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Human Resource and Knowledge Management System for Competences in Metrology using Information Technologies

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Abstract:
This article presents a proposal for the development of a Knowledge management system for the management of Metrologic knowledge. It was conceived to solve the problematic detected at some metrological organizations in México. It shows the revision of some information about HR problems, Knowledge management and Technology of education tendencies. The system is under development in the time this paper was written, however it is considered pertinent to present this information as a strategy that could be adopted by any organization concerned with metrology and on the other hand it expected to be improved with the comments of other NMIs (National Measurement Institutes) experiences.

1. Introduction: metrology in organizations and knowledge management advance review.

Measurement is a function that always goes together with any process, small or large. Measurement provides quantitative knowledge about the process, and provides elements for its control, adjustment or modification. Measurement in a company plays the role of the senses in animals and human beings, and the people that perform those functions become usually very specialized, after many years of experience.

Paradoxically, it is also rather common that when new people has to undertake functions of measurement, calibration, testing or verification, companies often find it difficult to identify appropriate education and training programs for them. Very often it is even difficult to define the required set of knowledge, experience and skills the new person has to have in order to be competent for the function. This situation could be caused by the fact that, metrology is considered as an enabling technology or infratechnology, it is below those considered as the key or core processes of most companies. The critical role of metrology and its full dimension within a company usually arises when there are severe problems in the processes that could be avoided if good measurements had been warranted. And the human factor with its knowledge and competences are the key aspect of all of it.

On the other hand, knowledge management (KM) has reached a state of maturity and productivity that cannot be denied. Successful KM programs that contribute to bottom-line results can be found in all industry sectors. Knowledge management technologies have matured and are being integrated into what Gartner dubs the smart enterprise suite. Certainly enterprise knowledge management practices and technologies are at a point where proven best practices demonstrate indubitable return on investment.
Nevertheless, an awful lot of KM programs that go nowhere after 1 or 2 years, and those that are successful take 5 years or more to become stable and the accepted way of doing business (French and Caldwell, 2004).
And that brings us to what is exciting for knowledge management and its relationship with Metrology training and learning.

There are some areas where KM is showing quick payback-knowledge-based:

- First, Customer Relationship Management (CRM). Traditional search vendors are playing in this space. This very same management system may be used by people performing measurement functions to share best measurement practices within the organization.
- Secondly, the new standard of accountability for business results within non-profit organizations and government agencies. Measuring systems should be accountable for their contribution to the organization results.
- Third and most importantly for the future of KM, knowledge workers themselves are investing time and money in "personal knowledge networking." Desktop personal knowledge search, instant messaging, Google, free VOIP, P2P file sharing and collaboration suites, social networks, RSS, are all making it possible for individual knowledge workers to take control of the management of intellectual capital within the enterprise. The people performing measuring functions may use all this Information, Communication Technologies

(ICT) tools to register, share and potentate the knowledge developed during their daily operations.

At this tipping point, enterprises risk losing control of their intellectual assets, and one could ask, what can be done to stop this loss. But considering the unyielding march of information technology that has made more and more information available to wider and wider audiences, the question that is better asked is: How can enterprises get value from their intellectual capital in metrology when they no longer control it? That is the challenge of the future for knowledge management in metrology.

The above information shows us that these kinds of practices are optimum for developing a metrology knowledge management system.

1.1 HR challenges

Literature on strategic Human Resource Management (HRM) indicates that HRM practices and systems contribute to the creation of a sustained competitive advantage for the firm (Arthur, 1994; Huselid, 1995; Macduffie, 1995; Terpstra and Rozell, 1993).

Resource and capacities theory of the firm and knowledge-based view of the firm consider knowledge-based resources as key elements for the achievement of a long term competitive advantage, as they fully meet the conditions proposed by Barney (1991): rare, valuable, non imitable and without substitutes.

Furthermore, there are several studies that find a positive relation between certain HRM policies or practices and organisational performance (Arthur, 1992; Pfeffer, 1994; Snell and Dean, 1992; Williamson, 1981).

From these studies we found that the following policies and practices are some of the main problems HRM face in the knowledge management system of their organizations.

a) The development of the human factor, hence the organizational knowledge is focused on the development of specialist workers instead of the development of the organizational knowledge. These situation leads to what is known as the knowledge vacuum. This situation develops when, lets say, only one or two metrologist understand the procedures, relationships and systems that are essential to the work of a team, department or division, and they have to be absent for a few days. Unless this operational knowledge has been captured prior to the employee’s departure, it disappears creating a knowledge vacuum.
b) The decision making of the development of the human factor is centralized. Instead of involving the human factor in each decision of their own needs and development carrier within the organization.
c) There are not effective systems to manage, and potentate the knowledge developed by the human factor. Most of the systems are made to satisfy the HR people instead of satisfying the needs of the operative process (measuring parameters, tolerances, measurement uncertainty, specifications, etc.) and the strategic objectives set by the organization leader.
d) The definition of the requirements that people performing measurement functions must meet, is made by HR people. The lack of involving the people performing measurement functions in the definition of their own requirements leads to erratic descriptions of their real work requirements, needs of training and of course performance measurement goals.
e) Training programs in the organization are built based on actual programs offered by external training institutions. Or in a better situation, HR people buys what they believe may be the best training metrology course for their people This situation leads to fulfill an indicator of HR people instead of fulfilling real needs of training of the people performing measurement functions in the organization. Most of the time, organizations do no save, record or register the knowledge developed by their people performing measurement functions, then the learning curve has to be developed again when a different or new employee takes over this job.
f) People performing measurement functions performance is made on the basis of activities instead of needed results that contribute to the achievement of strategic goals of quality and efficiency, such as: waste, time lost for reprocessing, etc. The performance system must address people competences to ensure the achievement of the desired results.
g) The organizational structure promotes individual work, especially at the field level where the people performing measurement functions work. The organizational structure must foster team work and competences of teams. Each team must be integrated by the people involved in a complete process. This includes the people performing measurement functions. In the long term, the organizational structure must enhance the core competences of the whole organization and contribute with more added value to its mission and stakeholders.
h) The high rate of rotation in organizations leads to the loss of skilled workers. This situation reduces an organization's ability to identify production problems and take corrective actions. In addition, the loss of intrinsic production knowledge significantly erodes their ability to sustain continuous improvement programs. This is

specially important when the people performing measurement functions leaves the organisation, since we have already mentioned that its training is long and very specialized. Companies are in dire need of ways to capture and retain the knowledge of their existing measuring knowledge development and transfer that knowledge to a collective information system that can be leveraged throughout a global manufacturing operation. Collective knowledge will effectively enable organizations to improve productivity beyond any econometric projections

1.2 Education Theories and Educational Technology

1.2.1 Education Theories

For this project, the case-based learning model and collaborative learning model are chosen for the following reasons:

• Using the case-based learning model, real situations can form part of the course content. These situations will represent cases that the learner should face during his daily work. This learning model can be carried out for one or more learners.
• The collaborative learning model is used so that the learners can communicate each other when they work on solving one or more cases by means of the exchange of their ideas and knowledge. This model is also used to carry out discussions among the learners and their instructors related to the course content as well as provide support from the instructors to the learners.
For more information consult the annex 1.

1.2.2 Educational Technology

For this project we consider the next educational technology:

- Working in group
- Certification
- Learning Communities
- Human interaction

For more information consult the annex 2.

1.3 Reference framework: CENAM and Mexico.

The National Centre of Metrology of México (CENAM) has among its functions the task of supporting education and training programs in metrology. This has been done for 11 years, since its inauguration in 1994. Also, a number of other organizations like high level metrology laboratories and training organizations have developed a significant number of training courses in metrology. However, a number of problems or areas of opportunity for improvement have been identified.

The most common are:

- Sometimes the training available does not fit the specific needs of the person or the organization.
- The background of the trainee candidates is very heterogeneous and many have very specific, personalized, requirements.
- To provide practical hands-on training is not always easy and involves higher costs of transport, facilities and personalized attention.
- The mobility of HR in young countries, with young industries, is rather high and very often the training provided is eroded.

Furthermore, companies looking for means to satisfy their needs in this area find out that there are not available ready-to-use, effective instruments for:

- Designing the required competence profile of people to meet a specific metrological function.
- Evaluating the competence level of candidates to meet a position.
- Training new comers to metrological activities and functions, both general and specific.
- Keeping and enriching the bank of knowledge that should be an asset for the company.
- Shortening drastically the training and induction periods of new people.

As we can observe, the problems facing organizations like high level metrology and laboratories and companies looking for means to satisfy their needs in metrology, are very much similar to those policies and practices that are the main problems HRM described in section 1.1.

Due to this similarity about problems facing on one side the industrial HRM people and on the other side the organizations where metrology is their core competence, and taking into account all the information about knowledge management and technologies of education, the MESURA Program, that was designed to provide integral solutions in metrology for industry, has given birth to MESURA-HR.

2. Objectives

2.1 Strategic objective

The final strategic objective of the project is to enhance the role of people and working teams that perform metrological functions so that, by these means, they increase their contribution to the objectives of their organizations and to provide greater added value to society.

For the fulfilment of this objective of the project, the program MESURA-HR has to provide a platform for an integral management of knowledge, human resources and intellectual capital in metrology in organizations.

3 Characteristics of the program

Besides the traditional methodologies and tools that any training or HR program has, MESURA HR has considered some advanced characteristics that make it a powerful tool for organizations:

- **Competence based.**
  Competences, rather than pure knowledge and skills, are the basis for development and evaluation of HR ability to perform a task.
- **Constructivist approach.**
  Meaningful learning is encouraged and considered for instructional development and training programs.
- **ICT use.**
  Intensive use of Information and Communication Technologies is done for the development of learning objects, knowledge data bases, interactive communication, virtual rooms, e-learning, bank of ideas, etc.
- **HPT organization.**
  When appropriate, the philosophy and approach of High Performance Teams is encouraged in metrology laboratories of organizations that are prepared for them.

- **Metrology Knowledge Management**
  The knowledge management concept and their practices are proposed for this project.

3.1 Competence based

Nowadays the trend about human resource management is focused in competence management.

Competence is defined as the set of knowledge, abilities, skills and aptitudes that a person demonstrate by means of their own performance and specific results.

The competence based human resource management implies the competence definition, competence evaluation and competencies development.

This project offers tools designed for competences recording and decision making tool. See figure 1.

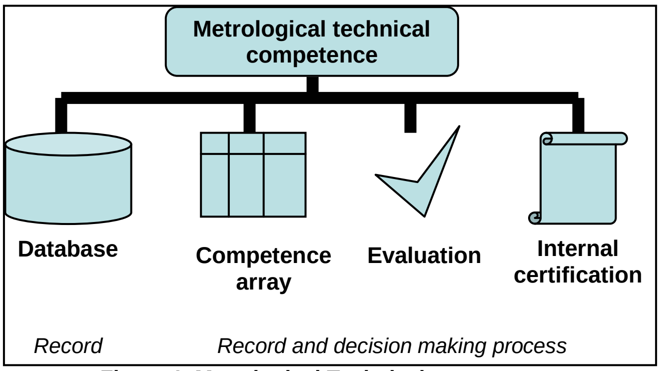

Figure 1. Metrological Technical competence

The ***database*** contains the competence descriptions needed in the enterprise. It is a tool for clarifying the functions and expected results.

The ***competence array*** contains the relationship between the competencies needed in the enterprise and the staff. This array allows to do levelling competencies and to obtain career planning and replacing cards for each people.

The ***evaluation*** is done based in the record and the achieved results. This allows us to evaluate congruent results and to obtain references for the training.

The ***internal certification*** allows to recognize the people in special way.

3.2 Constructivist approach

An e-learning module for basic metrology and a system to deliver information related to on-line training and events in metrology has been developed. The user needs and requirements specification of the Unit of Learning are obtained using a method based on the interaction design process. This process allows the use of any available technique, tool, or process for fulfilling each of its stages. Some of the activities are carried out at distance by means of computer-mediated-communication. Rita Pantoja [2005].

This method based on the interaction design process was selected because it is well-known and it is widely used to develop this kind of systems.

The e-learning module in basic metrology consist of two activities learn a lesson in basic metrology and make an assignment. The first activity consists of a learning activity and a support activity. The learning activity contains knowledge objects that form past of the lesson. The support activity allows carrying out discussions among learners or asking support to the instructor. This first activity defines two roles: Student and Facilitator. The Second activity has learning activities and support activities. The learning activities represent the steps to perform a case-based learning. The support activities allows to the learners carrying out discussions, receive feedback from the instructor, etc. The second activity defines three roles: Student, Facilitator and Evaluator. The support activities such as carrying out learning activities or discussions or providing support based on collaborative learning were selected.. These activities concretized the learning model: case-based learning and collaborative learning, Rita Pantoja [2005].

3.3 ICT use: Competence in Metrology Using Education Technology

On our research to find the best ICT technology, we found a lot of technologies available like interactive CD, animated web objects, films, and videoconferences. This last technology took our attentions because of its advantages, such as, to make the apprentice feel like if she or he were on the lab even when she or he can not be there for different reasons. So we decided to use this technology in order to complement the material to develop in the apprentice the metrology competences needed.

Using videoconference we can interact with the expert who can be in his laboratory and all the students can see all the practice and at the same time make their questions, or they can just see how they have to use the equipment properly. Also videoconference has the advantage of allowing the recording of the practice and then put it latter on the web, so the students can have access to the practice and learn it at their pace and convenient time.

Another technology that caught our attention was e-learning for the theoretical training material.

With these two technologies available we can choose between a lot of pedagogic methodologies available, to suit the best way of transferring the knowledge to the apprentices. On this way we began to use the Information and Communication Technologies for the Metrology knowledge training courses.

Always we had in mind that the technologies should be easy to use, so that the apprentices dedicated their time to learn Metrology not the Information and Communications Technology, so step by step we did videoconferences about some topics of metrology.

Then we began the production of some videotapes about calibrations, and use these tapes as part of the training material for some courses, this had a great impact between the students.

For more information about this section see annex 3.

3.4 HPT organization

High Performance Teams have many working advantages over the individual classical way of work.

First of all enhances the discussion as a way of solving problems (for instance measurement uncertainty budget or the selection of the appropriate standard) , which takes into account the different points of view from all team members. This form of committed participation gives a more solid decision making process.
Secondly, for many jobs the multi-skill practice is fostered. This leads to work enrichment and continual improvement of the different jobs that are overtaken by several members of the team (for instance, technical and administrative tasks).
Thirdly, and not less important, is the team responsibility for the process as a unity. The process way of viewing the work enhances the responsibility of each member of the team and encourages high quality products and services. An important application could be when the laboratory comparison is carried out.

3.5 Metrology knowledge management

The application of knowledge management in this project is related to the use of several tools described above in the section "Educational technology" that allows to learn, develop, register, preserve and share the metrology knowledge generated in the organizations and enterprises.

We consider the following platform as a standard one, where knowledge record tools, decision making tools and knowledge development tools are considered altogether. See figure 2.

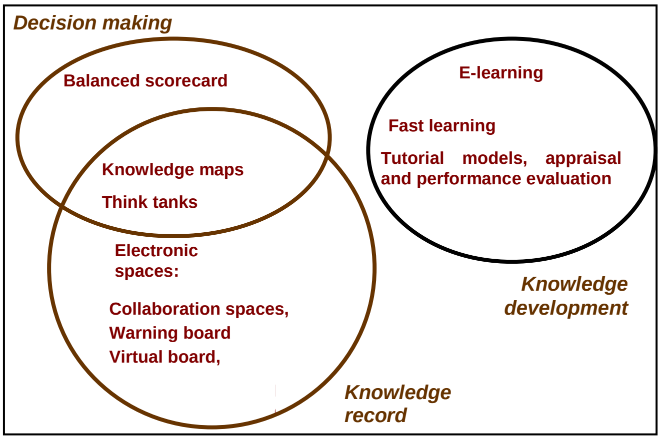

Figure 2. Metrology knowledge management

4. Methodology

The MESURA–HR program is proposed for implementation in the following stages, based on the MESURA Methodology:

All the stages described below must be developed, involving the people that perform measurement

functions if the organization is not conformed into process teams.
Short after a first cycle of implementation, and once the organization is structured into process teams. The team has to participate deeply into all the implementation stages.

i) Inventory: analysis of metrological functions and definition of competences needed according to the processes they serve in the company.
This analysis is based on a methodology used for designing competence standards of United Kingdom, New Zealand and México. It is denominated "Functional Analysis" and consists in developing the functions must be accomplished in an organization or enterprise splitting up the main purpose of the organization. The last level corresponds to those that are carry on for one person and has one evaluating result. The product of Function Analysis is the ***function map***. Once the function map is complete the competences are selected from this map and then are described.
It is important noting that the competence description is entirely accord the enterprise nature. In the metrology case, we don't obtain the competences in general metrology but we obtained the competence description for carry out the measures within the required measurement span and with the uncertainty required.
The analysis is performed taking into account: today and future Metrologic competence needs. This is important for an array of competences (knowledge, skills, experience and attitudes) must be drawn from this analysis. The array will take into consideration the competences needed today and those competences that will be needed to fulfil the vision of the organization.

ii) Diagnosis: competences needed vs existing, in every function; construction of empty bank of competences.
In this stage are evaluated the current competences for each people and the competence that person must acquire for reaching a desired level. For instance, a person that now is competent in the measuring verification could carry out calibration and would be selected the competences that person must develop in order to get the new competences.
In this stage are considerate the replacement cards and career plan.
All the information registered in the array of today and future competences has to be deployed to find out those pinch points (bottle necks) where the match of competences and Human factor may be a cause of knowledge vacuum. This pinch points must be listed and through a process of selection established by the organization (it may be a standard "Kepner Tregoe" alternative selection process) the list must be rewritten into importance sequence.

iii) Program: competence development, according to each function, choosing from a variety of means and learning objects, with intensive use of ICT. Before any program is developed, the organization should decide which platform of ICT will adopt. It is shown in the figure 2 above a suggested ICT structure, which is being developed at MESURA as a standard platform.
Once the organization has defined, and developed the ICT platform, the programming of training sequence may start.
The result of this program should include the relationship between the training items and the ICT tools that have to be used for that training. In some instances, as a result of this training the ICT tool will be a product deliverable. After selecting the set of competences for developing, it is designed the developing competences program. This program is based on e-learning in order to the metrologists could take advantage of their time in the trained required for get the competence desired.
In this stage are selected the knowledge management tools that the enterprise requires in order to preserve the metrology knowledge generated every day.

iv) Implementation: development of learning objects and means, development of material or use of existing, execution of programs, competence evaluation, HR certification.
The important aspect to take into account, when developing the training items, is the development of the ICT tool usage habit for all the trainees, since this will be the basis for knowledge development registration and sharing. This has to lead to a knowledge development management as a culture within the organization.

v) Continuous improvement: enhancement of the constructed platform with knowledge management, HPT, etc.
The very real growing of the knowledge management culture starts here. Many Knowledge management systems (KMS) fail at this stage (French and Caldwell, 2004).
The real secret for the success of this KMS is the persistence and support of the Metrology leader of the organization. The support must be given through the actions that facilitate the users of the KMS the access to the ICT tools. Another way to support the success of this system is the implementation of a measurement tool that reflects into the performance appraisal of the people that performs measurement functions in the organization.

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Annex 1. Education Theories

There are different learning theories in the literature. However, some theories quoted by people working on educational technology will be taken into account because the project is related to this kind of education. Thus, experts from this area such as Bates & Poole [2003] and Ally [2004] consider the behaviorism, the cognitivism, and the constructivism as the learning theories for developing effective online materials. The constructivist approach is considered for this project, because "*the learners can build personal interpretations of the world based on individual experiences and interactions (constructivist theory), rather than transfer knowledge from the external world into their memories (behaviorist and cognitivist theories)"* [Jonassen, Mayes & McAleese [1993]].

The main characteristics of Constructivism quoted by Conole & Seale [2004] are:

• Focus on the process by which learners build their own mental structures

• Pedagogical focus is task-oriented

• Favor hands-on, self-directed activities orientated towards design and discovery

• Useful structured learning environments, such as simulated worlds: construction of conceptual structures through engagement in self-directed tasks

Furthermore, Jonassen et al. [1993] describe three learning phases that characterize the knowledge growth in Constructivism: *introductory*, *advanced*, and *expert*.

In the *introductory phase*, the learners have very little knowledge about a subject or a skill. Thus, the learners do not have enough foundations to build a personal representation and hence, they should be guided by using practice and feedback. This can be provided by traditional approaches such as Behaviorism and Cognitivism.

In the *advanced phase*, the learners have more knowledge than in the introductory phase and they require to deal with complex and ill-structured meaning knowledge by means of coaching and apprenticeship. Jonassen et al. [1993] suggest the constructivist approach is more effective for this phase.

Finally, the *expert learning phase* can also be supported by a constructivist environment. In this phase, the learners have rich and coherent knowledge structures as result of their personal experiences. These phases should be seen as a continuous process of knowledge acquisition, rather than distinct processes.

There are different learning models that exist for the constructivist theory. A learning model is a concrete representation of a learning theory. The model consists of a set of instructional principles and directions that enable the instructor to implement a course.

Annex 2. Educational technology

Technology has always had a strong influence on the way of managing, developing, producing, and delivering education to the people. This influence has generated an area called "educational technology". It is defined by Bates & Poole [2003] as *"all the components of an integrated system necessary for using tools and equipment such as networks, PCs, software, audio and video recorder, etc., for educational purposes."*

Why has technology influenced on education? Because society has quickly adopted the new technologies in its daily life. At the same time, people have developed complex skills to use effectively and efficiently such technologies. Companies and institutions have also adequate technological infrastructure to it.

Some of the contributing fields to educational technology are distance education (e-learning, b-learning, etc.), learning standards (IEEE, SCORM, etc.), learning technologies (learning objects), computer-mediated communication tools (videoconference, e-mail, discussion forum, chat, etc.), human-computer interaction, and motivation.

For the purpose of this project is considered the definition wrote by Rosenberg [2001],*"E-learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance".* This definition describes the main purpose of this subject in the project: delivering education by using Internet, learning technologies, learning standards and other disciplines that allow modeling the pedagogical issues such as learning objectives and outcomes, individual differences, and case-based and collaborative learning models. This provides an efficient and effective education system for the learners.

The learning objects have many definitions that have been proposed by organizations such as the Learning Technology Standard Committee, ASTD, as well as by experts on the field such as Rehak, Mason, Wiley, Koper, and Cisco Systems. A broad and practical definition is that *"Learning objects are digital objects that have a stated educational purpose; and digital objects that are marked for specific educational purposes. Learning objects can be defined as any reusable digital resource encapsulated in a lesson or assemblage of lessons grouped in units, modules, courses and even programs. A lesson can be defined as a piece of instruction, normally including a learning purpose or purposes"* [McGreal 2004].

Learning objects in metrology could be developed and stored on repositories such as MERLOT, CAREO, SMETE Digital Library, etc. to be reused in various lessons. This is possible because their features are well identified by means of metadata, which facilitate the search, the evaluation, the acquisition, and the use of learning objects.

Computer-Mediated Communication is considered for the implementation of learning networks defined as *"group of people who use computer-mediated communication (CMC) networks to learn together, at the time, place and pace that best suits them and is appropriate to the task"* [Harasim, R., Teles & Turrof 1995]. That is, to permit the learners to carry out, before, during, and after an e-learning course, -including other activities-, face-to-face and online communications between instructors and learners by implementing a collaboration learning system, for instance, a virtual classroom.

Human-computer interaction (HCI) is *"concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them"* [Hewett & Verplank 1992]. HCI is important in this project, because the learners interact with an interface to reach the course content, the instructors as well as other learners, e.g., well designed user interfaces for computer simulations, multiple choices questions, virtual workspace, etc.

It is important to take into account how to motivate to the learners during the learning. In order to keep engagement from the learners in education to distance, we should consider several strategies to achieve it. These strategies according to Horton [2000] are:

• Working in group: The content of a course should have assignments that the learners should solve by working in group, but deadlines for the assignments should also be included as well. The working in group will encourage each other because they should accomplish the assignments at a given deadline.
• Certification: The course could be considered as part of a certification program. This means, the learner could get credits from the course and they will be taken into account for a certification program. Many companies promote their employees when they get
a certification.
• Learning Communities: This type of communities wake the interest of people for the questions or answer made among them. Moreover, the learners could express their ideas, misunderstandings or

misinterpretations related to the course or even other issues. In this way, they do not keep their doubts by themselves because they have means of sharing them.

• Human interaction: In the content of a course "live data" should be frequently included. This can be done by means of chat sessions or videoconference with the instructors or learners. The learner will feel that there is people around him whom are interested on listening, and whom can discuss (online) and receive a feedback at real-time.

In all these strategies the instructors have an active role because they should be able to observe whether the learners participated or not in the assignments, the learning communities, etc. If the learners did not do it, the instructors should know why the learners do not
participate and look for a rapid solution.

It is important to mention that the course should provide a mechanism for the learner to express his opinion about the course, the instructor, e.g. how to improve the course, etc.
Thus, the comments and suggestions made by the users should be analyzed for improving the course.

Annex 3 Competence in Metrology Using Education Technology

As we can see on the description of Education Technology, it has taken an important place inside the education process and more important if we are thinking on people who have developed the habit of self learning.

All those technology advances on telecommunications may be used to give the training information in a more efficient way. These technology advances may also help us to train on this important science such as metrology.

In order to develop some experience on this matter, we worked on a case which included the development of material on-line, this work took us over a year. During this year we did the analysis about the training material and created the informatics tools needed, also we proposed some multimedia tools that are on production. This work was part of the thesis for an MSc grade, of our co-author of this paper Rita Pantoja. At the same time we tried another tools such as videoconference and a web site.

Something important about this work was the decision to give the knowledge in metrology using every ICT tool we had access to, taking into account the metrology characteristics and facilitating the access an use to all our audience, because if something does not have the right quality or do not work right then the student can leave the training material and dessert from the training course.

First we decided about what we wanted to transfer to the auditorium, to make a change on the behavior of the audience who takes one of our courses:

- They have to know the right use of the equipment.
- They have to take in account the entire characteristic on the ambient necessary to make one practice of metrology.
- They have to understand, through one practice on metrology, about controlling all the variables that can be determinants on the results.
- They must observe all the movements of the experts on Metrology, and learn from these.

All these aspects presented us a big challenge, since we needed to show everything as if they were in the laboratories performing all the practice of Metrology. This abilities will not be learnt only in the classroom, they have to visit the laboratory, and practice. Here we faced another problem, because, in our case we have just one laboratory for each area of Metrology, were all the components most be treated carefully.

With this picture in mind we looked for something to use with the technologies available to show the complete frame on Metrology practice of laboratory. The most convenient technology was Videoconference.