
Radiation, a Tumor and the ANT: An Actor-Network-Theory Approach to a Medical Spin-off Creation

Hugo Pinto

Centre for Social Studies, University of Coimbra
Research Centre of Spatial and Organizational Dynamics, University of the Algarve
hpinto@ualg.pt

Abstract:

Actor-Network-Theory (ANT) is currently under discussion in Science and Technology Studies because it is reconstructing how social should be seen by social scientists. In the core of ANT is the concept of translation underlining how actors constantly engage in a process to translate their languages, their problems, their identities and their interests into the others. Understanding the social as an adjective is not adequate. The social cannot be constructed as a kind of material or domain and to dispute the project of providing a 'social explanation' of some other state of affairs. Focusing the knowledge transfer process, in particular the case of a medical spin-off firm creation, this article stresses the usefulness of ANT in analyzing complex objects by travelling wherever new heterogeneous associations are shaped. The role of a tumor is underlined as the actor that stabilizes the Actor-Network and transformed the services of this spin-off in an obligatory passage point.

Keywords: Actor-Network-Theory, Translation, Knowledge Transfer, Spin-off.

**Resumo:****Radiação, um Tumor e a ANT: Uma Abordagem da Teoria do Actor-Rede à Criação de uma *Spin-off* Médica**

A Teoria do Actor-Rede (no original Actor-Network-Theory - ANT) está actualmente em discussão nos Estudos Sociais da Ciência porque tenta reconstruir como o social deve ser visto pelos cientistas sociais. No centro da ANT está o conceito de tradução que evidencia como os actores constantemente entram em processos para traduzir as suas linguagens, problemas, identidades e interesses para os outros. Compreender o social enquanto mero adjectivo não é adequado. O social não pode ser construído como um mero material ou domínio a disputar a ambição de oferecer uma 'explicação social' para determinada situação. Focando o processo de transferência de conhecimento, em particular a criação de uma *spin-off* médica, o artigo destaca a utilidade da ANT a analisar objectos complexos viajando onde novas associações heterogéneas são moldadas. Destaca-se o papel de um tumor como o actor que estabiliza o Actor-Rede e transforma os serviços desta empresa num ponto obrigatório de passagem.

Palavras chave: Teoria do Actor-Rede, Tradução, Transferência de Conhecimento, *Spin-off*.

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1. Introduction

The university has witnessed a relevant change in its role. It is assumed today as one of the central actors in the territorial development, departing from the traditional roles of research and education to more complex and overlapping areas linked with what is called today third stream activities (Molas-Gallart, Salter, Patel, Scott and Duran, 2002). Several theoretical frameworks are compatible with this idea of a new role of university, such as the Mode 2 in Knowledge Production (Gibbons et al, 1994), the Triple Helix (Etzkowitz and Leydesdorff, 1997) and the Regional Innovation Systems (Uyarra, 2009; Benneworth, Coenen, Moodysson, and Asheim, 2009).

The change in the university was accompanied by a parallel movement of the evolution in the last sixty years of the relevance given to science, technology and innovation in economic development. Much as changed since the communication of Vannevar Bush (1945). Science, technology and innovation have abandoned the limited material view to assume more intangible characters and are seen as complex, evolving, path-dependent processes crucial to territorial development.

This impact in the economic aggregated indicators, stressed by several economic studies since the classical approaches of Solow (1957), induced huge policy relevance on the issues of science, technology and innovation. In the particular case of European Union, the notion that an European Paradox (European Commission 2009; Dosi, Llerena and Labini, 2006) could exist, constraining the capacity of the European good research to reach the market creating successful innovations and relevant spill-overs augmented the need to link knowledge production actors, commonly the universities, to knowledge users or diffusers, typically the firms. That is why, since the emergence of the Lisbon Agenda in the beginning of the 2000s, which identify the strategic ambitions of European Union member-states to become the most dynamic and competitive knowledge economy of the world, that knowledge transfer is a buzzword in policy-related documents.

A broad notion of knowledge transfer (KT) can be, inspired in definitions by Bozeman (2000) or Molas-Gallart et al (2002), a voluntary and active engagement process in the appropriation of new knowledge for mutual benefit, between research bodies, enterprises, governments or the community to generate, acquire, apply or give access to the necessary knowledge to improve material, human, social and environmental well-being. KT is, in this view, inclusive of other relevant activities such as the dissemination of technologies or innovation diffusion but as a broader meaning than commercialization of science. A major limitation is that, even if we have a broad idea of KT as the one previously stated, the focus of the majority of



the analysis remain linked to formal mechanisms, i) creation of start-ups and spin-outs, ii) development and exploration of Industrial Property Rights, iii) collaborative research bilateral or in consortium, or iv) other channels as cooperation in education/training, advanced training to corporate staff, staff exchanges, (*inter alia*, Bercovitz and Feldman, 2005; Debackere and Veugelers, 2005; D'Este and Patel, 2007). Nevertheless behind formal relations several informal contacts exist based in personal networks that increase the probability of knowledge sharing. These formal channels are too often transformed in metrics that are used to assess KT effectiveness and leave KT itself as a black-box. This situation often leads actors to consider means as ends. One example is the case of spin-offs. The number of spin-offs is now considered an extremely important indicator for the capacity of a researcher to link with market and industry, to the applied scientific potential and economic valorization of research group's outputs, and even to the success of innovation territorial policies. This situation creates strong incentives to focus on these indicators, which can be increased through an exaggerated support rather than on the actual effectiveness of the KT processes leaving a secondary relevance for the mechanisms that are more difficult to quantify. The transformation of a knowledge transfer process in an indicator causes a major loss in the information about the process itself. The spin-off creation is no longer analyzed as a complex process but as a dependent binary variable measuring the success of the creation or failure of the spin-off. An important part of the richness of the knowledge linked with the analysis of the spin-off creation is lost in the more traditional analysis of KT effectiveness.

In this article I try to underline some contributions that Science and Technology Studies can give to the analysis of knowledge transfer process. In fact, as a former knowledge transfer officer, the utilization of Actor-Network-Theory (ANT) and other theoretical frameworks that use the idea of translation between different collectives seemed really straightforward to me since that is exactly what I was doing in my everyday life (Pinto, 2010). With ANT the KT process can be understood in several of its phases detecting what went well (and specially and often forgotten, what went wrong). The case study pays attention to the spin-off creation in the medical field. It is particularly relevant in this case that even if the entrepreneur is the translation enabler that tries to engage all the other actors in an Actor-Network, and the knowledge transfer office gave a crucial support, are three non-humans actors that help the stabilization of the network: the radiation, the business plan and the tumor.



2. Research Development

2.1. *The Theoretical Scope*

This article tries to benefit from the contributions of the Actor-Network-Theory. ANT is a tool that has its origin in Science and Technology Studies, and the two of the most relevant researchers are Michel Callon (some examples are Callon, 1989; Callon, 1999) and Bruno Latour (more examples are Latour, 1986; Latour, 1987; Latour, 2005). The understanding of ANT as a theory is often criticized. In this article ANT is used as an approach to get close to a complex object that is often forgotten of some the most relevant features. In the core of ANT is the concept of translation, the problematization, the interessement, the enrolment and the mobilization, and how the actors constantly engage in a process to translate their languages, their problems, their identities and their interests into the others.

ANT is particularly relevant because it pays attention to domains not fully taken into account in other approaches: it pays attention to the network, understands the dynamics of the actors and its significance through the network, focus the translation process, underlines the role of the translation enabler, pays attention to obligatory passage points and consider the importance of devices and objects and other non-human actors. Actor-networks are shifting systems of alliances, 'performed' into existence by actors involved and necessarily include human and non-human elements. An Actor-Network is unstable over time and is continuously maintained trough the engagement of the actors or it will fail. Technologies and people interact and mutually shape each other. ANT proposes a radical symmetry between the agency of human and non-human actors. Human translation is analogous to negotiation of common interests but between human and non-humans the interaction is through the design of scripts. ANT is valuable to follow the traces when a new association is produced. Methodologically ANT is applied by following the actor, mainly with interviews and ethnographic research or by analyzing inscriptions.

The consequences of thinking the social sciences from an Actor-Network-Theory perspective are crucial once the "social" should be redefined (Latour, 2005):

- The social is not a quality/adjective meaning a stabilized state of affairs, a bundle of ties that, later, may be mobilized to account for some other phenomenon.
- The social cannot be constructed as a kind of material or domain and to dispute the project of providing a 'social explanation' of some other state of affair.



"[Sociologists of the Social] begin with society or other social aggregates whereas one should end with them. They believed the social to be made essentially of social ties, whereas associations are made of ties which are themselves non-social. They imagined that sociology is limited to a specific domain, whereas sociologists should travel wherever new heterogeneous associations are made. They believed the social to be always already there at their disposal, whereas the social is not a type of thing either visible or to be postulated. It is visible only by the *traces* it leaves (under trials) when a *new* association is being produced between elements which themselves are in no way 'social'" (Latour, 2005, p. 8). In this way the Sociology of the Social must be replaced by the Sociology of the Associations.

But Actor-Network-Theory has, at least three problems, huge problems, the meanings of actor, network and theory. These problems are not going to be discussed in this opportunity but even if complex, the utilization of ANT is an useful approach to open black-boxes, to understand how the social is reassembled and the processes of engagement that involve different actors through the process of stabilization. ANT could be an interesting approach to analyze technology change and innovation (Williams-Jones and Graham, 2003; Zendejas and Chiasson, 2008; Oliveira, 2008)

2.2. *Opening a Black-Box of a Medical Spin-off*

In this section a knowledge transfer black-box is opened for a spin-off using Actor-Network-Theory by understanding the creation of relationships between academia and industry as a process of translation.

The analysis is based on a case-study of a successful technology-based spin-off firm (F1) that emerged from a Portuguese university. The methods used were in-depth interviews and documentation analysis.

F1 can be presented as a spin-off firm from scientific research in Medical Physics, created to meet the needs of health services organizations with radiology facilities. It provides a range of key services for quality assurance and licensing meeting the requirements introduced in the legal framework (Decreto-Lei No 180/2002, 8 August). Its area of intervention is to prevent risks of excessive radiation to workers and users and to guarantee and to increase the continuous quality of the exams carried out with the machines. The clients are several organizations using x-ray machines, for example, dentists, vets, medical facilities and industry.

The translation enabler identified was the promoter of the spin-off, Zack (fictional name) a young PhD at the time of the creation of F1, a physical engineer qualified in radiation



protection, Portuguese but with international experience at the European Organization for Nuclear Research (CERN).

The idea emerged from this new national law that created the opportunity to explore commercially these services in 2002. The national laboratory based at the university where this young researcher was doing his PhD was solicited by some local enterprises and public bodies, such as hospitals, to perform this kind of analysis. They carried out the analysis in the context of the laboratory but it was often difficult to be paid because the university was too bureaucratic in answering to these needs. The idea was frozen until a contest of business ideas was promoted by the knowledge transfer office (KTO) in 2004. The proposal was instigated by the PhD supervisor and two junior researchers, Zack and Annie (other fictional name) submitted the project. This idea was one of the twelve winners. The main prize was a business plan done by a business consultant and the full support of the KTO for the launching of the firm.

When the firm was created it suffered several problems. The first problem was a too narrow concept of innovation in public support programs, specifically the NEOTEC, a program designed to support innovative start-ups. This program refused the proposal of F1 for a subvention because it was not innovative once the activity of the firm was forecasted in the legislation. Even if there was not any firm operating in the regional market and only one at national level this program refused the proposal because the notion of innovation. The second problem was the absence of a good market study to understand the market size and needs. The potential clients using ionizing radiation were not licensed at all. In this way, F1 had to reorient the services from quality assurance towards licensing activities and promotion/awareness of control of radiation. In the middle of this process, a third problem appeared, Zack had a PhD national grant by the national Research Council but his colleague Annie didn't. The timing from creating the firm and really beginning to work was too long for Annie and she had to quit. Annie was seduced by a bigger competitor, other firm operating in the same field at national scale, able to provide this young researcher the financial stability that she needed.

It is September 2007. Zack managed to finish his PhD and launch the activities of the firm. F1 was incubated in the university campus and beginning to earn the first payments. Today Zack has a team of four people under his supervision. Even if he prefers to speak in cooperative workers and not employees once they are all highly-qualified staff at Master or Doctoral levels, he was an entrepreneur creating his and other jobs. Now, with financial stability, with services all over the country, F1 faces a new problem how to grow and reach new demands: electromagnetic radiation (ultra-violets, ultra-sounds, γ -ray)?

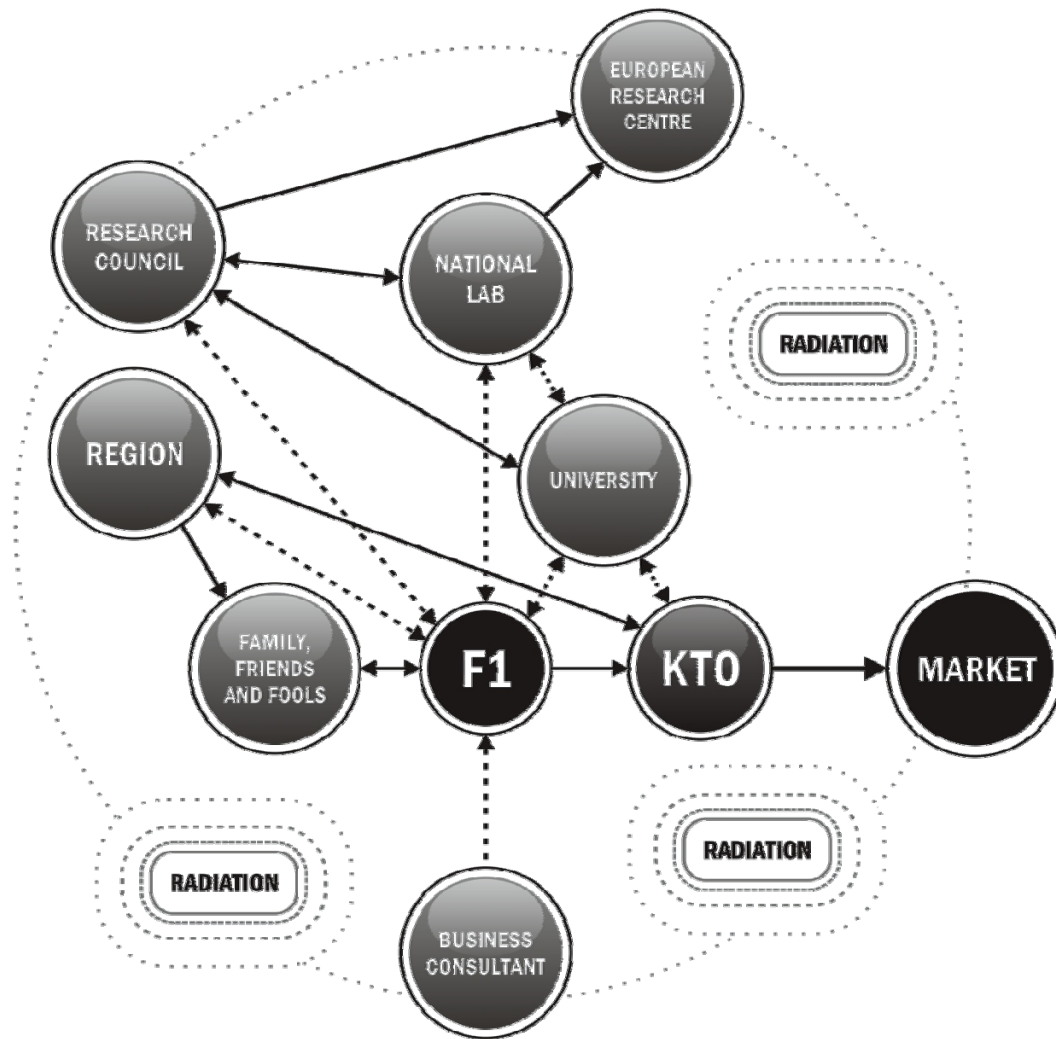


Figure 1: The Network

Source: Personal Elaboration

The analysis of this case study facilitates the understanding how the network was distributed. In Figure 1 is the sociogram with the main actors that were important in the development of F1. In the centre of network is F1 trying to evidence the relevance of its services. The bold lines underline relations that grew with the stabilization of the network. The dotted lines underlined relations that fade away. It is important to stress that this network only as a meaning because radiation is around all the actors. Is the presence of radiation, and its associated risks, induced other actors to believe in the interest of the services of F1. This non-human actor plays a central role in the definition of the Actor-Network. In the beginning F1 was

extremely dependent on the PhD grant of Zack from the research council, his activities in the university and the national physics laboratory and his visits to the European Research centre. Zack was connected to the region, where he was pleased to live and had the support of a sub-network of family, friends and fools, the first to instigate the idea and invest money in his company. Today the region is important for Zack but not for F1, the firm is operating at national level. The ultimate goal was to reach the market, another sub-network. Zack felt uncomfortable in contacting the market, he was more a researcher than a commercial person. Even if the market is treated here as a monolithic entity it is far from homogeneous. To F1 the market was a black-box worsen by the uncertainty about who where the potential customers. To achieve the market F1 had the support of the KTO. The KTO created at least three boundary objects to help spinning-off (Figure 2). A boundary object refers to a way to bridge different social worlds allowing productive communication (Fleischmann, 2006).

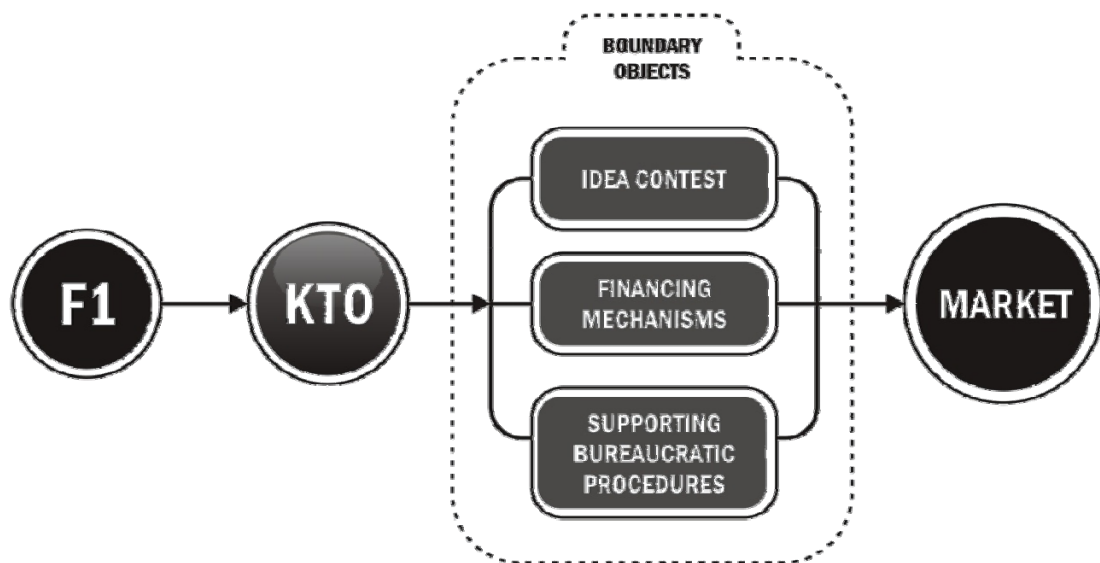


Figure 2: The initial relation F1-Market through Boundary Objects

Source: Personal Elaboration

The three boundary objects listed are i) the idea contest, that facilitate the consolidation of the idea to be in the basis of a economic viable company, ii) financing mechanisms, the screening of public programs, business angels and bank credit adapted to co-finance the needs of initial cash-flow and investment in the firm, and iii) supporting



bureaucratic procedures, such as licensing the activity, granting an incubation space or even the commercial approach to potential clients.

To understand with a different look the process of the spin-off creation the four moments of translation can be used as a framework to analyze the reality (Callon, 1999). With the transcriptions from the interview (personal translation from extracts of the interviews to Zack in 08 May 2009 and 26 November 2009) particular aspects crucial for the successful translation and the creation of the Actor Network are stressed.

Problematization

This is the phase where the actors detect a problem and imagine how to solve it. The major driver of the genesis of F1 was the European Directive (97/43/Euratom) transposed for Portuguese National Law. This law establishes the limits of radiation and obligation of quality control.

"The idea came through my PhD supervisor based on what came out in that law. There was a market need and the future of a nuclear physicist in Portugal is uncertain! Almost every people leave... I was able to stay at CERN in Switzerland, but I wanted to stay here! (...) We had knowledge of that law at the time we receive a contact from a hospital to ask if we could provide that service. We had interest, as a research laboratory, in providing this service through the university. But it was impossible."

Zack and his research group were interested in providing the analysis in terms of radiology but the very complex bureaucratic procedures in the university constrained this interest and incentive the need to spin-off.

"When the idea came we didn't advance much. Only the day I received an email with the launching of an idea contest by the knowledge transfer office I have decided to advance and compete. At that time I was with a colleague. I filled out the registration form and there was the first time I had to put the idea on a paper. Were simple questions but just today I realize that they were simple. At the time it was difficult for me. I started to understand that there were essential things I had not thought (...)."

The first jury panel was not exactly what Zack was expecting.



"I have filled the proposal fields, with a little imagination and a little joke. We then passed the first stage and had to go to an interview with the jury. I'm accustomed to jury panels, I am used to debates and I am used to talking to people about scientific and practical things. I went there in shorts, (...) I was coming from the beach (...) I entered the room and saw people lined up and my legs began to tremble, (...) this was supposed to be an informal thing, I get there I saw everyone in suit and tie, all shut up, lined up, behind the computer. (...) I was a physical scientist, a lab rat! This was an interview to proceed to the second stage of the competition. There was only one person that made all the questions and the others remained silent and the interview took place so far and I answered questions and tried to give them what they wanted to hear. (...) Until they reached the financial part, where we wanted twenty thousand euros of financing and the president of the jury said "20 000 euros?! You are here for only 20 000 euros?! ". Then my attitude turned around completely because I saw it as a threat. If I had that money I would not be there. I saw it as a threat and ended up taking the position to further develop the idea. We got to the next step."

Zack makes the final submission to the Idea contest and has to go to Madrid.

"At this stage there was following paperwork to fill out more detailed information. (...) To open the firm I needed to have specific training to obtain status as an expert in radiation protection and invested five thousand euros in this training course which was held in Madrid. During the training I was informed that we had passed this stage and would be rewarded with a business plan. We were assigned to a well known business consultant in Coimbra and our first contact with them was one time we came to Portugal and a second time they went to Madrid to visit us to finalize the business plan."

Interessment

Zack was not comfortable with the risks of having its own firm:

"(...) all the years of research a person gets used to not have the ultimate responsibility. I had always (...) someone on the top of me with another level of responsibility. (...) We received money to do anything (...). At the firm level is different. I saw everything as a joke ... 'let's try!' But what I never thought to live because the level of responsibility was to go up a level that I thought I had not. And the responsibility of a firm, I had no idea what it was. As a researcher I was used to receive money to do what I do every day. I never took the final level of responsibility, there was always someone behind me. I had



no idea what was running a business and do not consider myself an entrepreneur. I am a person with ideas and motivation. But I have no ability to take risk. The risk is the thing I fear most.”

The business plan was another non-human actor that played a relevant role in underlining the potential of F1. The business plan presented the idea to potential investors and validates the economic viability of the idea.

“I always devalue the business plan to a certain point. It was impossible to answer some questions. (...) So what we need to make it valid? You give me with scientific tools, I do know the way things are supposed to be and the result should be that. So we had to fill the business plan in order to make it viable and it was important. But others they gave more importance than we do. And then we started to think 'it will be worth the effort?'. And I have no doubt that all the people, who makes business plans, perhaps most, must feel what we feel. And I have to admit that, even today, looking at it, perhaps we could re-fill it. But that phase ended to be a bit painful because we continued to find that the business plan had problems ... 'Well, that's what they want to hear!' When we realized that we had to change things for the firm to be viable (...). It alerted us to what were the minimum criteria for the firm to give something. (...) The plan then came to the KTO, proved positive and we were awarded an incubation space, which served to move forward with this. And then it all began!”

Zack felt that the KTO was crucial to give him confidence to go on and approach other actors.

“I think the KTO convinced me (...) There were several phases that gave me more confidence. (...) I begin to believe in that initial idea. (...) Regarding the KTO... I found funny because when I speak to them today they put a smile... because it is an area, radiation (...) And then there seemed not so difficult, it was physics, this “strange” area but there was that law saying, 'This is mandatory and in Portugal! (...) The KTO was stipulating goals and that to me was essential. They told me 'Look, we need it now!' And I resolved it. This fact made me neglect a little of this part of management. When I have some doubts I go there. (...) They attended meetings with me, imposed the pace, talked with lots of people. (...) Then there were the human resources of the KTO. Because I think they have been involved in many stages. Maybe they gave me too much importance and accepted the evolution of F1 because they saw that I had difficulty in getting the licensing (...) Financial support will not say because it was not directly financial.”



The incubation was very important to F1.

“Another support was the incubation period for me... it was even a space in which I benefited... these costs: water, electricity, cleaning, Internet security... So one thing I did not need to pay to have it and not asked me anything in exchange. And this is what I still cannot understand ... the involvement of the KTO and the university ...”

Enrolment

F1 was looking for financing to have means to invest in the required equipment and to face some cash-flow needs.

“The financing organizations, they settled on the expertise of the promoter, me. They looked at my curriculum. I had a meeting and I hardly needed to speak! They said: ‘We got here this file. The curriculum is excellent!’. It was different and they looked at it and did not see anything, but the names of the director of the laboratory, a former Science and Technology minister. It sometimes counts... Then I had also CERN names... this is what I have in the curriculum... and was the only case I saw that, really, they relied on the expertise of the promoter. And then they thought: ‘This guy can take anything forward’. What is a lie, is not it! But it was there where they were focused, otherwise...”

The difficulty to access funds was immense. The main drawback was the refuse of a national programme that was supposed to support the financing of university spin-offs.

“There was the bank and a University of Lisbon which had a ideas contest. Microcredit was only after this first bank refused. Then I remember the NEOTEC programme (...) In NEOTEC I still can not really explain why it was not accepted. The NEOTEC ... everything went well, people gave impeccable references of me... But it did not fit in the idea of innovation because it was something that was already stated by a law. As it was foreseen in the law it cannot be considered innovative.”

To answer these problems Zack answered with is strong connection to family.

“For the family ... it's family! It was confidence. I cannot explain this specific thing (...) and the support of my wife at all levels. She says I'm her investment for the future. I am her project. The company requires many sacrifices, and sometimes there are things that



are illusions. The rest of the family there is support, is their reliance (...). But it is a simple way for living from day to day. And they are not waiting for anything."

The mobilization of allies

The moment where Zack found more difficulties were really close to the market, when approaching the market.

"The stage that I felt with more obstacles was the sales, when the company took off. The first contact with the customer. But that is because I have this calm personality."

The KTO was essential in this phase.

"It was the KTO ... other entities gave nothing. (...) I was accompanied here by the KTO in the early sales, so I understand how they make a sale. That was a very simple thing, but I do not knew! The mere fact to pick up the phone and know exactly what to say, without wasting time, understanding what potential customers need, without going into details. For me the sale is the most important part. And I had a such support from the KTO ... for now because the KTO can easily contact with an entity because it does through the university and... at least there's a name. So it's easier to get to a meeting. The F1 was introduced through support of KTO and then it was much easier to give me attention. "

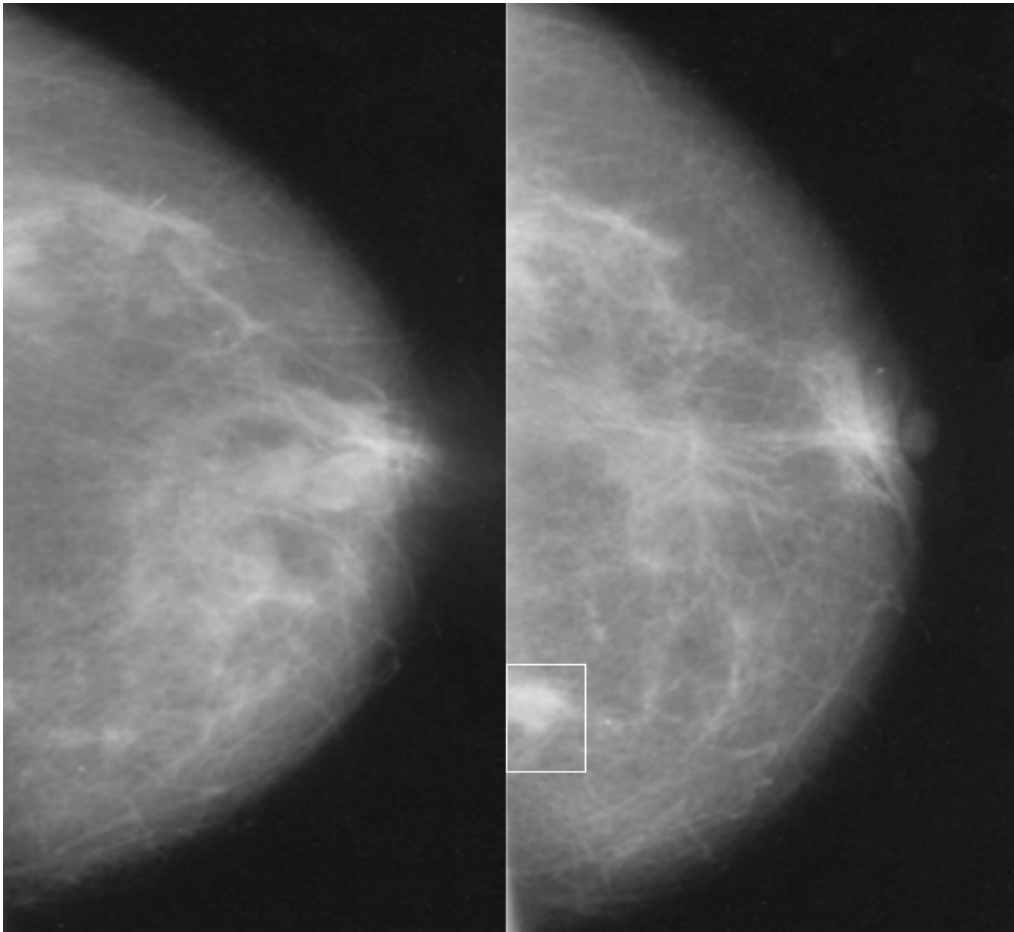


Figure 3: The Brest-Screening - In the right picture a tumor can be detected.

Source: Used with Permission of F1

Zack and F1 were trying to reach the markets and was this moment where the Actor-Network is created. Zack tried to show the importance of its services in verifying the quality of the x-ray machines. He begins to use an example in the presentation of the firm to potential costumers. A clinical case of a breast screening he was informed about in a facility he was providing the service. A female woman, 60 years old, that had taken two breast mammographies. The examinations were taken in two different clinics with exactly the same devices, the same manufacturer and model, with a week of difference between both the exams. The first mammography (Figure 3 left) is inconclusive, even an experienced annalist cannot find anything. The second mammography (Figure 3 right) shows in the bottom left a visible area with different density. This area was proved to be a tumor and was only detected due to a machine that was correctly calibrated. The quality assurance verifies the criteria for the



acceptability of the specific device, for example in terms of contrast, spatial resolution or compression, etc.

This story is one of the factors that caught the attention of potential costumers. This tumor, detected just in time to avoid problems to the patient, was the actor that stabilized the Actor-Network facilitating the translation of Zack interests into others, making them understand the need of the services of F1 and creating an obligatory passage point trough F1 to avoid the dangerous radiations and, specially the executioner tumors.

3. Conclusions: main findings

The article analyzed the creation of F1, a medical spin-off process. The Actor-Network-Theory approach was useful to underline the translation process for the creation of this firm. Zack, the entrepreneur was the translation enabler for the success of F1 but three non-human actors were crucial to the creation of the Actor-Network:

- the radiation justified the existence of F1 services;
- the business plan demonstrated the coherence of the idea and its economic and financial viability; and finally,
- the tumor explained to all actors the problems of not considering the pertinence of F1, creating a obligatory passage point by the firm and contributing for the stabilization process.

The case-study of F1 underlines the central role of distinct features for the success of a spin-off. The personal features of the translation enabler and his social capital, the supporting networks in science and industry, common aspects underlined in the studies of entrepreneurship proved to be relevant. Institutional changes, such as legal modifications, are often constraints but can be enablers of new opportunities. The F1 faced translation problems, that almost prevented the success of the firm: i) a too narrow idea of innovation in public support programs, ii) the absence of market study worsen the notion of market potential, iii) the withdrawal of a colleague/promoter seduced by a bigger competitor, and iv) reaching and satisfying different new demands.

The knowledge transfer office by creating boundary objects and by supporting the entrepreneur, namely in the activities more linked with the market approach and management capabilities, was absolutely central in the words of the translation enabler. These results increase the interest in focusing, in future research, the role of KTO in the translation process



and the diversity of bordering objects they create to legitimize the cooperation between university and firms and the migration of knowledge from fundamental to more close-to-market areas.

As a concluding remark is important to underline that KT is commonly linked to economic and management theoretical frameworks that treat KT mechanisms as ends. What happens from the original idea to the success remains the majority of times as a black-box. A new spin-off, new patent, a new collaborative project, are important success measures but they are only means for the transfer. The consideration of this intermediate measures as outputs affects the explanations of the phenomena and induce artificial interest of the actors in carrying on these activities changing all the reality. To this issue sociological approaches can contribute to a deeper understanding, in particular, ANT is an interesting framework by facilitating the analysis of the changes in the social, the translation process that creates the Actor-Network.



Bibliography

- Benneworth, P., Coenen, L., Moodysson, J., and Asheim, B., (2009). Exploring the Multiple Roles of Lund University in Strengthening Scania's Regional Innovation System: Towards Institutional Learning?, *European Planning Studies*, 17(11), 1645–1664.
- Bercovitz, J., Feldman, M., (2005). Entrepreneurial Universities and Technology Transfer: A Conceptual Framework for Understanding Knowledge-Based Economic Development, *The Journal of Technology Transfer*, 31, 175-188.
- Bozeman, B., (2000) Technology transfer and public policy: a review of research and theory, *Research Policy*, 29 (4-5), 627-655.
- Callon, M., (1999). Some Elements of a Sociology of Translation. In M. Biagioli (Ed.) (1999) *The Science Studies Reader* (pp. 67-83), New York and London: Routledge.
- Callon, M., (1998). *The Laws of the Markets*, Oxford: Blackwell.
- Callon, M., (ed.) (1989). *La science et ses réseaux: Genèse et circulation des faits scientifiques*, Paris: La Découverte.
- Callon, M. and Muniesa, F., (2005). Economic Markets as Calculative Collective Devices, *Organization Studies*, 26(8), pp. 1229-1250.
- Debackere, K., and Veugelers, R., (2005). The role of academic transfer organizations in improving industry science links, *Research Policy*, 34, 321-342.
- D'Este, P., Patel, P. (2007) University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *Research Policy*, 36, 1295-1313.
- Dosi, G., Llerena, P., Labini, M.S., (2006). The relationships between science, technologies and their industrial exploitation: An illustration through the myths and realities of the so called 'European Paradox', *Research Policy*, 35, 1450-1464.
- European Commission, (2009) *European Innovation Scoreboard 2008: Comparative Analysis of Innovation Performance*, Luxembourg: Office for Official Publications of the European Communities.
- Etzkowitz, H., and Leydesdorff, L., (Eds.) (1997). *Universities and the Global Knowledge Economy – A Triple Helix of University-Industry-Government Relations*, London: Continuum.



- Fleischmann, K. R., (2006). Boundary Objects with Agency: A Method for Studying the Design-Use Interface, *The Information Society*, 22, 77-87.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., and Trow, M., (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, London: Sage.
- Latour, B., (1987). *Science In Action: How to Follow Scientists and Engineers Through Society*, Cambridge Mass, USA: Harvard University Press.
- Latour, B., (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory*, New York: Oxford University Press.
- Latour, B., (1986). Visualization and Cognition: Thinking with Eyes and Hands, *Knowledge and Society*, 6, 1-40.
- Molas-Gallart, J., Salter, A., Patel, P., Scott, A. and Duran, X., (2002). *Measuring Third Stream Activities: Final Report to the Russell Group of Universities*, Science and Technology Policy Research Unit, University of Sussex.
- Oliveira, L., (2008) *Sociologia da Inovação – A Construção Social das Técnicas e dos Mercados*, Oeiras: Celta Editora.
- Pinto, H., (2010) What are the Implications of Overlapping Areas for Technology Transfer? Perspectives from Science and Technology Studies, *Tomorrow's Technology Transfer, The Journal of the Association of University Technology Managers*, 2 (1), 59-68.
- Solow, R., (1957) Technical Change and the Aggregate Production Function, *The Review of Economics and Statistics*, 39 (3), 312-320.
- Uyarra, E., (2009) What is evolutionary about 'regional systems of innovation'? Implications for regional policy, *The Journal of Evolutionary Economics*, 20 (1), 115-137.
- Vannevar B., (1945). *Science The Endless Frontier*. A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945, United States Government Printing Office, Washington.
- Williams-Jones, B., and Graham, J.E., (2003). Actor-Network Theory: a tool to support ethical analysis of commercial genetic testing, *New Genetics and Society*, 22 (3), 271-296.



- Zendejas, G., and Chiasson, M. (2008). Reassembling the Information Technology Innovation Process: An Actor Network Theory Method for Managing the Initiation, Production and Diffusion of Innovations. In Léon, G., Bernardos, A., Casar, J., Kautz, K, and Degross, J. (Eds.) *Open IT-Based Innovation: Moving Towards Cooperative IT Transfer and Knowledge Disffusion* (pp. 527-539). Boston: Springer. IFIP International Federation for Information Processing, Volume 287.

Additional References

- Decreto-Lei n.º 180/2002 (2002, 08 de Agosto). *Diário da República*, N.º 182, Série I. Document available online at <http://www.dgies.min-saude.pt/paginas/legisla%C3%A7%C3%A3o%20relevante/pdf/DL%20180-2002.pdf>

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