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BUILDING AND GENERATING A CREATIVE AND FLEXIBLE WORK FORCE: KEY COMPETENCIES

Beatriz Muñoz-Seca*

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* Professor of Operations Management and Technology, IESE

Research Division
IESE
University of Navarra
Av. Pearson, 21
08034 Barcelona - Spain

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Abstract

The purpose of this paper is to concentrate on the competencies required for a flexible work force. It will therefore provide a frame of action and some concrete ideas on how a company can develop the key competencies needed to create a flexible work force. These competencies will provide part of the capacity for solving the challenges posed by our work environment.

The paper is divided into four sections. Section one concentrates on the definition and identification of competencies. Section two isolates the competencies that are critical in order to have flexible workers. Section three defines technological competence as key to the success of today's work force. Finally, the paper provides a frame of reference for the design of an action plan from the point of view of the (any) administration.

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Introduction

Today's world is in constant turmoil. News of companies merging, closing, restructuring or being created reaches us daily at the breakfast table. The main issue is long-term survival and, to achieve this, companies need to reduce response time, increase flexibility and provide excellence in service.

The rapid pace of change imposes a demand on the work force: *the need constantly to adapt*. Constant adaptation amounts to being skilled at solving problems, inventing new ways to approach situations and implementing new ideas. Creativity (generating new ideas) and innovation (implementing those ideas) are now essential in every sector, and are no longer exclusive to "innovative" companies.

Companies have to deal with clients who constantly change their requirements. As a result, they have a constant need for problem solvers. In addition to this, workers have to perform in an uncertain world in which new paradoxes seem to be emerging constantly. They have to find solutions to new problems, and companies have to rely on their employees' ability to find the solutions most likely to provide competitive advantage. We are living in an age of paradox in which "conflict and disagreement push employees to question existing premises and make sense of their experience in a new way" [13].

How does this fit with the European worker? Is our work force up to this challenge? Is our education system providing companies with a work force that has the necessary capabilities? The answer seems to be no. The education system is failing, and companies have to invest in retraining their work force, no matter what age, to give it a new profile. Even more painfully, the education system is creating widespread *illiteracy in the use of technology*. In a world that is becoming more technologically complicated every day, we are creating a work force that may not have the key knowledge, or competencies, to survive.

To add to this gloomy picture, unemployment is now the number one concern of European governments. The fallacy that European companies will be able to create the 20 million jobs Europe needs has gained currency. Clearly this is quite impossible. We are facing a crisis with clearly recognizable symptoms, but the diagnosis is inaccurate. In our view, the root of the problem lies, to a large extent, in the inadequacy of European workers' capability profile and in the crisis of the sociological model of the company as a provider of long-term employment.

Governments and administrations will evidently have to find new solutions to the old problem of unemployment, putting the emphasis on providing the individual worker with the backup and infrastructure he/she needs in order to generate his/her own response to the problem. Some of us believe that the answer is not directly to provide employment, but lies more in the administration's ability to *generate demand and market infrastructure*, which will lead eventually to the creation of employment.

In 1992, the company in charge of the World Fair in Seville (1), Spain, was considering how to use the event to create employment in Andalusia. Many new companies had been created just to provide the advanced services required by the Expo, services with very low demand, at the time, outside of this type of singular event. For instance, a number of virtual reality companies were set up to produce advanced, very expensive, one-shot shows for the Expo. We were commissioned to draw up recommendations on how to proceed. We designed a framework for the Andalusian government and the Spanish central government to create an infrastructure of demand that would lead to the creation of jobs in the area in the future. Thus, the answer [16] was not to generate direct employment, but to generate a set of (specially demand-oriented) infrastructure conditions that would motivate and sustain the new activities.

This type of proactive approach requires a great deal of coaching, assistance and education from all levels of government. However, we believe that the answer does not lie in the old solutions, but in new and imaginative ideas for an old problem.

A different profile of capabilities and competencies needs to be developed in the European work force. Europeans also need to acknowledge their need for survival skills and labor independence. Every worker needs to develop entrepeneurship and intrapreneurship capabilities. Companies cannot just lay off people. They should provide workers with the capabilities they will need to succeed in the world they have been thrown into. Time is against Europe and we need fast answers. We cannot indulge in academic debate when the population of Europe is immersed in an unemployment crisis. Some companies have already turned their backs on their governments and are finding their own solutions to these problems. Nonetheless, a coordinated effort by all institutions is needed to meet the great challenge of developing a competitive work force.

This paper will concentrate on the competencies required for a flexible work force. It will therefore provide a frame of action and some concrete ideas on the development of the key competencies needed to create a flexible work force. These competencies will provide part of the capacity for solving the challenges posed by our work environment.

The paper is divided into four sections. Section one concentrates on the definition and identification of *competencies*. Section two isolates the competencies that are critical in order to have flexible workers. Section three defines *technological competence* as key to the success of today's work force. The final section provides a frame of reference for the design of an action plan from the point of view of the (any) administration. I hope this paper will

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(1) The World Fair took place in Seville in 1992. The Spanish Government planned it in such a way as to respond to local development needs. The main purpose of the Fair was to act as a driving force for renewal and economic growth in Andalusia. EC regional development funds were invested in new roads and a high-speed rail link between Madrid and Seville. The Fair brought together people from all over Spain, representing a portfolio of knowledge and experience that could have been the key to developing the region. Unfortunately, much of it was wasted and lost, partly owing to the lack of vision of central and regional governments.

give the reader food for thought and help fuel a discussion relevant to the practical implementation of the ideas it contains.

Competencies: definition and identification

Webster's dictionary defines *competence* as "physical, mental, or legal power to perform". Work competencies have been considered relevant for centuries and can be traced back to the medieval apprenticeship system [8]. However, the word "competence" has recently acquired a status in which its meaning seems to have become diffused. It has suffered the same fate as the terms "quality" or "technology", whose meaning seems to have been lost, or at least to have reached a state of confusion. McLagan [8] analyzes the way the word "competence" is used in different contexts and with various meanings. Table 1 shows her analysis of the meaning of "competence", the characteristics of each meaning, and the level of detail.

Table 1. McLagan's definition of competence

Meaning of "competency"	Characteristics	Level of detail
Task competencies	Job activities	Subtasks
Result competencies	Abilities	Subcomponents
Output competencies: results for clients	Ability in an output	Subcomponents of outputs/standards to define them further
Knowledge, skills and attitudes	Subject matter, process abilities, attitudes, values	Identification of knowledge, skills and attitudes
Superior performer differentiators	People's abilities with roots in intelligence and personality. Distinguishes superior performers from others	Define intelligence and personality
Attribute bundles	Collection of knowledge, skills and attitudes	Identification of knowledge, skills and attitudes

It is easy to see how any discussion of competencies will be difficult if the word is given different meanings. Prahalad and Hamel [14], in their classic article "The core competence of the Corporation", define core competencies as "the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies ..." (page 81).

McLagan and Prahalad share a common point of view. McLagan, focusing on the individual, stresses the notion of ability, claiming that competencies are mainly the collection of *knowledge, skills and abilities* ("KSAs" she calls them) to perform a given task. Prahalad,

focusing on the corporation, talks about the union (or “bundle”, as McLagan calls it, with reference to individuals) of *skills and technologies* to attack problems. The similarity is obvious. Skills, abilities and technologies are simply knowledge at different levels. Skills and abilities are “concrete knowledge that allows the performing of a task” [9]. Technology is “formalized knowledge for action” [10, 17]. Coming back to the Webster definition, we could combine McLagan’s and Prahalad’s ideas and define competence as the *knowledge necessary to perform*. This has a very important implication: if our definition is correct, *we could identify competencies by identifying knowledge*.

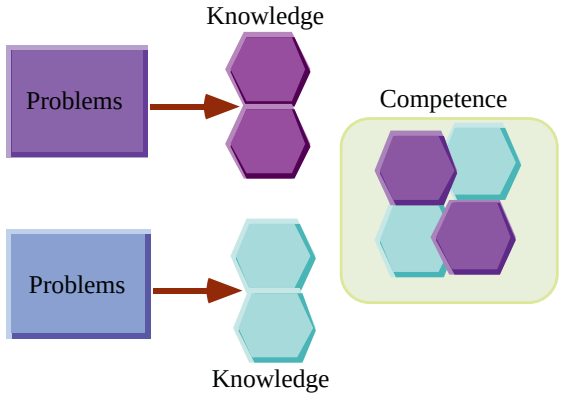
What do we mean by *knowledge*? The reader will be aware that this question has been pondered by the most illustrious minds in western thought, from Aristotle to the present. Obviously, in the company of these thinkers, one runs the risk of sounding trivial, if not utterly ridiculous. Therefore, we would ask the reader to refrain from deep philosophical considerations and remember that our purpose is strictly practical: we want to identify knowledge in order to define competencies.

Knowledge is stored in the individual, probably mostly in the neuronal interconnections of the brain. This makes knowledge itself almost impossible to observe. The difficulty in observing knowledge lies at the core of the problem of identifying and evaluating it. For centuries, educators, presumably trying to increase the inventory of knowledge in students, have argued about the right way of testing for its existence. Exams, tests, continuous assessment, etc. claim their right to belong to the set of experiments that allow the detection of knowledge. All these tools are based on observing the results achieved by the individual when engaged in *problem-solving activities*. This has led some authors to propose [16] that knowledge is the ability to solve a given set of problems, with a given effectiveness. Dealing with knowledge, then, is dealing with classes of problems and their solutions. This is observable and is what lies at the core of many tests that try to identify knowledge.

Inspired by extensive evidence, we claim that the only observable item is the result of the problem-solving activity, problem solving being carried out on the basis of a given piece of knowledge.

We are ready, now, to define competencies. If knowledge is manifested in problem solving, a competence can be defined as the structured combination of a set of knowledges. More precisely, *a competence is the organized cluster of knowledges that makes it possible to solve a related set of composite problems*. Figure 1 expresses this idea.

Figure 1



If we follow this line of reasoning, we see three outcomes:

1. The only way to identify a competence is by identifying its knowledge cluster.

2. The only way to identify the knowledge cluster is by identifying the problems that belong to it.

3. Problems are not alike, they have different degrees of difficulty. There need to be different levels of knowledge to solve different types of problems.

The first two issues do not fall within the scope of this paper. We refer the reader to [10] for a methodology for identifying knowledge. The third issue is relevant to the extent that it helps us complete our notion of competence.

The levels of Knowledge

There are many ways to associate levels with knowledge. In our work we have used five levels of knowledge. Four of them are well known [2, 21] and documented in the literature. The fifth, which we call “Know to Learn”, is new, although it has its roots in the “Learning to Learn” school [2]. Let us briefly define the four classical levels and expand on the fifth one. The levels of knowledge are:

1. *Know About* (KA): the subject has information on the status of some knowledge.

2. *Know How* (KH): the subject has skills that allow the procedural use of the knowledge.

3. *Know Why* (KW): the subject has skills to understand the logic of the knowledge and to reason about it.

4. *Know to Improve* (KI): the subject can extend the knowledge and modify its use.

5. *Know to Learn* (KL): the subject can modify the logic of the knowledge and has a *self learning capability*.

At the *Know to Learn* level, the individual is capable of constant improvement by seeing in each problem a challenge to be solved [9]. It is more than *learning to learn* (1). To relate the two ideas, [21] defines “Learning to Learn” as “the continuing process by which people come to, and are assisted to, make appropriate educational decisions and carry out instrumental tasks with successful lifelong learning”. In the same vein, Carnevale [2]

(1) Existing “learning to learn” theories can be classified into four main schools [2]: Behaviorist, Structuralist, Functionalist and Humanist. The behaviorists maintain that a learner’s behavior and learning can be shaped through predetermined structures. Structuralists argue that the human mind has the same function as a computer. Functionalists believe in learning by doing and that people will “learn to learn” mostly from practical experience. Lastly, the humanists believe that “learning to learn” is a natural process that needs only the appropriate surroundings to be successful.

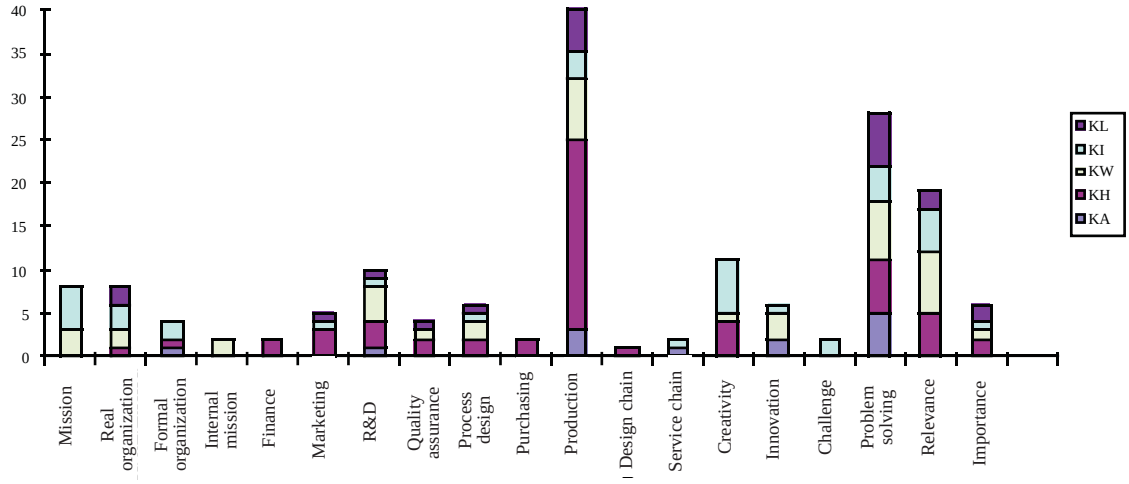
establishes the learning to learn process on the basis of learner needs, learning style and training. For Carnevale, this process is a must in order to maintain a competitive work force that can innovate to improve the product line and change to keep pace with advances in theory and technology.

But our Know-to-Learn concept goes beyond these ideas. *Know to Learn leads to a modification of the subject's mental structure and enhances its learning capabilities* [9]. Know to Learn results in improved problem solving. It leads to an expansion of human capabilities and thus to a better understanding of the self and others (humanist approach). This, in turn, fosters true motivation in the worker. González Simancas states that "the best motivation consists in getting people to know –and make their own– the reasons why they do –or must do– what they are asked to do" [9]. This is the reason why, whenever Know to Learn develops, problems are no longer seen as hurdles, but as challenges, and the worker feels intrinsic motivation towards solving challenges. One could say that we are substituting challenges for problems, and are thus getting a more innovative and competitive worker, the kind of worker that incorporates attainable challenges in his/her daily life. This means that the worker, through his/her own motivation, can improve his/her performance, develop new capabilities and thus increase his/her inventory of knowledge. People develop a sense of accomplishment that motivates them and makes them more productive. This is the type of knowledge that is needed in order to engage in constant innovation and improve performance.

In a research project carried out for DG XXII of the Commission of the European Communities [11], we identified a number of European companies that were actively pursuing these upper levels of knowledge through specific training actions. In our sample of 80 companies, we saw how they constructed a portfolio of knowledge levels in specific areas of the firm. The histogram in Figure 2 shows the areas and the levels of knowledge that we discovered in our research. The key shows the different types of knowledge, and the horizontal axis shows the areas of the company where the learning is taking place (1).

(1) We must warn the reader that there are some areas that will not be immediately understandable; these areas will be addressed in the next section (we are referring mainly to the terms "relevance" and "importance").

Figure 2



In this histogram, we can see that “Know how” knowledge is the commonest level. However, in most areas we also found explicit evidence of actions being carried out to acquire “Know to Learn” knowledge. The functional area that showed the highest level of initiatives to generate learning was Production, followed by the Problem-Solving activity.

For the purposes of this paper, the pertinence of the data lies in providing empirical evidence that these types of knowledge are being generated and sought after in companies all across Europe.

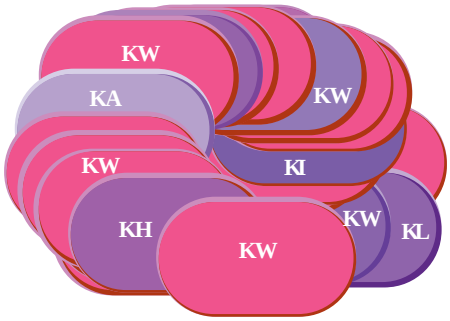
The full notion of Competence

There are different degrees of knowledge and this needs to be reflected in our definition of competence. Now, we are ready to provide the full definition of competence required for the development of this paper. To summarize:

> **A competence is an organized cluster of knowledges. This cluster is normally made up of knowledges at different levels. The competence is more than the sum of the individual problem solving capabilities, because of the synergistic effects among the component knowledges.**

Therefore, evaluating competencies has to be done by *evaluating knowledge and defining knowledge levels*. There are specific methodologies for conducting such evaluations and we refer the reader to [10]. Each individual has sets of competencies. Figure 3 suggests a possible structure for a competence.

Figure 3. The Cluster of competencies



Are all competencies alike? Do people have a differentiated set of competencies? In order to answer these questions we need to develop a competence typology.

Types of competencies

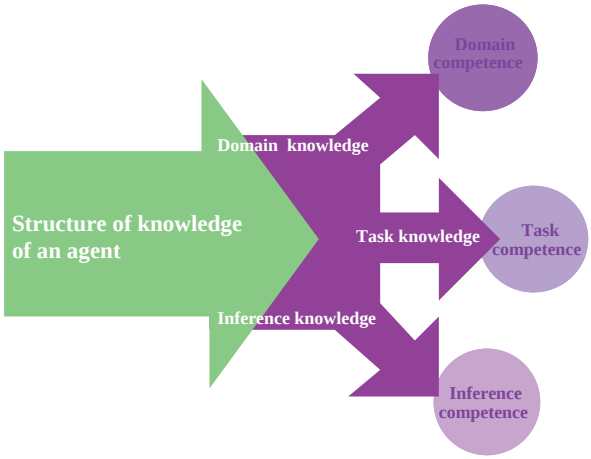
In order to present a typology of competencies, I propose to borrow some ideas from cognitive science. The cognitive science literature seeks to provide concrete answers to the problems of knowledge representation, and is focused on creating knowledge systems. At the present time a great deal of work is being done on developing knowledge modeling frameworks for building knowledge systems. This effort has provided the non-technical expert with a rich body of research on the operationalization of knowledge. It is from one of these pieces of research [22] that we take the starting point for the competence typology we shall present here.

In [22] the authors propose three categories of knowledge: *domain knowledge, task knowledge and inference knowledge* [22], defined as follows:

- *Domain knowledge* is relevant knowledge *about the system* that a task is about.
- *Task knowledge* relates to the *goal of the task, as well as the activities* that contribute to the achievement of that goal.
- *Inference knowledge* specifies *basic inferences that can be made* in the domain of knowledge and specifies the primitive reasoning steps. It relates to the ways in which rules can be combined to derive new information.

Translating these categories to the world of competencies, we come up with a typology that differentiates among *domain, task and inference* competencies. *Domain competencies* will be the competencies that *surround* the performance of tasks. *Task competencies* are the specific competencies required to perform the task. Finally, *inference competencies* will be the competencies required to *structure* the processes of knowledge generation. Figure 4 represents this scheme.

Figure 4. KADS definition, adapted to provide a competence typology



In order to compare our typology with others, let us go back to the original typology of competencies provided by McLagan. Table 2 compares the two. We find matches at the task and inference level but none in the domain.

Table 2

Mc Lagan	***KADs***
	Domain
Task competencies	*Task*
Result competencies	*Task*
Output competencies: results for clients	*Task*
Knowledge, skills and attitudes	*Inference*
Superior performer differentiators	*Inference*
Attribute bundles	*Inference*

As specified in [22], the "domain knowledge category specifies the forms, structure and contents... specified by different ontologies that provided partial coherent views". In our interpretation, *the domain* category broadens the scope of the concept of competence by including *related knowledge* that is needed to be competitive.

In the KADS *task* definition we can include three related aspects: The *task* per se, the *internal result* and the *external result*. This is knowledge specific to the problem that needs to be solved. This knowledge consists of skills, abilities and technological knowledge related to the task.

Finally, in *inference*, we will refer to the competencies needed to provoke the knowledge generation steps. In 1966, Gomersall and Myers [3] described a study performed in Texas Instruments on job performance, innovation and the required profile for a

competitive worker. They defined creativity, problem solving and lack of anxiety about the task as the most critical elements when it came to increasing workers' productivity and efficiency. In [12] we have defined the absorption of innovation, creativity, and problem solving as the critical elements in generating knowledge in an individual and in a firm. This [22] inference *structure* describes dependencies between these elements. In this paper, I will call them the *absorption of innovation, creativity and problem solving* inference competencies.

Summarizing, the KADS typology seems to provide us with a rich and focused means of differentiating competencies. Table 3 provides a summary.

Table 3

KADs	**Specific competencies**
Domain	Related knowledge that is needed to be competitive
Task	Related to the particular task
Inference	Problem solving
	Creativity
	The absorption of innovation

In the rest of this paper we shall concentrate on inference competencies as those that make a work force flexible.

Inference competencies

To define inference competencies we need to consider the process that lies at the heart of any work force that is subject to change: the process of learning. Learning is inseparable from change and is the critical element in a proactive work force. Argyris [1] defines learning as "a process in which people discover a problem, invent a solution to the problem, produce the solution and evaluate the outcome, leading to the discovery of new problems".

Adults [2, 5, 6, 21] learn mainly through problem solving, and to understand the process of problem solving it is essential to clarify what we mean by a "problem". We shall borrow Pérez López's [15] definition: "... a problem is the existence of a situation that is not agreeable for a person". In line with the above definition, we can define problem solving as "changing a disagreeable situation to one that is agreeable to the person, or bridging a perceived gap between what is and what ought to be". Thus,

problem solving is the most efficient approach to accomplish learning

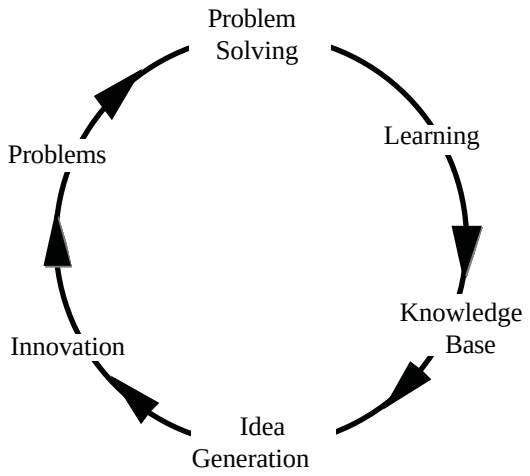
Now we need to probe further into the process and define the variables that are responsible for generating problems. What generates problems? If a problem is the existence of

a situation that is “not agreeable” to a person, defining what produces “not agreeable” situations could help us locate what produces problems. Anything that is “new” is the result of change. In any action situation, problems appear whenever the agent’s environment changes to include new situations. In business, change has been analyzed for a long time under the heading of innovation. But it would be a mistake to think only of major innovations. Most innovations in a company are changes in the way operations are done, often small changes that do not have a dramatic effect on the lives of the people affected by them. Innovation is simply doing things new or old in new ways. Innovation [9] is “creating and introducing original solutions for new or already identified needs”. Putting it all together, we can say that the main source of problems is change and that change is the result of innovation.

Thus, we conclude that innovation is the first-order provider of problems. Innovation is therefore the continuous and dynamic process of efficiently using the company’s knowledge base to do things, old or new, in new ways. It brings into the firm problems that need to be solved through a problem-solving process. A further important point in relation to innovation is the individual’s capacity to absorb the challenge that the introduction of an innovation represents. The key point is that innovation can be assimilated as long as the challenge it presents lies between certain bounds. If the challenge is too small, the problem is trivial, no effort has to be made to solve it, and very little learning results. If the challenge is too great, frustration ensues. The problem solver is incapable of making a dent in the problem, and feels frustrated and alienated from the environment.

In summary, knowledge is fed and generated by learning. Learning is generated by problem solving, and a higher level of knowledge will lead to the generation of new ideas for application. Generating new ideas is essentially formulating suggestions for change, which demands creativity. Now, creativity fosters innovation, which in turn generates problems that need to be solved, and the problem-solving activity itself generates learning. Thus, innovation creates problems, problem solving induces learning, and learning increases the company’s knowledge base, closing the circle of competitiveness. Figure 5 shows this circle, which we call the knowledge generation loop [10].

Figure 5. The knowledge generation loop

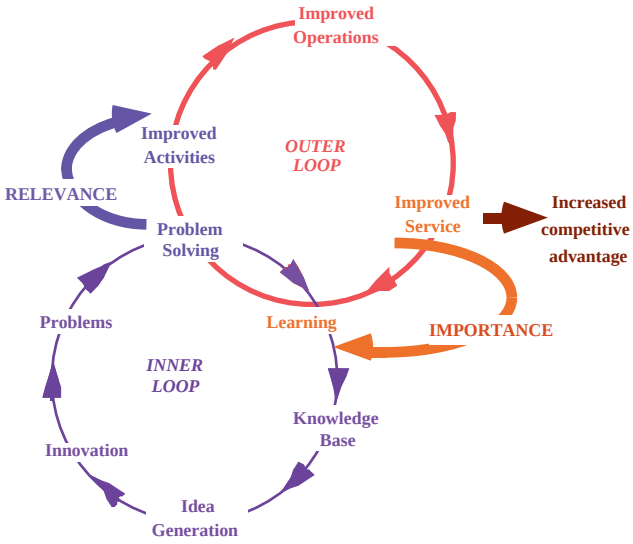


This virtuous circle of learning is a purely internal cycle: the company becomes wiser but not necessarily more competitive. It learns a lot and increases its knowledge base. But learning should be put to good use if the company is to achieve and maintain a competitive position. *We have to find a way of linking this internal cycle with the company’s*

competitiveness. The relationship between knowledge and competitiveness is given by another causal cycle, which we could call the external cycle. The main point to understand is that competitiveness improves when the problems solved are relevant to the improvement of the company's competitive advantage. *This relevance links the problem-solving activities with improved business activities.*

Similarly, the improvement in service needs to be a source of learning for the company. We call this feedback the *importance* mechanism. Both relevance and importance are mechanisms that relate to the idea of total quality, allowing the workers to hear the voice of the client and giving them feedback from client responses. Figure 6 illustrates this external cycle, showing the "relevance" and "importance" variables.

Figure 6. The external cycle



The above scheme justifies our earlier assertion regarding the existence of three basic inference competencies for a flexible work force. It also adds two mechanisms that link the competencies with the firm's competitive advantage. Table 4 summarizes them.

Table 4

Inference competencies	• Problem solving
	• The degree of challenge assimilation
	• Creativity
Competitiveness mechanisms	• Relevance
	• Importance

Developing Inference Competencies

Inference competencies are essential for the constant adaptation currently expected of the work force. But how do you acquire inference competencies?

We claim that:

> **Inference competencies are not inborn qualities; they need to be developed and generated.**

The first problem we encounter is that none of the European school systems *teach* these competencies (1). Who, in the educational world, is currently stressing that tomorrow's workers need to come up with these competencies (2)? The education system, both schools and universities, needs to realize that *inference competencies are becoming a critical need* for the new work force. They are no longer an added advantage or a differentiating asset, but a basic requirement for all workers in today's workplace.

Companies are investing a great deal of time and money in providing their workers with tools to acquire the three inference competencies. Much imagination is used in doing so. For instance, a company in the UK is providing free time to its workers to train them in how to learn. The workers choose a desired area of knowledge development (task competence, in our vocabulary), which is normally totally unrelated to their work in the company. The company's objective is to make the workers familiar with the *learning process* and thus capable of starting to learn the inference competencies required for their work in the future.

Returning to the project carried out for DG XXII [11], the data showed that enterprises were utilizing *training* as a way to generate inference competencies among their workers. Problem solving was the most frequently seen inference competence being developed by means of training actions. The composition of the inference competencies we found showed that companies were trying to generate in their work force all levels of *problem-solving* knowledge, whereas *creativity* and *innovation* were less frequently seen. Whenever they were present, the configuration of their levels was somewhat different. Figure 7 shows the composition and the number of companies in the sample that were carrying out focused training actions to develop inference competencies.

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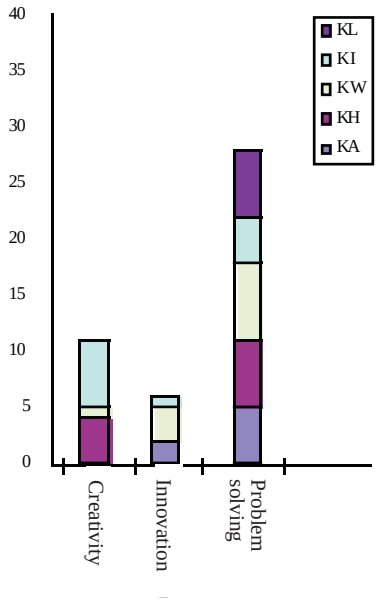
(1) At least, not to my knowledge. In the Expert Commission of DG XXII and in the Study Group on Education and Training, we discussed these issues and none of the Member State representatives presented any evidence that their school systems sought to develop these competencies.

(2) Of course, there are exceptions, both in Europe and in North America. As an example, we quote the following description from a colleague: "At the University of Michigan we are developing a teaching model for leadership (team building) based on competencies. We have identified about 40 areas, such as active listening, assertive behavior, goal setting, etc., that are important. Some of these will be taught as part of specific required courses, others will be included in optional courses, some will require independent study by students.

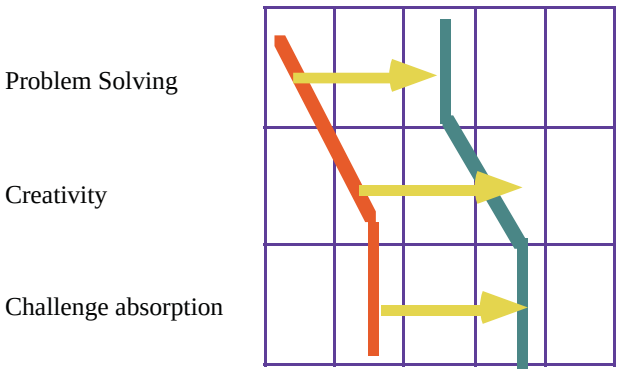
Figure 7



These data lead us to consider two issues: First, it might be possible to establish the *existing inference competence profile* of each worker, together with the level of specific knowledge. This would enable us to draw a *proficiency profile* for each competence. From this, we could obtain the desired level of each knowledge in each competence. A match between the two profiles could be accomplished through training or some other knowledge development activity. Second, a plan could be drawn up for specific training actions to develop inference competencies.

Figure 8 summarizes the above ideas by schematizing the actual and the desired profile of inference competencies for a worker. The arrows indicate the path that competence development has to follow.

Figure 8. The inference competency development path



An important question remains to be answered. We have seen that some companies are actively pursuing the required competence profile in their workers, but *who is doing this for those who are unemployed?* Are they becoming more *outliers*, acquiring only task competencies but not inference competencies? In the last section of this paper, we shall propose that specific programs be organized to develop not only task competencies but also inference competencies among the unemployed.

In the next section, we shall identify a final new type of competence which is required in order to be competitive at a personal level (1): *technological competence.* We present it separately since its nature seems to be somewhat different from the main competencies. The others are structural, part of the basic personal process of learning and improvement, whereas technological competence seems to be transient, the natural disequilibrium resulting from the rapid technological evolution of the past 15 years.

Technological competence

Jointly with the inference competencies, a new competence is emerging as a critical need in today's world: technological competence. We define technological competence as:

> **The cluster of knowledges that gives a person the capacity to interact in a satisfactory manner with the technological processes embedded in today's work world.**

This section is devoted to explaining this concept. We have two main concerns in this respect:

1. Lack of technological competence may represent a *handicap for the European work force.*

2. Lack of technological competence may widen the gap between the employed and the unemployed, *making the unemployed obsolete for the* challenges of future job opportunities.

1. Lack of technological competence may represent a handicap for the European work force.

Over the past few years the interface with technology seems to be emerging as a critical element in people's work. In learning a skill through multimedia, or sending a message via e-mail, technology is becoming the great modification of recent years. The term "technology" is used in a variety of contexts. Perhaps a definition will clarify the meaning it has in our work. In an earlier publication [10], we defined technology as *formalized knowledge for action*. Thus, we can talk about technologies as formalized bodies of knowledge.

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(1) We remind the reader that in this paper we are not addressing either task competencies or most domain competencies. These depend on the specific knowledge development of each individual and his/her area of expertise.

Technology is a body of knowledge that disrupts the basic processes that link the worker with the processes taking place in his environment. Technology changes the way elementary operations are performed. It opens windows of opportunity to create new relationships and different ways of processing old relationships. Nonetheless, this great body of knowledge rolls into practice bringing with it a great risk: *the technological explosion could make us technologically illiterate in many of the processes that surround us. We seem to be overcome by a wave of technology that exceeds our assimilation capabilities.*

Some companies are aware of this problem and have made conscious efforts to facilitate the assimilation of their technology through the end-user interface. And some have found in it an added competitive advantage. Apple computer, when it first designed its system, designed the interface of its Macintosh in a user-friendly way, with elements organized in a logical and predictable way. If you wanted to discard something, you just had to put it in the trash. If you wanted to find something, you just had to click on the icon and the items would appear (1). The others, PC computers, were difficult to understand. PCs had an interaction that only specialists could feel comfortable with, and processes were not organized as "logical processes". Apple's success was so tremendous that it changed the whole approach to the design of system software.

Is this a common approach? Unfortunately, it is not. The difficulties with the processes of the work world become apparent when workers do not know how to use new tools, as lately more and more managers have told me. It appears that the surrounding processes have become indescribable problems and that the time spent learning how to operate them is increasing at a tremendous rate. Workers seem to be overwhelmed as the pace of new introductions drowns us in a world of complexity. The *predictable* world has collapsed and the relationship among elements is no longer obvious. Conventional task knowledge and common sense are not sufficient to perform satisfactorily, we need to develop some "scientific" sense.

We are not, here, talking about a mysterious body of knowledge. *Scientific sense* might consist of elementary or back-to-basics [2] knowledge such as elementary physics, mathematics, mechanics or chemistry, but maybe *different* elementary concepts! We are talking about the need to define *basic technological knowledge* that is needed in order for the workplace to cope with the new relationships that are emerging. This concept should be added to the work performed by Carnevale et al. [2] on the basic skills needed to have a competitive work force. These authors [2] identified 15 skills, ranging from reading, writing and computation to adaptability, group effectiveness, problem solving and learning how to learn. Now, in line with the work done by Zuboff [23], we have to add another essential skill: the *ability to perform in the technological environment* (2).

When managers say that workers cannot understand the new machines, they may be talking about either of two things. Either the process of relating to the tool was designed in a poor, non-intuitive manner (more like the old PC system than like the Apple system), or the worker may lack the technological competence required to perform in the new work surroundings (3). Specific training in using the machine might not be enough. A deeper layer of knowledge may be required. Figure 9 illustrates this idea.

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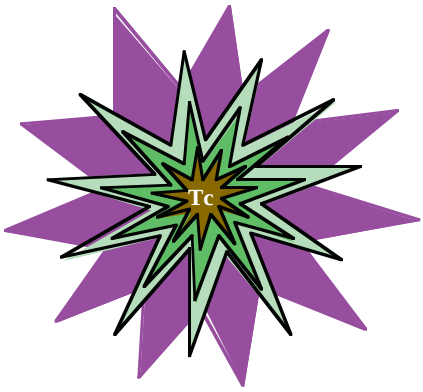
(1) In the Apple approach, an anthropological study was conducted in order to understand human processes and facilitate the use of the technology. This made Apple Computer a winner. Unfortunately, Apple's approach is an exception.

(2) It is inevitably going to be difficult to understand why a computer is not working properly if you do not have the background knowledge to realize that it is in fact not working properly.

(3) And some of the portfolio of task and domain knowledge was probably missing, too.

Figure 9. The structure of competencies



In the center of the star (in brown) we have the technological competencies. Surrounding the center (in different shades of green) we have the formalized knowledge and the task and domain competencies required to succeed in specific job performance. This is the competencies portfolio specific to the worker's field of expertise.

One might think that in order to solve the technological blocking factor, the work force would need to learn about specific technologies and, then, become comfortable with their use. But this is not true, since in many cases the portfolio of technologies that the work force has to be comfortable with is increasing day by day. Workers would need to learn constantly in order to assimilate the continuous changes. This is why the inference competencies need to be present to destroy this blocking factor. The inference competencies are represented in Figure 9 as the outer layer of the star (in violet). Research needs to be done to specify, and gain a better understanding of, the set of core knowledges that make up technological competence. To sum up, in the present state of technological evolution, *it is critical to add technological competence to the inference competencies. All are key competencies if we want to have a flexible work force.*

Here, again, we face exactly the same problem as with inference competencies. Technological competence is currently being developed in workers that already have jobs (1), and to some extent the school system (2) provides facilities for developing it among the younger generation, but *the unemployed seem to be at a disadvantage in this field.*

2. Lack of technological competence may widen the gap between the employed and the unemployed, making the unemployed obsolete for the challenges of future job opportunities.

The training programs designed for the unemployed are focused mainly on task and domain knowledge. A few address the need to learn about the specific use of a specific technology. But none, as far as I know, addresses the need to develop *technological competence.*

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(1) With regard to the older section of the work force, there is a clear need to assess their level of knowledge and design specific activities that will help them feel comfortable with this knowledge acquisition.

(2) I have no data on the other Member States, but going by what I know of the Spanish school system, the outlook is grim.

Often, basic computational abilities are taken for granted in the entire working population, and yet in some cases, and in some countries, workers have to be taught and have to learn basic computational arithmetic. Likewise, even if we assume some basic technological abilities [2], Europe's unemployed need to acquire the basic knowledge that constitutes technological competence. Specific courses might have to be designed in, say, elementary physics, mathematics, mechanics or chemistry, to provide the unemployed with the necessary core knowledge. Also, people who are in employment acquire a lot of knowledge through informal channels, in which knowledge is transferred "on the spot" by colleagues or superiors. The unemployed lack this opportunity.

This is certainly widening the gap between the competencies of the employed and those of the unemployed. Special measures are needed to tackle this situation.

An action approach: a framework

In this final section we aim to provide the reader with an action approach. Our objective is to build a framework that could facilitate the implementation of actions to generate Inference and Technological Competencies (ITC). We shall approach it from the Administration's point of view.

Other approaches are possible. We could approach it from the personal (cognitive development) or company level. In [10] we started to develop the company approach. Nonetheless, for the purpose of this paper, we believe that a comprehensive framework for ITC development from an Administration point of view is more appropriate. One of the main criticisms that can be made of many administrations (1) is the lack of coordination and synergy among the whole portfolio of actions, programs, and initiatives they have. In [11] we summarized our ideas in the following terms:

> The constant turnaround of companies and slimming of structures makes it important for European citizens to become conscious of the fact that labor conditions are changing. European citizens need to become competitive on their own and develop their own core competencies to find their own future. Companies can no longer bear the responsibility of full employment and we are faced with the challenge of job creation in a work force which has always been company-dependent. To do this, the European Commission and DG XXII face a tremendous task: *to initiate policy lines capable of encompassing this drastic labor and sociological change.* This will entail drastic changes in the whole spectrum of the knowledge providing system, starting with training bodies and finishing with schools.

To develop the action framework we can consider three elements: the *purpose* of the actions, the *recipient* of the actions, and the *desired effect* of the action.

- *Purpose of the action:* In our framework the purpose is to develop ITC.

Purpose

Problem solving	Creativity	Absorption of challenge	Technological competence

(1) Starting with the European Commission. In our report [11], we state that a comprehensive synergy effect must be achieved among the knowledge creation actions undertaken at DG XXII, XII, XIII and V.

- *Recipient of the action:* In our framework we identify four agents:

  1. *The working individual*, who might receive part of the assistance through his enterprise but who might also have to proactively look for assistance.

  2. *The individual not working or unemployed*, who does not benefit from the actions described above but needs specific assistance to reach the level of competencies employed workers are developing.

  3. *The enterprise*, which might need to become aware of the need to develop the necessary profile of competencies and might need assistance in doing so. We must remember that Europe is mostly small and medium-sized enterprises, which need specific action for knowledge supporting systems [9].

  4. *The knowledge providing system* (KPS). KPS encompasses the whole portfolio of institutions that are knowledge providers, starting with the school system and ending up with companies that are training providers. This whole spectrum of bodies needs actions to support the development of ITC competencies in individuals.

Recipients

Working individuals	The unemployed	The enterprise	KPS

- *Desired effect:* The type [9] of internal reaction we want to produce inside the recipient of the action. We shall consider three categories of effects: *Awareness, Access* and *Implementation* [9].

  There are needs that can be categorized in terms of the lack of *awareness* on the part of the recipient. Here, "awareness" means the realization of something not generally perceived. Awareness measures are those designed to make recipients consider what ITC needs they have and how these competencies could benefit their work life. They address the need to realize the urgency of ITC.

  Other needs can be categorized under *accessibility.* Here, "access" means attending to the recipient's "right to participate". This category includes all the measures designed to facilitate the process of *acquiring* knowledge for ITC competencies.

  The third category covers the special measures needed in order to *implement* ITC. It includes the measures taken to overcome every recipient's weaknesses when it comes to making ITC effective.

Desired Effect

Awareness	Access	Implementation

We can now place our three action dimensions in a matrix. This matrix interrelates the *desired effect, the recipient of the action, and the type of competence in the ITC group.* We have organized this three-dimensional matrix into two tables. Table 5 relates to the individuals (working or not working) and Table 6 relates to the external bodies, the enterprise and the knowledge providing systems (KPS).

With the help of this framework we can classify existing actions and analyze the need to carry out specific actions for all the agents involved in the pursuit of flexibility and excellence. An action by just one agent might not be enough, nor might an action that affects just one aspect of infrastructure. Agent and infrastructure measures are synergistic and both play a critical role in the development of a competitive work force in Europe.

Table 5

	Awareness		**Access**		**Implementation**	
	Working	N. Working	Working	N. Working	Working	N. Working
Problem solving						
Creativity						
Absorption of innovation						
Technological						

Table 6

	Awareness		**Access**		**Implementation**	
	Enterprise	KPS	Enterprise	KPS	Enterprise	KPS
Problem solving						
Creativity						
Absorption of innovation						
Technological						

Just to give an idea of how this frame of reference could be used, we have applied it to two samples. First, the Leonardo da Vinci occupational training project in Spain. Second, the training courses for the unemployed offered (1) by the Spanish Government (2).

(1) http://www2.inem.es/rigprubd/scripts/esparea.idc
(2) With and without the assistance of funds from the European Commission.

We have used our framework to see what kind of measures addressed ITC. We must warn the reader that we had only the course descriptions for the Leonardo Project. For the second sample we could access only the titles of the courses (via the Internet). No additional information was available for January 1998.

In the Leonardo project all the courses were mostly task oriented, none ITC oriented. Even the one called “Experimental plan for open training in the industrial sector”, oriented towards the acquisition of multimedia technology, did not appear to develop any technological competence.

An analysis of the courses offered to the unemployed showed an ample portfolio of task and domain competencies. There was no sign of any course on ITC, not even a quality course.

These preliminary data indicate that the need to develop ITC is probably met mostly through internal company programs. If our sample is representative, we can hypothesize that ITC development is not an objective of programs for the unemployed. If this is true, our assertion about the gap between the employed and the unemployed would be confirmed, suggesting that the gap is getting wider by the minute.

Conclusions

In the introduction to this paper we identified some of the elements and problems that might hinder the development of a competitive work force. These problems are present all over the industrialized world. Nonetheless, Europe has a differentiating factor: the high level of unemployment. The particularity of Europe’s unemployed work force lies in the fact that the gap of incapacity to perform becomes wider with each day that goes by. The unemployed are excluded from the stream of learning among employed workers, which is driven by the need for constant adaptation and to acquire the key competencies to survive.

1. We claim that specific measures need to be taken to develop ITC among the unemployed.

What is worse, the tendency for companies to reduce their labor force is increasing, and people are becoming a resource that needs to demonstrate its relevance in adding value to the service. This places a tremendous strain on all workers. They need to learn constantly, and uncertainty about the future viability of their job puts them in a stressful situation. They need help to cope with all these changes and, moreover, they need “to acknowledge their need for survival skills and labor independence”.

2. We need specific measures to help the employed work force to develop new approaches to their *future unemployment* problem.

In this paper we have addressed the question of the competency profile any worker has to have in order to have ITC. These competencies are not inborn but have to be developed in order to absorb constant change.

3. We claim that there is a pressing need to develop ITC in the entire European employed work force. Special measures are needed to help those enterprises that find blocking factors in developing ITC, specially SMEs.

It is a challenge that concerns us all, knowledge providers, enterprises, administrations. Proactive measures are required, as the risk of having an unprepared work force is growing daily. Our purpose has been to draw attention to this risk and shed some light on the composition of the necessary competencies. □

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