Knowledge management strategies in a national metrology institute

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Abstract. The members of national metrology institutes are involved in two main categories of activities: maintenance and dissemination of national measurement standards and research and development activities in metrology. On one hand, the "standardized" activities that involve a strong reuse of knowledge, and on the other, the expertise activities that make use of tacit knowledge of the team in order to produce new knowledge. Depending on the dominant type of model, an organization should implement a preferred type of knowledge management strategy. For the standardized activities, the appropriate strategy is codification based on a "people-to-document" knowledge transfer. For the "expertise" model, the most appropriate strategy is personalization, which involves the promotion of social networks and communities of practice. The paper shows the evolution of metrology institutes’ activities in the last 50 years and comments on the continuous assessment of the relevance of chosen knowledge management strategies.

1. Introduction to knowledge management strategy
Knowledge management purpose is creating knowledge within an organization, while many systems focus on the storage and distribution of information. To foster the creation of knowledge it is essential to understand its full scope. As a tool, Nonaka & Konno [1] suggest identifying two types of knowledge: explicit knowledge (quantified, written instructions and transmission by documentary means) and tacit knowledge (sometimes summed up in "know-how" acquired by experience but which include other dimensions such as individual mental patterns, beliefs, values). The challenge of knowledge management lies in the transmission and sharing of tacit knowledge that is directly involved in the creation of knowledge from information.

Knowledge, and its effective use within an organization, is closely linked to the organization's strategy. To manage knowledge, it is necessary to clarify the strategic objectives, identify the knowledge needed to achieve them, and examine what exists and what remains to be created. But strategic objectives are not the only criterion of choice in knowledge management. Hansen et al. [2] point out another essential aspect: the level of standardization of the products or activities of the organization. It distinguishes organizations that offer standard products or services from those offering à-la-carte services. The former operate in a reuse of knowledge logic, the latter in a logic of creation of new knowledge. In the case of products, some have reached maturity, the others are innovative. And in the functioning of human capital, some rely on explicit knowledge, others rely more on tacit
knowledge for the solution of problems. This approach is also promoted by the European Committee for Standardization in its guide to good practice in knowledge management [3].

The strategy that meets the needs of an organization centered on the reuse of knowledge in the realization of standardized products is a strategy of codification that involves the majority use of explicit knowledge. Access to information is through a people-to-document system. For organizations that offer personalized services or innovative products, the codification effort is not justified because reuse is not systematic. These organizations apply a management model focused on personalization. Access to knowledge is through a "people to people" mechanism.

The choice of the dominant strategy has consequences for:
- IT investment: very heavy in the "codification" strategy, moderated in the "personalization" strategy (tools to facilitate communication);
- Human resources: people capable of reuse and efficient implementation of existing solutions for the "codification" strategy, people who are comfortable with problem solving for the "personalization" strategy;
- The type of training: classical group and e-learning or mentors and one-to-one;
- Rewards and evaluations: related to the performance of the contribution to the databases on one side, related to the direct exchange of experience of the other.

Studies on different sectors of activity (Hansen et al [2], Venkitachalama et al [4], Bosua and Scepeers [5]) have shown that effective organizations set up one of the two knowledge management modes. The suggested optimum is to focus 80% of efforts on one mode and 20% on the other. This may have implications for the evolution of the activities of the organizations because, if the type of activity changes, if the services become standardized rather than innovative, it is dangerous to maintain the same type of knowledge management.

National metrology institutes are involved in two main categories of activities: maintenance and dissemination of national measurement standards and research and development activities in metrology. On one hand, the "standardized" activities that involve a strong reuse of knowledge, and on the other, the expertise activities that make use of tacit knowledge of the team to produce new knowledge. The economic model is on the one hand "reuse" type and the other type "expertise". From the point of view of knowledge management these activities require different tools and techniques.

2. The case study of a national metrology institute

The missions of a national metrology laboratory have historically focused on putting the international system of units into practice and disseminating it to national economic actors or any other user of a measuring instrument. In Belgium, for example, this mission was defined in the national legislation in 1970. It also includes a knowledge transfer component. In practice, the SI transfer is done through calibrations services. Additionally, to ensure traceability and international equivalence a metrology institute participates in international intercomparisons and improve the implementation of references by implementing new developments.

An important part of the daily activity of a national metrology is traditionally dedicated to calibration. However, the establishment of accreditation systems for calibration laboratories has allowed the delegation of numerous secondary calibrations to private laboratories. In the same time, the technical complexity of realizing the standards has increased considerably and the evolution will go on with the foreseen redefinition of the SI in 2018. The knowledge transfer mission involves training-information and participation in quality audits of accredited laboratories as technical experts.
Another important historical development for the national metrology laboratories was the signature in 1999 of the Mutual Recognition Agreement (MRA) by the member countries of the CIPM (International Conference on Weights and Measures.) This agreement guarantees the equivalence of calibrations proposed by the national laboratories of the signatory countries. The actions needed to ensure national equivalence therefore increased during the start-up phase of the system and are now decreasing.

If we compare the situation in 1970 and now, we see a gradual evolution of tasks, ranging from repetitive activities and average complexity to more and more innovative activities and a higher level of technical complexity. Table 1 summarizes the evolution in Belgium from the perspective of the typologies of knowledge management strategies introduced by Hansen et al. [2]: reuse and expert economic model.

Many studies show that knowledge management requires, in addition to the choice and the implementation of the main strategy:

- The implementation of the second strategy, in a smaller proportion (80% - 20%) - an organization can not totally ignore the benefits of coding or using tacit knowledge across communities of practice or personalized learning;
- Continuous assessment of the relevance of the chosen model to the strategic objectives of the company and the evolution of its activities.

Table 1. Evolution in time of different activities’ share related to the missions of a national metrology institute and evolution of the sharing between “reuse” and “expert” economics.

| Mission                          | Activity                     | Model  | Share in 1970 | Share in 2000 | Share in 2010 | Share in 2017 |
|----------------------------------|------------------------------|--------|---------------|---------------|---------------|---------------|
| Maintain and disseminate standards | Calibration                  | Reuse  | 55 %          | 30 %          | 25 %          | 20 %          |
|                                  | Traceability and international equivalence | Reuse  | 25 %          | 35 %          | 25 %          | 15 %          |
|                                  | Improve calibration capabilities | Expert | 10 %          | 10 %          | 10 %          | 10 %          |
| Metrology knowledge transfer     | Technical audits             | Reuse  | -             | 10 %          | 10 %          | 5 %           |
|                                  | Support to legal metrology and regulations | Reuse  | 5 %           | 5 %           | 5 %           | 5 %           |
|                                  | Training                     | Reuse  | 5 %           | 5 %           | 5 %           | 10 %          |
| Foster innovation                | Technical consultancy        | Expert | -             | 5 %           | 10 %          | 20 %          |
|                                  | Research projects            | Expert | -             | -             | 10 %          | 20 %          |
| TOTAL share for REUSE economics  |                              |        | 90 %          | 85 %          | 70 %          | 50 %          |
| TOTAL share for EXPERT economics |                              |        | 10 %          | 15 %          | 30 %          | 50 %          |

a. Introduction of the international Mutual Recognition Agreement CIPM-MRA
b. Begin of participation in European Metrology Research Program EMPIR

From this analysis it appears that the coding strategy is perfectly adapted to the economic model in which most of the activities of Belgian scientific metrology were carried out until 2010. Following the CIPM-MRA and the implementation of accreditation the activities’ share changed: expertise activities...
have increased from 15% to 30% in recent years and this tendency was accelerated by the participation in the European Metrology Program EMRP.

The analysis also evidenced that, until now, the coding has been limited to activities related to calibrations within the quality system: knowledge generated in other recurrent type activities such as international equivalence or training / information is not systematically codified. On the contrary, the strategy applied for these activities is of the "people-to-people" type through group work.

The secondary strategy, the personalization, is not implemented in a concerted way and above all does not cover all the useful interaction levels. Due to the small size of the team, internal "people-to-people" interactions are naturally effective; but are neither valued nor exploited optimally. Aspects such as the transfer of expertise or learning from the team's experience are identified as weak points in an internal survey on knowledge management in the service.

The lack of personalization-style strategy is even more prominent when it comes to interacting with other teams that have the same interests or with stakeholders. For example, the training-information activity, which is of the "reuse" type because the media developed once can be used for many presentations, suffers from the lack of social networks that would keep the communication channels open with the clients to find out about their needs and inform them of changes in our services.

Contact with teams with the same interests is partially implemented through the participation of representatives in international technical committees and through the participation of all in targeted international conferences. But this contact is very limited (one meeting a year and a specialized conference every two years). Since calibration activities accounted for the majority of the activities and new developments were still based on the purchase of equipment, this was not a major problem before 2010. However, in the evolution of missions towards high-level expertise and research it is imperative to learn how to learn from other teams. Participation in the EMRP European research program will certainly facilitate the "natural" establishment of communities of practice, but it is also essential to promote within the team "personalization" as a knowledge management approach through individual contacts with members of other teams, short stays in another laboratory, participation in discussion forums on common themes.

3. References

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