BARIERRS AND SOLUTIONS IN THE KNOWLEDGE FLOW PERCOLATION MODEL

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Abstract:
The present paper investigates the barriers against the knowledge flows which are intented to produce innovation. The analysis is made at the at the individual, organisational and inter-organisational levels, underlining the importance of knowledge communication, collaboration and accumulation in assuring the percolation of knowledge and making the grid of our model more and more fertile and able to support innovation. The paper also identifies some solutions to decrease the identified barriers.

Key words: knowledge flows, technological innovation

JEL classification: O 31, O 32

INTRODUCTION

In a very recent previous paper (currently under review at the 18th IBIMA conference), we proposed a new model of innovation based on knowledge flows, named Knowledge Flow Percolation Model (KFPM), as a basis for future observation in this very important and attractive domain of study. We added, in this sense, a new perspective more focused on the complexity of knowledge flows and more particular interested in innovation as their output, in comparison with (Nonaka, 2001) and (Holsapple, 2007) models. We treated the knowledge flows at the individual, organisational and inter-organisational levels, underlining the importance of knowledge communication, collaboration and accumulation in assuring the percolation of knowledge and making the grid more and more fertile and able to support innovation.

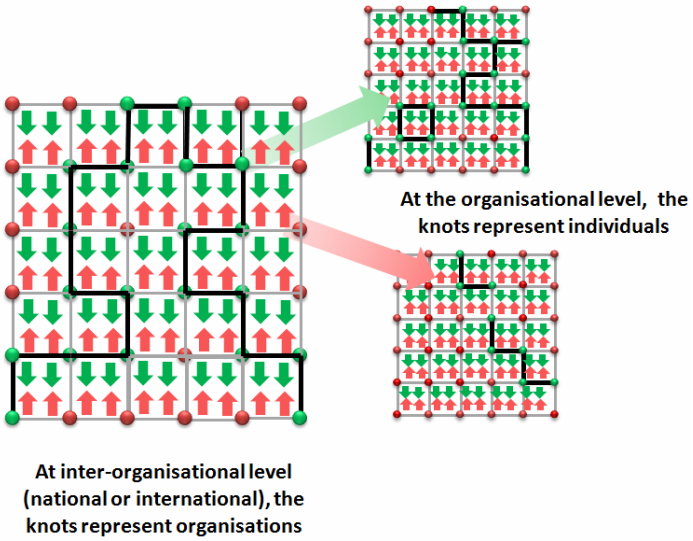

Figure 1. Refined Knowedge Flows Percolation Model (KFPM)

Our Knowledge Flows Percolation Model is based on a cumulating model firstly used in Physics in order to prove whether resources can „flow" (be percolated) in a network or a grid. In engineering, percolation models are used in order to analyse if fluids can flow through a solid material (such as water through absorbent soil, for example).

Graphically, the model is built starting from a grid with vertical and horizontal lines. The grid will be seen as a network where each intersection between two lines will be called *knot* (node),

and each line between the knots is an *edge*. The edges are assimilated, in this model, to channels each having two stages: close or open.

In our opinion, we can associate those individuals generating and consuming knowledge to the knots of this model. The more persons transferring knowledge among them, the more channels are opened and the system the persons belong to may pass to another innovation level. Moreover, we can also use the model at the national level, substituting individuals with organisations and keeping the same hypotheses. Another interesting aspect is that more opened channels represent more possible paths for knowledge – the grid entirely becomes more fertile. The KFPM is, without doubt, a dynamic model, where the configuration of the knowledge flow is permanently changing. The results of these flows are accumulated inside the system, making it more robust and more capable to support further knowledge development.

Analysing the models above we can intuitively state that *barriers against the individual and composite flows drives them away from the context exposed by this paper, namely innovation*. In other words, the more impermeable the grid within the KFPM, the more difficult the transformation of knowledge into innovation and furthermore into competitive advantage. We refined the model, adding red arrows downwards on the grid signifying barriers, the stops against the flow of knowledge on innovation and as a counter point, green upside-down arrows signifying the actions to be taken by the decision factors at the organisational, national or international level to remove those barriers, taking the grid to the desired permeability level – see Figure 1. These barriers and solutions are addressed in the present paper.

KNOWLEDGE FLOW PERCOLATION MODEL - BARRIERS

According to Tom Davenport, "the successful knowledge transfer does not require computers, documents but people" – (Davenport&Prusak, 1998). But, at a **individual level**, we can observe a series of barriers against this transfer.

Daniel Kahneman, a Nobel Prize winner, made a very important observation regarding the interaction and knowledge transfer among people. In his recent book *Thinking, fast and slow* (Lowenstein, 2011) he says that individuals generally tend not to be rational (or led by a slow internal system which is conscious, ‚thinking', analysing, evaluating and responding - System 2), but respond more to the emotional environment rather than to information processing (directed by a System 1 which is automated, lazy, responding effortless to the environment, taking into account past experiences and preferences, strongly subjective). From our point of view, these *subjective* interferences of System 1 into our normal functioning cast on the knowledge flows generated by individuals a certain suspicion regarding the lack of accuracy, deformity of the emotion mirror and, as a counterpoint, question the availability for the correct reception of those knowledge flows which, for example, do not correspond to individuals' prejudices.

On the other hand, the knowledge transfer may be affected by *ambiguity* both with regard to the explicit and the tacit knowledge. In the case of the explicit knowledge, the causing factors are the cultural differences, language, over-specialization and lack of a common vocabulary among individuals with different professions. Although the explicit knowledge can be interpreted according to its content, the interpretation of the tacit knowledge is based on knowledge from other 'internal' sources, which increases ambiguity and deforms the transfer even more.

Individuals' refuse to share knowledge takes place from different reasons – *fear of failure or replacement with other employees*, the *feeling that they do not have anything important to say*, the *fear that their ideas might be refused by the interlocutor* (group, organisation), f*eel uncomfortable in front of the experts recognized by the company, the fear of being unemployed* (taking into account the financial crises we all have to face), *the fear that they are being evaluated by the organisation according to what they know* and not according to their potential, which impedes them to share knowledge to other people. Interesting details regarding this syndrome are found in (Collison, 2010).

The refuse to assimilate new knowledge from others is caused by a *fear for new experiences*, *feeling uncomfortable with change*. It shall be met especially with elderly or old employees, who are stuck into a status quo bias.

The same as the knowledge flows are enormously multiplied from the individual to the organisation, the barriers at the individual level are multiplied and propagated when we refer to the **organisation**. Both subjectivity and ambiguity cumulated from individuals to the organisation increase their power exponentially and function as deforming mirrors distorting the knowledge flows, spoiling their meaning and making them invaluable. The individuals' refuse to communicate, once supported in the organisation, empties the grid of our model drying it, annulling the permeability which is so necessary to transform knowledge into innovation.

Furthermore, at the organisational level, the following barriers stand *against knowledge assimilation*:

- Overloaded working environment, which makes individual do their jobs mechanically, without prioritising knowledge creation and communication;
- Instable environment for the employee, with a permanent job change, uncertainty, which leads the employees keep the knowledge for themselves, in order to keep their job advantages or to use it for further activities, especially for competitors;
- Protection of intellectual property rights in such a manner that employees do not have access to relevant and valuable knowledge in their field.

The *knowledge generation* might be impeded by the following elements:

1. An inhibiting, tensioned working environment where errors are not allowed, the new ideas are not encouraged, the organisational culture is punitive, based on sanctions which impose fear; this environment intimidates and disarms employees, it ‚shuts their mouth' and force them to keep to themselves;

- A working environment not encouraging competition; new ideas and learning are useless, employees are happy with their positions as little wheels of a big mechanism and will never try to improve their professional performance;
- Intellectual rights protection; employees cannot freely transmit knowledge as a consequence of confidentiality agreements ;
- Excessive bureaucracy or high organisational pyramid; the employees, perhaps with an attitude based on previous experiences, will not communicate new ideas because they are sure of failure either because of the high mountains of paperwork or the multiple high-rank employees.

Other barriers, more general, can be:

- Distance, culture, language differences between individual agents who are to be involved in the knowledge flow which impede the process;
- Small financial retribution for employees, cause either by a reduced financing (as for example the Romanian research field) or as a bad payment method – for each invention and not for continuing activity;
- Small, badly organized and poorly administered human resources;
- Managers' lack of competences on strategic and organisational levels, lack of interest for the tasks supposing knowledge management;
- Technology, which can over simplify work and not lead to innovation. The consequences are a change in social relationships by increasing the abstractisation of tasks, negative psychological effects caused by excessive computer monitoring of the professional performance, the change of occupational configuration determining even the disappearance of certain jobs from the work market with effects on the social plan, informational saturation, etc.;
- The strong adherence of old knowledge inside an organisation. This impedes the innovation process which supposes losing old knowledge and develop new and different sets of knowledge (Leuca, 2008, p. 11);

- Fear of failure, which appears also at the organisational level and is perhaps the worst inhibitor or innovation. One of the basic principles in an organisation is to learn from previous experiences, avoid errors, better risk management and improving, for a long term, the professional activity of the employees. In reality, the history of knowledge management has many stories of expensive and inefficient intents to create knowledge databases filled with highly structured formal reports of the learnt lessons – their structure though generated the loss of any context, emotion, and relevance for the reader and did not prove to be useful as it was forecast. Consequently, organisations would rather not invest in creating, storing, and transferring knowledge but only wait to use it.

At the **inter-organisational level**, the following barriers stand *against knowledge assimilation*:

- Rigid, inert system failing to valuate change;
- Protection of intellectual property rights reason which fails in sharing them for this reason.

The *knowledge generation* can be impeded by:

- Systematic discouraging innovation, lack of incentives etc.;
- Exaggerated control.

Other barriers may be represented by:

- Distance, culture, language differences between individual agents who are to be involved in the knowledge flow which impede the process;
- Ideological stuck, identified by Brătianu (2011, pp. 521-524) in Romania, which can also be extended for other countries weekly developed. This barrier, from the author's opinion, is the strongest, a real innovation killer. Innovation and knowledge creation have been systematically discouraged in the socialist period. The only source of new knowledge and idea which was then admitted was the communist party. As the consequence of the absence of competition in the centralized economic system, the employees were not encouraged to get involved into innovation activities. The same situation is kept, in a residual, inert stage, even today:
- Excessive bureaucracy. Taking again Romania as a clear example, Brătianu (2011, pp. 521-524), observed that bureaucracy got clear negative connotations as a consequence of its unlimited application during the communist period. Its excessive rules were implemented in order to keep the control, and the resulted petrified structures, especially in the public administration, which persist today, would kill any interest for innovation, change, new knowledge. The inherited hierarchies were advantages were directly proportional with the occupied position generate even today corruption and underground retribution systems, far from meritocracy. All these discourage the potential sources of innovation in their involvement in technological transfer activities destined for similar countries;
- Lack of financing;
- Linear thinking, mechanist models, based on cause-effect, discouraging innovation, creativity, and the diversity of opinions;
- Lack of cooperation between organizations, inexistence of spaces for common experiences;
- Insufficient resources (especially human) to the source and especially to the recipient;
- Big differences between the technology transferring organisation and the recipient organisation. It can be observed that, together with the increase of the technology used in production, the increase of knowledge included tends to be more accelerated whereas transferability is harder to take place. Although limited, small improvements of performance requires a large amount of knowledge and the improvement is obtained as a consequence of the application of technology, organisation, costs, etc. Therefore, if the basic functional principle is exhausted, the possibilities to improve performances require high costs and hard work, as the have a small transferability, although the knowledge and experience to produce them do exist.
- Non-involvement process, syncopated innovation.

One more time we need to mention that barriers are subjected to the same propagation process, from the organisational to the national level, increasing their intensity and negative effect in a cumulative and exponential manner. We also want to draw the attention on the idea that those barriers associated with the existing technology transfer must not be underestimated. The reason is that, although not new for the sender, the ‚sent' technologies may be quite new for the recipient. Even the tangible, relatively mature technologies, require technical and organisational abilities at the destination, which could allow the assimilation and adoption of important technology.

KNOWLEDGE FLOW PERCOLATION MODEL - SOLUTIONS

Individuals, in order to generate new knowledge, the firstly have to be curious to explore the adjacent possible and surpass its limits. In order to do that, they must have the necessary instruments – in our case, knowledge, perspectives of interpretation of problems they face, different heuristics to find solutions. They have to treat change as incremental and not radical. We can see a individual's good idea as a network. A specific constellation of neurons – thousands of nervous cells – activated simultaneously for the first time in his brain and a new idea rises in his consciousness. The individual has the right to keep it alive and connect his brain to the most creative networks. To get an innovating mind, he has to place it in certain environments with the same defining features: networks of ideas or people imitating the neuronal networks exploiting the adjacent possible.

In order to fulfil this request, the environment of the **organisation** has to be free, where individuals are allowed to be creative, curious, and open to new experiences. The calculated chaos is a good solution – creative ideas appear when people are encouraged to think differently, to have a different approach on the things around them and make changes. The innovation specialists are necessary – any company must benefit from internal employees taking charge of innovation – it is not exaggerated to consider hiring an innovation manager whose main task would e to collect and structure ideas from the other members of the organisation.

We have identified below a series of *qualities knowledge managers must prove*, disregarding the position held in the company, which we can oppose to the barriers mentioned above:

- Personal abilities that generate participation and satisfaction from innovation employees, against not motivating negative aspects;
- Support an innovation culture. As many times new ideas do not come over night, the employees will have the freedom to be creative, without constraints or time pressure. , Any employee has to be curious and all managers, no matter the position held in the company, have to think positive and not let themselves to be led by the syndrome „Not invented here", and refuse all good ideas. Diversity must be encouraged;
- Knowing the technological development in the field of activity and therefore know what has already been invented and also identify the tendencies of the field;
- Non-linear thinking and not underestimate changes and be conscious that the world does not change as it did the past months and that technological development is exponential;
- Appreciate and understand the technical problems and difficulties that may arise during the knowledge transfer;
- Be open to informal networks between employees and between employees and people ouside the organisation;
- Understand financial costs, benefits and risks of knowledge transfer and organisation innovation;
- Ability to valuate persons – resource, with competences in creating, storing, transferring and using knowledge. It is recommended that these specialists be sent across the organisation in order to facilitate creativity. The organisational structure is therefore more linear and employees are encouraged to talk without respecting the hierarchy. These changes can generate inefficiency but they encourage communication and creativity;

- The ability to encourage certain behaviour features to employees, addressing questions about problems and opportunities, need of new abilities, assume risks and be pro-active, have the same beliefs and values as the organisation;
- Prove good management of those relations influencing the way information is divided, as they become (and generate) knowledge, understand the management of relations, knowledge and information for a great variety of organisational purposes – see also Young (2010).

The relationship between managers and individuals must have the following features (Popescul, 2011):

- Motivation - From the very beginning, teams or organizations should hunt positive people, willing to get involved, whereas those who want to be stars will be left aside. Motivation, staff involvement – besides the traditional stimuli, such as salary or a rapid promotion – a positive attitude of managers and a pleasant working environment are also desirable;
- Attitude - Employees should receive the same respect and responsibility employers offer experts. People's safety that the organization will not get rid of them, the transparency in using knowledge and the desire to improve the environment should be increased - using instruments such as the peer assist, communities of practices, offers and requests, self-assessment and internal benchmarking, river diagrams and knowledge cafes. Social media is a solution because it covers the traditional hierarchy structures and increases participation. Besides the techniques, the visible involvement of the leader is the one that makes the difference. At the same time, managers must encourage the knowledge requirement aspect, because people are normally

  1) reserved regarding ideas or good practices which come from outside the organization or from one of its different areas,

  2) self-sufficient, that is, they avoid requiring somebody else's help in order not to seem weak. Solutions to encourage the requirement are knowledge fairs, internal benchmarking, and communities of practice;
- The correct treatment – the violation of a correct process logically involves the non-recognition of the individuals' intellectual and emotional value. The well-known thought and behavior pattern in this case can be summarized as follows: if individuals are not treated as if their knowledge mattered, they will feel intellectually indignated and will not share their ideas and experience; they will rather keep the most logical reasoning and the most creative ideas for themselves, not allowing new perspectives to come into the light. Moreover, they will deny other employees' intellectual value. It is as if they said: "You don't appreciate my ideas, I won't appreciate yours. I don't even trust and care about the strategic decisions you made";
- Communication – over communication can harm love relationships, but when it comes to business relationships, the managers should consider all the ways in which communication works (either electronically or face to face). An important challenge is to *effectively* communicate vision, rules, and guidelines to employees and other stakeholders.

At the national level, quoting (Sánchez and Rodríguez, 2009, pp. 389-390) we assert the necessity of public politics actions to promote research, innovation and technological change. Therefore, the politic administration can influence the growth of the productive system in a country, aiming to have economic growth or create comparative advantages promoting innovation and technological improvement. The main objective of all technological policies is improving life standards which can be achieved by improving production and, implicitly, the competitiveness of the production sector or by solving social and environmental problems. All countries shall have a systematic vision on innovation including all agents and public bodies intervening, interactions and interdependencies, taking into account the following constraints:

- Innovation and new technologies depend both on individual factors but also on the interaction and synergy of different factors;

- The innovation capacity of a country or region depends not only on the effort in the E + D (expenses and personnel) but also on the technological structure, the interaction between enterprises, public administrations, etc.;
- The innovation activities require an innovative environment where the most important are the mutual staff exchange, scientific and technological knowledge, specialized services and innovation stimuli;
- Such instruments as technological centres must be improved and future technologies should be assessed by impact studies;

The knowledge transfer must be managed efficiently and supported by adequate financial instruments and widely disseminate public funds research as well as publishing freely scientific data and papers.

At the same time upside-down response actions are necessary for companies to extend their activities by sharing experiences, create dialogue spaces and new knowledge testing places, becoming components of improving clusters. (Neştian, 2007).

CONCLUSIONS

Both organisationally and nationally, *the existence of a strong cooperative and collaborative culture is an initial requirement*, extremely important for the knowledge transfer between individuals and groups. Without the right mechanisms to encourage cooperation, the structured or technological knowledge transfer interventions may not function. Moreover, an approach based on problem identification and solving, quite experimental, would be appreciated. Many theoretical approaches – see (Chirică, 1997), (Johnson, 2010), (Page, 2011) - support the importance of *diversity* through innovation. The more diverse the ideas and solutions for problems at a certain level, the higher the registered growth – recombined the old and the new ideas and solutions exponentially produce other ideas and solutions. Even if the solution which do not prove to be efficient may be used eventually and for this reason they should not be considered to be lost time and money but gains from the created experiences and knowledge. Therefore, connecting ideas is more helpful than trying to protect them. When we consider innovation in nature and culture, the environments building walls around good ideas tend to be fewer innovators for a long term than the open environments. Good ideas want to connect, to fusion, to recombine they want to reinvent themselves surpassing conceptual borders. They want to complete each other as much as they want to compete- see (Johnson, 2010, p. 29).

On the other hand, a widely accepted idea is that such an uncertain and complex process as innovation, luck plays an important part (Leuca, 2008, p. 20). There are, still, cases when success comes accidentally – and sometimes the resulting benefits are enough o finance the following failures. The true success resides in the capacity to repeat the success, to manage the success and although impossible to guarantee, have the chance to happen again. This also depends on the understanding and management of this process so that very little is left to hazard. In reality, it was demonstrated that success is based on the capacity to assimilate, to learn, permanently accumulating knowledge and solutions. The accumulation of efficient actions along time has a more important result than an efficient action undertaken after a radical change. In other words, (Sandu, 2002), the possibility to have technological improvement have a cumulative nature for companies, organizations, countries, namely it depends, among others, on the technical level they have previously acquired. The innovation activity is also cumulative, with a growth rate in time. The previous experience determines the future possibilities, except for the specific uncertainty of the creative process. In this sense, supporting innovations are as important as radical/disruptive innovations for the success of an organization or a country. The accumulation effect is also visible in Geoffrey West's model (Johnson, 2010, p. 17), according to which the bigger the cities, the more rapid the production of ideas. He discovered an over-linear scaling phenomenon: in spite of the noise, crowd, attention distracting, etc, an average inhabitant of a city with over 5 millions inhabitants will be more creative than an inhabitant of a city with 100 000 residents.

As a consequence of the non-exhausting inventory of barriers against the flows of knowledge in the model we proposed as well as of the identification of a new set of solutions, (also far from being exhaustive), we are now capable to re-assume that, if the network represented by the grid becomes sufficiently liquid, it will be able to facilitate innovations. The liquid environments contribute to the re-contextualization of individuals' problems, reduce individuals' problems, reduce reasoning errors, help good ideas appearing sometimes as intuition be disseminated and completed.

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