract the relevant information. Some of the principal difficulties are: moving vegetation, rain, changes in the light, reflections, low camera quality, etc. The recognition algorithms also allow objects and/or people to be identified and classified. Experience in, and knowledge of, these algorithms are the keys to adapting them and finding the optimal solutions. Vaelsys, being a specialised company, can combine different factors such as recognition rates, failure rates, performance, etc, to provide a realistic and effective solution.

Finally, the use of several different artificial intelligence techniques increases the potential of artificial vision applications. Using the human eye as a reference, Vaelsys investigates and develops automatic learning systems which can extract complex characteristics. The artificial intelligence processes govern the other processes, creating, adapting and controlling the algorithms for detection, recognition, trajectory analysis, etc.

Currently, Vaelsys is taking on the greater entrepreneurial challenge of horizontality, as represented by the different areas of security (intruders, suspicious packages, stolen goods, fires), intelligent home systems (care of the elderly, surveillance of children near swimming pools), people flow (crowds, head counting at entrances/exits, headcounts at demonstrations, impact of advertising, heat map), traffic at road works (accidents, use of motorcycle helmets, use of safety helmets, traffic offences), while taking into account the configuring of specific solutions which have differentiated added value.

This context of horizontality makes it clear that there is a wide-open panorama of potential customers, including individuals (houses, large estates, garages), commercial customers (hotels, warehouses, banks, shopping centres), security and defence forces (police, civil guard, Ministry of Defence), communication hubs (railway, underground railway, and bus stations; airports), power stations (nuclear power stations, solar power farms, fuel storage depots), which provide a wide range of business opportunities.

In this respect, the core of Vaelsys' product offering is a solution based on two product lines:

› The ViFence product range incorporates the most advanced analysis technology, (which minimises the transmission of irrelevant video data to the Monitoring Centre), and a wide range of programming functionalities, warning generation and high quality recording technology. This product can be used with IP or analogue cameras in both new and existing installations.

› The Vaelsys Video Monitoring Centre (CSV), which can receive tens of videos simultaneously. Unlike inferior products, the CSV plays video clips which not only contain the information of the event itself, but also the pre- and post-event buffer recording times (before and after the detected event), and not only isolated frames. This system allows for several simultaneous operators, and has warning queues and profile management. The videos are received automatically and played in an intelligent video matrix which allows for up to nine clips corresponding to nine different clients, and thus multiplies the effectiveness of the monitoring. Each client will be assigned to a slot and an operator, so that if an installation malfunctions and causes a high number of video events, the system will not overwhelmed and the quality of monitoring will not be affected. This makes it unnecessary to go into the equipment, and thus reduces access times and multiplies the productivity of each operator (see figure 4).

Since Vaelsys prepared the company's strategic plan for 2010 and 2011, it has grown exponentially, with a significant increase in its workforce. It has now reached the consolidation phase, which is characterised by solid technology, the evaluation of the product's value by the first customers and the expected commercial opportunities arising from different market forces (see figure 5).

Obviously, as has been mentioned in the description of the general scenario, the focus on "security" has been the driving force of the company, which has leveraged R&D resources to win specific projects in that market.

This approach has matured to a point where an understanding of the importance of "horizontality" has become part of the organisation's thinking, and changed its development strategy to one based on relationships. In this strategy, identifying, selecting, capturing and working with strong partners is understood to be the way to create the aspect of Vaelsys' activity which will be focussed on channels rather than on contact with the end-user or end-customer.

Cost reductions and increased return on investment. Why choose innovation in CCTV?

The two main functions of a CCTV system are, on the one hand, the real-time monitoring of a site, to keep a better watch on the activity – principally, to detect theft, intruders and other potentially dangerous situations – and, on the other, recording the activity at a site, making it possible to check up on events and provide evidence about them.

A security system should ideally facilitate those processes that prevent any events which endanger or put at risk any of the following: human beings, an organization, or its assets. The most important function is therefore real-time monitoring, which can result in an immediate reaction and thus prevent a damaging event. A security system costing €50,000 that prevents thefts of €200,000 would seem to be a good investment.

The cost-effectiveness of a CCTV installation is evaluated by comparing its cost with the value of the goods not stolen or the damage that it prevents.

It may be harder to demonstrate the return on investment of a recording system, especially at large sites. What is the value of recordings of a €200,000 robbery? How much would a customer pay for the recordings of a burglary? Probably much less than a customer would pay to prevent the burglary. It is obvious that the recordings of events are very useful, and the higher the quality of the videos, the more useful they are, since they may possibly enable us to find out who did it, how and when, etc. However, the true cost-effectiveness of a CCTV installation is in prevention.

What is the point of installing cameras that produce images which are not seen? A camera that does not transmit quality video is probably the worst possible CCTV investment. What is the point of installing 80 high quality cameras if they must then be monitored and controlled by an operator who has a monitor divided into 16 tiny squares? Everyone knows that it is impossible to closely watch several cameras simultaneously and continuously over time. However, that is how CCTV usually operates. If there are 80 cameras but only the images from 16 are being shown, there is obviously 80% of the site's activity that not even an "ideal super-operator" can see.

The problem with relying on CCTV systems originates from the amount of information generated. Each camera produces 1440 minutes of video per day. This obviously depends on the environment the camera is focussed on and the purpose of the camera. For example, in the case of a camera which is monitoring a cash register, it is necessary to monitor the times when any operation is taking place, which is probably more than 70% of the time. However, in the case of a perimeter surveillance camera, it is only necessary to supervise the times when someone is present in the area, in order to determine whether or not their presence is a threat. The Vaelsys supervisor's intelligent video matrix can play up to nine videos simultaneously. For the majority of CCTV installations, this allows a single operator to effectively supervise hundreds of cameras.

Video analysis systems multiply the trustworthiness of large CCTV installations, since, to a large degree, they automate camera monitoring.

In the traditional paradigm, there is no difference between the effectiveness of an operator in an Alarm Reception Centre and an operator at the site, since, in both cases, the person is watching a monitor that is continuously showing video images. This is the usual case for large logistics centres, external monitoring of industrial parks, solar energy farms, offices outside working hours, etc.

In these environments, with Vaelsys technology, a local operator could reliably attend to hundreds of cameras, since the amount of video received per camera would be very small. In this scenario, resources are being under-used. At sites with less than a hundred cameras, the operator will probably have no video to monitor for long periods of time. To summarise, an investment in video analysis can pay for itself in just a few months.
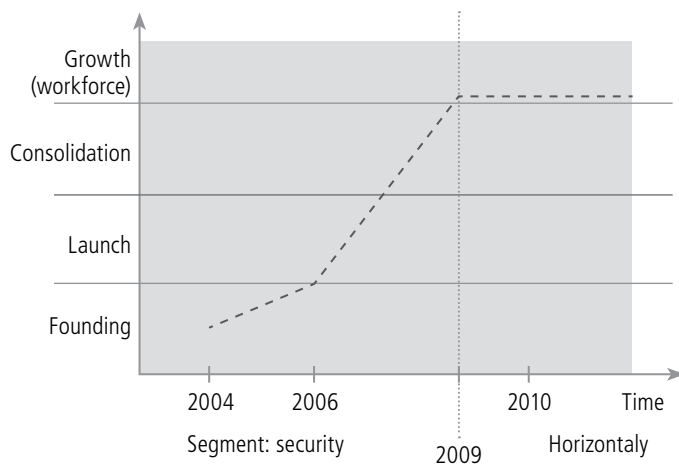
Figure 4. Cases and examples. Source: Author.

Figure 5. The evolution of Vaelsys' business concepts. Source: Author.

It is therefore critical to find out how far a company can go along the value chain, and also to avoid feeling any obligation to reach the end-user market. In fact, many technically-based entrepreneurial projects must recognise that there is a "business space" on which they must focus their strategy, and where they must identify the external resources and capabilities with which to join forces. This criterion requires the product offering to be directed and channelled. In the case of Vaelsys, this results in a core business focussed on R&D and industrial and intellectual property, as well as on the expertise to identify, choose and work with partners (see figure 6).
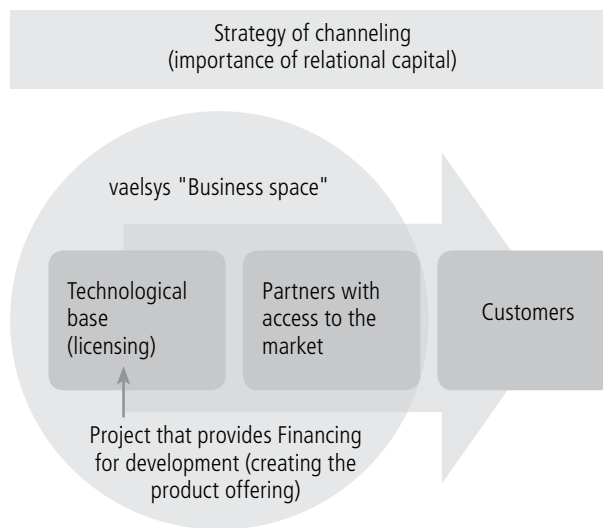

Figure 6. Vaelsys' business space. Source: Author.

In this strategic plane, Vaelsys reinforces its previous re-thinking exercise and takes as a reference the intellectual capital models which are based on a component for diagnosing intangible assets, which will then allow it to more consistently demonstrate the value of its business.

The report on intellectual capital that has been prepared allows the company to identify the three critical pillars of the business which are associated with the significant external recognition that provides key support for deploying the organisation. These pillars are in addition to the company's significant R&D work, which is the principal differentiating factor in the product offering, and also in addition to the existence of strategic partners which guarantee it, in terms of both the market and institutional support.

The intellectual capital report shows the following specific organisational strengths:

› A set of credentials derived from R&D projects.

› Specialised know-how.

› Membership of the Madrid Scientific Park.

› Protection of R&D results.

› Orientation towards "R&D as business".

› Strategy of alliances.

› Contacts with public bodies.

› A strong presence on the internet.

Vaelsys can thus consider creating a series of sales arguments based on all these criteria, while also taking into account the need to manage the series of areas for improvement (in terms of human, structural and relationship capital) which have been identified in this diagnosis. This will therefore enrich the work of the company's managers.

Conclusions

Management of technological horizontality has been considered, both implicitly and explicitly, throughout this document. This has highlighted a series of critical aspects which are key success factors that provide additional added value to Vaelsys' business and character, which can be replicated in other entrepreneurial contexts. The final conclusions can be expressed in terms of three key axes, which can thus be more easily understood and assimilated, (see figure 7):

› Organisation and strategy. In this axis, it is important to take into account the management of technological "short-sightedness", since horizontality is more common than one might think, and so a company must avoid mindsets which are obsessed with a specific sector. In this respect, and within a risk management framework, it is also important to handle the balance between diversification and concentration, and to make sure that the company does not "die of success", while ensuring that the company's load capacity

is not exceeded. Moreover, given the open aspect of horizontality, it is necessary to set up "open innovation" scenarios, in which innovation can be envisaged as a participative and networked process. Finally, given the strategy of searching out channels and partnerships, it is obviously necessary to have the legal resources required to protect industrial and intellectual property and manage partnership agreements.

› Product offering and technology. This axis includes the requirement to package differentiated, tailored solutions which take into account the need for various degrees of sophistication, since there may be a product line for the general public which has low specifications, low cost and may even be suitable for self-installing. It is also important to consider the usefulness of technology monitoring as part of a forward-looking approach. This will allow the company to bring forward developments which make it possible to meet new requirements and also integrate with other applications. This is especially important given the complexity and additional work resulting from horizontality.

Organization/Strategy
› Avoid technological "shortsightedness"
› Managing diversification vs concentration
› Open shemes for thinking
› Legal "muscle".

Offering/Technloogy
› Package differentiated solutions
› Versions having increasing sophistication
› Technology watch and foresight
› Integration with other applications

Market/Commercialisation
› Configure and make good use of the "driver" segment
› Translate functionality into savings and returns on investment
› Differentiated sales arguments
› Horizontality vs "dissolving"

Figure 7. Conclusions as lessons learned.
Source: Author.

› Market and commercialisation. This axis includes the initial need to choose a market sector to act as the driving force for the company, and from which the resources to develop the

business for a broader vision will be obtained. It is also necessary for all the products marketed to be described in terms of, and recognised by, cases of return on investment or savings which are clearly identified and easily understood. These case studies must articulate the different sales arguments which fit the customers' emotional paradigm. Finally, but very importantly, technological horizontality must be considered in terms of the danger of becoming "dissolved" in a wide spectrum of sector applications and ending up as an unbranded product. To avoid this, the product offering must be publicised within the framework of key trends in the current economy, such as sustainability, innovation, social corporate responsibility etc. To do this, all available communication channels must be used, especially those of internet 2.0. and social networking.

This set of conclusions exemplifies the key lessons which have been learned. These are clearly the added value of presenting a business study case within an open entrepreneurial context, which clearly requires in-depth and repeated strategic thinking, in a state of continuous evolution, and with large doses of flexibility.

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