The Invisible Hurdles to Knowledge Sharing within Engineering Organizations

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Abstract. Knowledge is widely recognized as the key asset of any engineering firm. Knowledge is created by the people in a firm or organization but learning at the individual level does not imply or guarantee that the firm or organization learns and capitalizes on that knowledge. Several authors have stated that knowledge does not flow always as desired, frequently 'sticking'. In order to propose appropriate actions that could help improve the current situation a diagnosis was required, to ascertain the root causes behind the lack of effective knowledge sharing in many engineering firms. This paper shows the results of a survey conducted with over 400 individuals in 6 countries, identifies the main reasons why knowledge sharing is far being from satisfactory in the majority of the firms, and provides a set of recommended remedial actions

Keywords: knowledge, management, diffusion, Knowledge sharing barriers one, two, three, etc.

1. Introduction

Almost everyone agrees that there are many benefits at all levels (personal and organizational) associated with an open attitude towards knowledge sharing within firms. Yet, that theory or belief is seldom put into practice. People say that they believe in the importance of knowledge sharing, but generally very few walk the talk. Potential gains are enormous, as felt intuitively by many and documented by several [1-3]. Compared to other animals, we human beings are extraordinarily slow in our development, but that is widely compensated by our huge capability for learning and developing things [4]. Knowledge sharing differentiates the human being from other animals and has always been a key engine in individual and collective progress, yet organizations normally constrain, impede and eventually kill this basic human instinct[5]. Knowledge is perhaps the only true competitive advantage of engineering firms and "managers are those that transform knowledge into something productive" [6]. The question is then, why is it that it in general so little knowledge is shared within engineering firms? In the absence of learning, we simply repeat old practices; what we learn out of our own experience or reflection should be complemented with the knowledge we acquire from other people. That is especially true and worrisome when it comes to mistakes, which are repeated over and over unless due lessons are learned from them and are shared with other members of the firm, who otherwise would repeatedly stumble on them. As the philosopher put it, those who cannot remember the past are condemned to repeat it [7]. By not transferring knowledge internally, engineering firms are recurrently repeating the same mistakes and are not widely benefiting from isolated, successful practices. Can engineering firms continue to afford such waste of their most valuable asset? A perfect illustration of the unfortunate situation experienced by many firms was the famous statement made by Jerry Junkins, president of Texas Instruments, when he said 'if we only knew what we know!'; some time later Lew Platt, from HP, lamented in a similar manner [8]. Knowledge sharing is recognized as a key and true characteristic of a learning organization. It is people that generate knowledge, not institutions per se, but the fact that someone learns does not automatically imply that the company he works for has also learned; that knowledge has to be transferred to other individuals in the organization, who have to absorb it, understand it and put it into practice for the organization to say that 'it has also learned'. The very first step towards solving a problem is to have a thorough understanding of its nature and root causes. Without the proper diagnosis, it will be sheer luck if the adopted remedy is successful. In pure medical terms, diagnosis can be defined as the act or process of identifying or determining the nature and cause of a disease or injury through the evaluation of the history of a patient, his examination, and the review of pertinent laboratory data. In the context of this paper diagnosis will be understood as the identification of the root causes for the undesired lack of sufficient knowledge sharing and transfer within organizations. Such diagnosis will faciliatate the adoption of the appropriate remedial actions.

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2. Knowledge Diffusion Versus Knowledge Sharing

An undisputable goal for all engineering firms, especially in today's extremely competitive markets, is to effectively and efficiently put to work their best asset, that is, the knowledge possessed by their employees. That requires that such knowledge is identified and made available to all other parties in the firm that could benefit from accessing to it and putting it into practice [9, 10].

Knowledge sharing can be seen as different from knowledge diffusion; the latter conveys the idea of someone making available to others some possessed knowledge, for example through uploading documents in a common repository or intranet. Knowledge diffusion is indeed valuable, but in itself it does not guarantee that people will get to know of the existence and availability of that 'knowledge', nor does it ensure that if people know about its existence they will actually access it, read it and understand it, and even more, truly absorb that knowledge and put it into practice. Knowledge sharing goes one step further; it only takes place when in addition to a 'source' or an 'emitter' there is at least one 'receiver' who actually absorbs that knowledge and admits he has not just received it, but also understood it. This feedback coming back to the knowledge 'emitter' is the true verification that knowledge was shared, and not simply broadcasted. Figure 1 summarizes the main differences between knowledge diffusion and knowledge sharing.

Knowledge diffusion	Knowledge sharing
✓ Source is known; actual receivers may not exist, or may remain unknown. ✓ Receivers do not necessarily have to have direct communication with the source. ✓ Effectiveness of the knowledge sharing cannot be easily measured or tested. ✓ It can rely largely on technology (common repositories, intranets, and the like).	✓ Source and receivers exist and are known. ✓ Receivers necessarily have to have direct communication with the source. ✓ Effectiveness of the knowledge sharing can be easily measured or tested. ✓ It relies primarily on direct interaction and on the motivation of the parties.

Fig. 1: Differences between knowledge diffusion and knowledge sharing.

Several authors have already recognized that knowledge sharing requires, among other things, a source or emitter and a receiver [11-13]. That has led to thorough analyses of the reasons why knowledge does not flow easily, and instead it 'sticks' somewhere in the transfer process. In the rest of this paper we will address the problems associated with knowledge transfer.

3. The Invisible Barriers to Knowledge Sharing

What motivates someone to share knowledge with a colleague (whether a superior in the hierarchy, a peer or a subordinate)? There are a number of potential reasons, which can be divided into two groups, based on the motivation that the knowledge sharer has: those that are altruistic, and those that are self-centered. The altruistic motives are mainly the wish to help a colleague and the wish to foster teamwork and/or build team 'spirit'. On the other hand, the self-centered motives are usually the wish to earn reputation as an expert in a given field, the wish to earn the favors and/or sympathy of the recipient, and the wish to earn the rewards given by the company associated with transfers of knowledge (like bonuses, promotions, distinctions, and the like). It is worth reminding one of the more popular taxonomies for types of authority [14], the one that divides them into the following five types: coercive, reward, legitimate, expert, referent. Clearly one may be willing to share his knowledge if he wishes to be recognized as an expert in the firm, regardless of his actual hierarchical position and level of responsibility. There are many potential reasons, whether altruistic or self-centered, for sharing knowledge. Yet there is also a dark side, there are barriers or hurdles that inhibit or hinder the process of knowledge sharing in engineering firms. Even worse, many of these barriers or hurdles are rather 'invisible', that is to say, we are not always duly aware of their existence and presence. Because of that, knowledge sharing takes place generally at a rather low and unsatisfactory level. Using a marine analogy, proper identification of these barriers and of their root causes can help managers at the wheel (at company, division, project or team levels) govern the ship and be effective skippers in getting their crew members to share knowledge in a continuous an effective manner. Hurdles or barriers are 'additive'; that is, if for example an individual is not willing to share knowledge, and the firm in which he works is not encouraging the sharing of knowledge, odds are that knowledge will show a large degree of stickiness regarding its flow throughout the organization. As perceived by the authors as a result of many years working for different engineering firms, combined with teaching knowledge management issues and

following the practices held by a number of companies, the following could be the main hurdles to knowledge sharing among individuals in engineering firms.

3.1. Pertaining to the Individual.

The feeling that one has not been treated properly by the organization (for i.e, thru lack of promotion, recognition, or salary raise, ect) and thus he 'retaliates' by adopting such reserved and reluctant attitude towards knowledge transfer. Whether those feelings are really justified or not, some people develop those feelings over time and that constitutes a formidable barrier to knowledge transfer.

The feeling that one is competing with others (for a bonus, for promotion, for recognition, ect) and is thus not willing to help competitors, that could otherwise more easily beat him. Competition always exists to a lower or higher degree in engineering firms like all organizations are more or less hierarchical. Competition may be open or subtle, but to the extent that some individuals perceive they are competing with peers for rewards, promotion, they will be reluctant to share knowledge to others and that weaken his own relative position in the firm.

The lack of trust in the people one could be transferring knowledge to. Quite frequently the lack of a personal relationship of mutual trust hinders a potential transfer of knowledge.

Even if we strongly want the best for our corporation, we do not want it at our own expense; maximizing our own profit (in the broad sense of the term) normally goes against maximizing the overall profit of the organization. We all want the best for our companies, provided that it also means the best for our own development in the firm. Whenever those two goals, the individual one and the organizational one, are somehow in conflict, difficulties for knowledge transfer will rise.

Excessive workload, which prevents devoting time to talking to people and sharing knowledge with them. For a large number of reasons people tend to be overloaded with work, especially those that possess the most valuable knowledge, and that time limit that a day has for us all translates into very little time spent with others in general, and in particular transferring knowledge (which demands time and dedication), posing thus an almost insurmountable barrier.

'I do not get paid to train or teach others'. Quite often people state that they get paid 'to work', not 'to train others', as if the latter were note an essential part of the former!

I do not know things that could be valuable to the firm. As opposed to the arrogant attitude exhibited by some people, the other extreme is equally pernicious or harmful. Being humble is quite a desirable attitude, but people that are inappropriately humble tend to consider that their knowledge is not valuable and relevant to the firm, and thus do not even consider the possibility of transferring it to others!

'I do not know who could be interested in the knowledge I have'. This is especially true dramatic in the case of large engineering firms, with many employees at different locations, in which people simply do not know who else could be interested in, and benefit from, a transfer of knowledge.

The lack of motivation to transfer knowledge can result of the feeling that people might change jobs or firms. Although there are no comprehensive statistics available, many say that people change jobs every 5 years, which means working for an average of about 6 or 7 companies throughout the professional life. With such short stays in each company it is no wonder that people in general have little motivation for transferring their knowledge.

The fear of becoming less valuable or powerful by giving knowledge away. Knowledge is often called the infinite resource, as it can be given away without losing it. Yet, people are frequently reluctant to transfer their knowledge to others in the understanding that by so doing they become less valuable or relevant in relative terms in the firm, as they do not have any longer that differential factor of possessing certain knowledge.

The perception or belief that one is not good at telling or explaining things. Another derivative of inadequate humility is to think that one will not be capable of transferring to others knowledge that one accepts that he has. It is true that not everybody has the same communication skills, but when knowledge is available then its transfer should be sought, if necessary with the support of other colleagues that may be better qualified for the purpose of making knowledge explicit and get transferred to others

The doubt of receiving something back. Some people expect always something in return and thus will not be willing to transfer knowledge unless they clearly see what they will be receiving back, either from the firm of from the colleagues to whom he transferred part of his knowledge.

3.2. Pertaining to the Firm.

The 'not-invented-here' mentality. Some people might tend to disregard what has been done (or what is known by) other colleagues, as if implying that accepting to learn from them would mean own excessive ignorance.

Managers verbally encourage knowledge transfer but they do not practice what they preach, failing to become true models for the rest of the people in the organization. Without walking the talk, good words are just empty rhetoric.

Excessive scattering or dispersion of the employees in multiple locations, which hinders the necessary frequent contact that is essential, among other requirements, for knowledge transfer to take place.

Low personnel rotation within the organization, which limits the people and environments one gets exposed to.

Lack of previous recognition. When someone has transferred knowledge and afterwards became frustrated because the firm failed to provide some kind of fair recognition or reward (in the broadest sense of the term), his willingness to continue to transfer knowledge will be seriously reduced.

Lack of financial incentives to transfer knowledge. A financial reward is a true motivator for most people will feel inclined to share what they know.

Lack of promotion-related incentives to transfer knowledge. A reward in form of promotion is another powerful motivator for most people; in the absence of such type of reward, some people will not feel inclined to share

The nearest boss not fostering or promoting knowledge transfer. The more hierarchical a firm, the more powerful the immediate boss is; if the immediate boss does not actively preach and practice knowledge transfer his subordinates will very unlikely feel inclined to doing it themselves.

The immediate boss discourages sharing knowledge and experiences with members of other divisions or departments in the firm. Unfortunately it is common to see internal feuds and rivalries in firms, in which people can be even afraid of transferring knowledge to peers in other areas of the firm

The lack of means in the firm that would facilitate and enable knowledge transfer. Even when there is the will to transfer knowledge, some resources (meeting rooms, labs, facilities, intranets, common document repositories, and so on) may be required to facilitate the knowledge transfer process.

The firm does not organize in a structured manner the activities that would facilitate knowledge transfer (like round tables, internal seminars, discussion panels, and the like). If knowledge transfer is to be happening recurrently throughout the firm, appropriate activities should be organized in a systematic manner to act as catalyzers and facilitate them.

Knowledge transfer is not clearly stated as part of the job description. Unfortunately job descriptions do not normally include the need to transfer knowledge, and then such expectations come from the firm as an additional task demanded, thus being frequently rejected.

The firm does not record and explain previous successful stories of knowledge transfer. It is easier to continue with a successful and proven practice than to initiate it. Thus, when firms fail to record, document and explain success stories, they might raise barriers to knowledge transfer.

In order to determine potential barriers that inhibit knowledge sharing, we adopt a qualitative approach. A questionnaire based on individuals and organizational barriers as defined in previous parts, was specified and sent out to over 400 engineers in six countries in Western Europe. We used the likert scale in order to assess the individual and organizational barriers. Furthermore, respondents had to identify the top three reasons in their opinion that hinder knowledge sharing, ranking them from 1 to 3 in order of importance, and their second top set, of three reasons too, also ranked from 1 to 3 in order of importance.

Figure 2 summarizes the main data of the survey, run on a large number of people with selected demographics (ages within ranges 25-35, 35-45, and 45-55, to discriminate as per experience and level of responsibility in the firm.

Main Survey Data	
Number of individuals contacted	408
Number of companies	84
Number of countries	6
Number of people accessing the survey web page	160
Number of people actually completing the survey	150

Fig. 2: Main survey data.

In this paper only the most representative responses received are shown, in Figures 3 through 8. The responses to 'strongly disagree' and 'disagree' have been gathered, as those to 'agree' and 'strongly agree', leaving the 'neutral' responses.

Potential barrier	Responses (percentages)		
I have not been treated in a fair way by the firm in the past, so I am reluctant to help others in the firm by sharing with them the knowledge I have	Strongly disagree	54%	81 %
	Disagree	27%	
	Neutral	8%	8%
	Agree	9%	11 %
	Strongly agree	2%	

Fig. 3: Distribution of responses to potential Individual Barrier # 1.

Potential barrier	Responses (percentages)		
I do not get paid to teach others, so I do not share my knowledge	Strongly disagree	51%	81%
	Disagree	30%	
	Neutral	11%	11%
	Agree	7%	8%
	Strongly agree	1%	

Fig. 4: Distribution of responses to potential Individual Barrier # 6.

Potential barrier	Responses (percentages)		
I do not share knowledge because I want to remain in a strong position	Strongly disagree	35%	72%
	Disagree	37%	
	Neutral	17%	17%
	Agree	10%	11%
	Strongly agree	1%	

Fig. 5: Distribution of responses to potential Individual Barrier # 10.

Potential barrier	Responses (percentages)		
My nearest boss does not foster and promote knowledge sharing	Strongly disagree	4%	25%
	Disagree	21%	
	Neutral	11%	11%
	Agree	37%	54%
	Strongly agree	17%	

Fig. 6: Distribution of responses to potential Organizational Barrier # 20.

Potential barrier	Responses (percentages)		
My nearest boss discourages sharing knowledge and experiences with members of other divisions or departments in the firm	Strongly disagree	21%	63%
	Disagree	42%	
	Neutral	16%	16%
	Agree	17%	21%
	Strongly agree	4%	

Fig. 7: Distribution of responses to potential Organizational Barrier # 21.

Potential barrier	Responses (percentages)		
Knowledge sharing was not clearly stated as part of the job description when I was contracted, and it later came as an additional task demanded	Strongly disagree	22%	53%
	Disagree	31%	
	Neutral	23%	23%
	Agree	20%	24%
	Strongly agree	4%	

Fig. 8: Distribution of responses to potential Organizational Barrier # 24.

Regarding the selection of the top three set of barriers the results, summarized in Figure 9, left no doubt; as a barrier identified in position 1 is more important than another one ranking 2 or 3, an aggregate result was computed by multiplying the number of responses in each position times the weights in reverse order (weight 3 for position 1, 2 for position 2, and 1 for position 3).

Barrier	Results		
	Position	Number of responses	Weighted result
Lack of appropriate culture in the firm	1	54	248
	2	30	
	3	26	
Lack of infrastructure and means	1	28	196
	2	42	
	3	28	
Lack of training	1	22	154
	2	28	
	3	32	

Fig. 9: Main barriers to knowledge sharing as perceived by the respondents.

Based on the large number of responses, the following conclusions can be reasonably drawn:

- The results of the survey confirm the good willingness of the people to share knowledge; if knowledge sharing does not take place to the extent desired it is not because of lack of interest of the individuals.
- It is confirmed that people in engineering firms have no objection to knowledge sharing (in general people either 'strongly disagree' or 'disagree' to many potential reasons in both the individual and the organizational barriers).
- What is needed in engineering firms is: an appropriate knowledge culture in the firm, better means for facilitating knowledge sharing, and specific training.

The above results and conclusions reinforce the statements made by other experts regarding what constitutes a learning organization. There are three building blocks to a true learning organization, a firm that shares knowledge and capitalizes on it: a supportive learning environment, concrete learning processes and practices, and leadership that reinforces learning [15]. In a way this is good because it constitutes another piece of objective evidence

4. Recommendations to Foster and Enhance Knowledge Sharing

As an aftermath of the findings of the performed survey, there are no invisible hurdles that block or inhibit knowledge sharing. That is good news, as if there were a dark side type of explanation, the solution would be much more complex. People are clearly in favor of sharing knowledge, but the lack of culture, tradition and means in many firms creates an environment in which knowledge sharing simply does not take place, or happens at a very low level. With a better understanding of the actual reasons that inhibit a more widespread and effective sharing of knowledge in engineering firms, a number of recommendations can be issued to foster the sharing of knowledge in engineering firms. These proposals are not about the goodness of knowledge sharing, which is not questioned, but on how to make it more widespread and effective in the firm. Specifically, the following recommendations are identified:

- Develop a knowledge culture in the firm, in which knowledge is seen and recognized as a key asset and where knowledge sharing is stimulated and valued. Knowledge sharing is to be practice consistently from the very top of the organization, providing thus an example for the rest to follow. This has to be initiated at the very top, with the people having the highest levels of responsibility being the first to act accordingly and thus setting for the rest an example to follow. Such type of leadership will motivate other to follow until the culture permeates the entire organization or firm [16, 17]. Rotate people within the organization, and if for understandable reasons they cannot be permanent, at least organize temporal stays with people embedded in other environments (like short sabbatical stays). This will increase the exposure of people to other colleagues, other projects and other points of view in the firm, facilitating the identification of potential recipients for knowledge sharing. Furthermore, taking new posts within the firm will force many people to leave their reasonably comfortable situations and move into areas where they face new challenges; being more exposed to potential failures is a key driver in stimulating the learning process at the individual level

[18] duly channeled, individual learning can be capitalized and transformed as an asset in the organization [19].

- Set up the right incentive system, to include financial rewards, promotions, ect. Hierarchically-speaking not everybody can make it to the top, but that should not prevent everybody from getting the deserved recognition in the organization. For example, you may not make it to Division Director, or even to Project Manager, and still be widely recognized and respected leader in a given area. For instance, if someone is recognized as an expert in something, whenever those issues are discussed his or her opinion should be requested and considered, in spite of his or her post or level of responsibility.
- Collect and distribute feedback on knowledge that was shared and successfully used by the recipients to the benefit of the organization. 'Seeing is believing' and well-documented and honest feedback on successful stories of knowledge sharing can foster knowledge sharing, in a positive-feedback loop.

If the array of recommendations were to be summarized in a single word, then that word would undoubtedly be 'attitude'. We human beings learn by listening, we learn by seeing, and we value coherence. It is much easier to follow the issued recommendations that emanate from the top of the firm when the people with higher levels of responsibility in the hierarchy are the first ones to fully put them into practice. Technology can help, but it alone will not save the day. And that is fantastic news, especially for those companies or institutions that cannot afford huge investments in intranets or common repositories that, among others, facilitate access to documents created by other people. It is the attitude of those holding higher posts in any organization that can really trigger and catalyze the process of knowledge sharing in their organizations.

5. References

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