

Amiram PORATH

The College for Academic Studies, Israel

TECHNOLOGY TRANSFER AND DECISION MAKING

Key words

Technology transfer, decision-making, bounded rationality, behavioural-models, availability heuristic, descriptive-models, academia, industry.

Abstract

Technology Transfer, especially from Academia to Industry has interested researchers, policy makers, and practitioners in recent years. With the acceptance of knowledge and an economic engine, the importance of new technologies derived from academic research has increased; therefore, the process of transferring them to the applicators has been researched extensively. Since the process involves decision making under conditions of uncertainty, an observation of the selection of the recipients from the point of view of the Academia under recent understanding of the decision-making processes is presented here. The nature of the decision and available information limit the possibility of a full rational process pushing towards a Bounded Rationality process, while the human aspect of decision making in the specific relevant environment introduces the availability heuristic into the process under certain conditions.

Introduction

In some systems where the legal system views the exclusive license as an asset rather than permission to use, *exclusivity* is considered as a sort of

ownership, it could have a negative impact on the rate of Technology Transfer (TT) from Academia to Industry. The role of Academia in TT is normally considered to be that of the Technology / Knowledge provider, that is to say that knowledge flows from Academia to Industry [14]. Then either direction, while it still exists [14], is less relevant. Moreover, commercialisation of knowledge by Academia is non-existent compared to that of the Industry.

That accepted concept has led to a set of demands [8, 9] on the readiness for use of the knowledge supplied by Academia. It has to be free for use, and it should be protectable, which is a derivative of the need to be usable [21]. This leads to a conflict regarding publications, which can be resolved in several ways [14]. The discussion has mostly focused [4, 5, 10] on the demand placed on the Academia, while the demands on the Industry focused mostly on fairness and financial issues [6, 7, 12, 13]. However, in this paper, I would like to stress some potential inhibitors to TT from the Industry's angle and the environment in which the Industry operates. There are several different issues that require attention in the Technology Transfer process and that make decision making in the process special.

1. Decision-making issues in technology transfer

There are many decision-making issues regarding TT that can be analysed [15, 16]. One of the major issues is the partner and business model selection decision. The TT process from the academic point of view requires a recipient for TT. That recipient may be a spin-off or an existing entity, whichever is selected, and it requires a business model extensively expressed in the TT agreement [14–16].

In order to explain the difficulties in making the decision, one needs to bear in mind that, for most technologies, there are more than one potential recipients – at minimum the different options of spinning off the technology (directly to a start-up, technology incubator, etc.). Therefore, the decision regarding the selection of potential recipients and the business model offered them, which is the commercialisation strategy, demands taking into account that the technology will fail to reach the market for various reasons. The full rationality model [1, 2, 3, 11] requires that the potential recipients be identified, their relevant models be developed and weighted and then all these possibilities be graded in order to make the required decision. This may be possible in certain cases where the options are limited in their number. It is my claim here that, in the case of TT, since there are different potential recipients and different business models, and since, in most cases, there is some doubt regarding the ability of bringing the technology to the market, there are several uncertainties involved regarding the TT decision making. As a result, the utilisation of a full rationality model is hardly possible; therefore, the decision making regarding the recipients is not

fully rational, and other models, such as bounded rationality and heuristics, influence the process.

So how do the uncertainties and actual decision making models, the behavioural models influence the TT process?

2. Bounded rationality in decision-making

The full rational model, even under uncertainty (3), requires that the decision makers know or have access to the full range of required information. The decision maker is required to be able to access the relevant information, weigh it, and then grade the FULL range of options based on the benefit / damage and the weight. The selection among the different options then can follow several rational models.

However, in the TT world, since the scope includes the entire world, both developed and developing, with different and complex interlinks between different operators, some parts of it are flooding the knowledge highways with more information than can easily be processed by a single person, while other aspects are hidden for commercial security reasons and not open for viewing at all. It is very difficult to imagine a relevant sector in advanced technologies that can easily be assessed and that all the relevant players are known and their number is small enough to be easily handled.

It is also important to remember that, due to different constraints (mostly economic in nature), the Technology Transfer Offices in most academic organisations are limited in their HR capabilities, meaning that each TT officer normally has to handle more than one project at a time, making him or her even more limited in his or her capability to find absorb and process ALL the relevant information for each one.

Therefore, it can be easily understood that a preferred model would be that of bounded rationality. However, even that is not the end of the process. An important factor is just how bounded is that rationality and what effect it will have on the TT process and its potential success. It was Herbert Simon who presented both the Bounded Rationality and the Satisficing terms [17–19], to explain that we would accept “good enough” solutions and not strive to the “optimal solution,” especially when confronted by complex situations or events.

3. Bounded rationality in technology transfer

Full rationality in the TT case is not possible. As mentioned above, the minimum complex case would entail at least two optional recipients, and in most cases the possibilities are much more complex. To demonstrate this, we shall focus on three issues: the number of potential uses the technology can have, the number and identity of potential recipients, and the last issue is the

different business models that can be proposed to the different recipients. The full list can then be weighted and graded, and the highest grades acted upon.

The process described above would be ideal, but even at the first stage, we run against an insurmountable problem. That problem is compiling the full list of the potential uses of the technology, because some uses may not be foreseen at the moment (e.g. an algorithm for identifying communication mistakes maybe used for identifying production errors – faulty segments in the production, anomalies in the queuing or something else entirely). If we can recall Viagra, the famous drug that has had a huge financial (if not social) success, it was originally approved as a heart drug. The final and successful use was considered a side effect, not a very welcome one. If that can happen between different drug uses, what can we expect from more general or obscure technology (e.g. communication coding)? We need to accept the fact that we cannot always envisage the full range of uses that the technology may have. In that aspect, our rational analysis is limited.

The next hurdle is created partly by the first one. If we cannot envisage all the uses, how can we identify the entire scope of the potential recipients? The problem however is not totally dependent upon identifying the uses. There is a more inherent problem, and that is the global aspect of the world market of current knowledge. There are too many different companies, many of whom are not well known, and some are start-ups in formation. There are also confidentiality issues as well as language and accessibility issues that make this task impossible in most cases. So again limited rationality is forced upon us due to the prevalence of possibilities and the difficulty of defining them.

The last issue is again dependent at least partly on the former two. Defining the specific business model without the intended use and recipient identity is impossible in a fully rational model that considers all options.

Since rationality will not work for us by definition due to our limitations, we are forced to consider bounded rationality as the next best rational option. Furthermore, in recognising the satisficing effect mentioned above, in our case, the over-burdened TT office and the officers employed there would accept that, due to pressure and insufficient resources, they cannot reach an optimal knowledge recipient and settle for a good enough knowledge recipient. A recipient that they already agreed with and managed to deal with would certainly be a good enough if not an optimal solution.

4. The bounded rationality and other heuristics – introducing limitations

Our ability to perform the rational process is limited. We can divide the limitation across several paths: the ability to locate and identify all the relevant knowledge, the ability to process it and weigh the different options, and finally the ability to grade the options and make the rational decision.

The problem of identifying all the options is easily understandable, if you consider the process of finding all the firms in the world dealing with, for example, tools (e.g. screwdrivers for special uses). Since this is a relatively rare product, one would expect the number of firms involved to be limited, and one would try to find all the firms involved using search engines directories, etc. But it is never possible to identify every one, because there are always firms that have not yet registered, firms entering the market, and countries where the firms do not register at all, etc., which makes finding ALL very difficult. Additionally, if one considers the time element, one would have to continually restart to search to check for new entries. Then if we consider the enormity of the task when dealing with a loose definition regarding other technologies that are more confidential, in development, or at the other scale of innovation, traditional or low tech, the process is daunting. We will tend to limit the search to a more manageable search, to the firms that we can identify using our tools, to types that would be more fitting for our purposes (e.g. firms dealing in R&D), and here we introduce the first boundaries to our rational process.

The second path, the one of weighing the options, is again difficult for our purpose, since Academia is a complex motivation agent. While a firm would be a focused agent looking to maximise profit (legally) Academia has additional purposes. Profit is not its main concern. In most cases, academic institutions are defined as non-for-profit organisation. They do have, in most cases, the public obligation to promote the public good; therefore, they also have an obligation, a moral obligation, to make sure that the technologies licensed or transferred are put to use for the public good. Academic organisations do not want technology shelved for commercial reasons. They want the knowledge forwarded to other firms and put for use for the public good if there are failures in the firms first receiving the knowledge. Therefore, weighing the different possibilities involves the potential revenues of each option and the success chances of each option. While the scope of the activities of firms may be available to the public, their strategies and chances of success are often not. Therefore, we face another limitation on our ability to proceed with the full rational process and have to limit our search to the possible – either firms that we know more about (public firms, large firms that have good chances of success) or assume that they all have the same chance of success and grade according to their market performance. Therefore, the next limitation is on the possibilities of success, and sometimes also on the shelving potential, publication permission and other parameters that Academia is interested in, in addition to the potential revenues.

The third path is limited first by the first two paths and their limitations. The grading and the rational decision are in balance between more a rational decision being taken by a group of business development agents and the less rational processes such as the availability heuristic exhibited in the single

person decision-making process [20]. The availability heuristic means that the TT officer in charge of commercialising will have a preference for recipients that were either mentioned lately in a relevant context or that he or she has been working with lately or that are considered as good recipients by the TT Office. This preference would interfere [20] with the rational grading and decision making, when the process is made by a single TT officer. The problem is reduced when the grading and decision making is made by a well-managed group, but that possibility is cost more in both money (several expensive people involved) and time (longer process).

The introduction of limitations and the additional possible heuristics are placing a limitation on the rationality of the decision-making process in TT.

5. How do we really perform TT?

As mentioned above, Academia has additional considerations to the economic interests that need to be taken into account in the TT decision-making process. One of the important obligations from the academic point of view is to make sure that the technology created reaches the application stage (in most cases the market) and increases the public good. Since this is a major obligation, it has a significant weight in the decision-making process and, apart from the uncertainty, regards the ability to reach the market an important part of the different business models and solutions developed.

Failing to reach the market can happen for various reasons. The technology may fail to meet the market standards. The cost of utilising it may make it unprofitable compared to other options, and there may be regulatory issues, etc., depending on the maturity of the technology (how advanced is it towards a marketable product/service). Since technologies that originate in academic research are normally a long way from becoming product, it is a significant risk that may depend on the relevant sector of industry and regulations.

Different recipients, such as licensees or spin-offs, offer their own understandable uncertainties, regarding the ability to reach the market. The spin-off may fail from a number of reasons not related directly to the technology, while the licensing may end in shelving or postponing development due to strategic considerations and other reasons.

However, the ability to deal with these uncertainties is complicated further by the different business models available, and the complexity of international knowledge markets. The example below will illustrate such a complication.

Example 1 – TT demonstration case

Demonstration case – The universities are public organisations designed to act for the public good. The TT is part of their service, but they have to do it for the public good. Therefore, they require financial returns and that the knowledge be used (non-shelving). Therefore, there are several parts to a TT agreement with Academia – financial returns, non-shelving (use) and the return of the knowledge in case the industry does not use it or is being dissolved. The non-shelving has several solutions and will not be discussed further in this article. This case demonstrates a complication that may be met when trying to commercialise in a specific legal environment. While Academia in that legal environment has developed some solutions, other organisations under a different legal environment would probably not have them. This case demonstrates the problem of operating outside your known environment. Otherwise, this would create a barrier to TT. This is especially true for the EU, while it is a single economic entity (or seems to be) there are different legal environments in the economic zone.

Therefore, when TT offices have to choose, they prefer to identify the potential recipients from their close environment, past experiences or from publication of recent events. They do not form a full rational process but at best a bounded rationality process, while, in most cases, the availability heuristic would rule. This is further supported by *Satisficing*, another term, in addition to *bounded rationality* coined by Herbert Simon [17–19], in parallel with Bounded Rationality. The effect of satisficing is that it allows us to accept “good enough” solutions instead of optimal solutions. In our case, it empowers the TT offices and TT officers to select solutions that offer some option for a TT instead of the best possible TT.

Another aspect in that venue is the preference to a certain business model. While there may seem to be a variety of business models, each TT office tends to develop an affinity to certain models that seem to work better in most cases. In time, the TT office would invest effort and time in perfecting the relevant contracts that fit their preferred model and then try to force the model to fit the specific TT project at hand. However, there is no real rational model working in most cases.

Regarding the recipients, there is a preference for recipients from familiar environments with a positive past experience. A full search would be put into play only if the number of recognised possibilities is limited, e.g. under the Israeli R&D law in former years, knowledge developed by government support could be commercialised only to local industry, automatically limiting the scope of potential recipients.

Conclusions

The topic of decision making in Technology Transfer is both important and complicated. Understanding the forces that underlie the process can help one to understand and perhaps improve the process itself. We have seen that the process of selecting the knowledge recipient, in most cases, cannot adhere to the full rational model in decision making. Additionally, we have also demonstrated that a bounded rationality model combining the satisficing effect presents a more realistic approach employed by the TT offices.

Before recommendations, such as increasing the familiarity of TT offices with potential knowledge recipients so as to augment the TT potential, can be seriously examined, empirical support should be provided to the arguments presented above.

References

1. Ariely D.: Predictably irrational. HarperCollins Publishers, USA, 2008.
2. Ariely D.: The upside of irrationality. Dan Ariely, USA, 2010.
3. Baron J.: Thinking and Deciding. (3rd ed.) Cambridge University Press, 2008.
4. Etzkowitz H.: Bridging the gap: The evolution of Industry-University Links in the United States. In Branscomb L.M., Kodama F. & Florida R. (Eds.), *Industrializing technology: University-Industry linkages in Japan and the United States* (pp. 203–233). Cambridge, MA: The MIT Press, 1999.
5. Etzkowitz H., & Leydersdorff Z.: *Universities in the global knowledge economy: The triple helix University-Industry-Government relations*. London, UK: Cassell Academic, 1997.
6. EU Commission. FP7 in Brief. How to get involved in the EU 7th Framework Programme for research. European Communities, Luxemburg, 2007.
7. EU FP7 – description downloaded from <http://cordis.europa.eu/fp7/> on December 7th 2009.
8. EU. Communication from the Commission: Investing in research: An action plan for Europe. COM (2003) 226 final/2.
9. EU. Report of the CREST expert group on: Encourage the reform of public research centres and universities, in particular to promote transfer of knowledge to society and industry. Final report, March 2006.
10. Fontana R., Geuna A., Matt M.: Factors affecting university – industry R&D projects: The importance of searching, screening and signalling. *Research Policy*, 35 (2), 2006, 309–323.
11. Kahneman D. And Co-Authors, Ed. Bar-Hillel M.: *Rationality, fairness, happiness*. USA, 2005.

12. Laursen K., Salter A.: Searching high and low: what types of firms use universities as a source of innovation? *Research Policy*, 33(8), 2004, 1201–1215.
13. Porath A.: Legal incentives to economic growth – the case of the Israeli R&D Law. *Managerial Law*, 48(3), 2006, 322–333.
14. Porath A.: *Collaborative Research in Management, inside-out*. Sage Publications Ltd. UK, London 2010.
15. Rahman H., Ramos I. (2012a): SMEs and Open Innovation: Global Cases and Initiatives (pp. 1–356). doi:10.4018/978-1-61350-519-9.
16. Rahman H., Ramos I. (2012b): *Cases on SMEs and Open Innovation: Applications and Investigations*. ISBN 978-1-61350-314-0 (hbk.)
17. Simon H.A.: *Reason in Human Affairs*. Stanford: Stanford University Press, 1983.
18. Simon H.A.: *Models of Thought, Vol. 2*. New Haven: Yale University Press 1989.
19. Simon H.A.: *Literary criticism: A cognitive approach [Target article]*. In: *Bridging the Gap: Where Cognitive Science Meets Literary Criticism* (Franchi S, Güzeldere G., eds). *Stanford Humanities Review* 4(1). 1995, Available at <http://www.stanford.edu/group/SHR/4-1/text/toc.html>.
20. Tversky A., Kahneman D.: Availability: A heuristic for judging frequency and probability. *Cognitive Psychology* 5 (1): 1973, 207–233.
21. www.magnet.org.il downloaded October 2012.

Reviewer:
Irena HEJDUK

Transfer technologii a procesy decyzyjne

Słowa kluczowe

Transfer technologii, proces decyzyjny, ograniczona racjonalność, modele behawioralne, heurystyka dostępności, modele opisowe, przemysł.

Streszczenie

Zagadnienia transferu technologii z jednostek badawczych, zwłaszcza uczelni, do gospodarki stanowią w ostatnich latach przedmiot zainteresowania badaczy, decydentów i praktyków. Wraz ze wzrostem znaczenia wiedzy jako czynnika zmian gospodarczych wzrosło także znaczenie nowych rozwiązań technologicznych, stąd też zagadnienie ich transferu do przemysłu stało się przedmiotem szeroko prowadzonych analiz.

Ze względu na fakt, że transfer wyników badań związany jest z podejmowaniem decyzji w warunkach niepewności konieczne jest odpowiednie zaplanowanie procesów decyzyjnych związanych z tym procesem. W artykule zaprezentowano przykłady decyzji odnośnie do wyboru potencjalnych odbiorców opracowanych rozwiązań. Charakter podejmowanych decyzji i dostępnych informacji w znacznym stopniu wpływają na racjonalność procesu decyzyjnego i decydują o jego ograniczeniach. Zjawisko to znane jest pod pojęciem ograniczonej racjonalności (ang. *Bounded Rationality*), według którego podejmowanie decyzji w niektórych obszarach wiąże się z wprowadzaniem uproszczonych metod wnioskowania określanych mianem heurystyki dostępności.