Science, technology, technique, management science and actionable knowledge

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ACADEMY OF MANAGEMENT 2004: CREATING ACTIONABLE KNOWLEDGE

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Introduction

Actionable knowledge is linked with its user: the practitioner. But this link does not mean that its content should only be a set of techniques. In relation with management science and management education, should it then be enough (or not) to formalize and to teach these techniques? This argumentation will try to show that the concept of technology is probably the closest notion to actionable knowledge.

Let us examine briefly the type of persons related with actionable knowledge.

If the practitioner is a person possessing the knowledge of his art and the mastery of the related practical means, the theorist is, by opposition, a person who studies the theory, the ideas, the concepts in his domain. But the theorist also defends the principles of a "scientific" doctrine.

Professional means the existence of a social link related with his identity (for a child, his parents' professions, for example). But it is also an activity made to earn an income. A profession qualifies a social position (the profession of accountant), as well as all the

persons exercising the same profession (the accounting profession). In management for example, a professional is considered as being able to reach his objectives because of adequate initiatives despite a relative absence of certain means or reference to uncompleted rules. This ability is the sign of his efficiency. The professional possesses a specialized and formalized knowledge. This specialization and formalization are his framework for judgment. The mastery of formalized methods (and related protocols) is a real barrier of entry in a profession. The professional is a reference for education institutions because it has to be trained in a specific way regarding a specialized knowledge but also in relation with a more or less formalized applied Ethics. In this sense, professional knowledge can be taken as a synonymous for actionable knowledge.

The scholar is someone who "knows a lot" or someone who copes with Science. The scholar dedicates himself by profession to the study and the development of Science. That is how he is distinguished from an artist, a practitioner etc..

But the main part of this argumentation will be dedicated to associated concepts to reach a better definition of actionable knowledge in front of those of Science, technology and technique.

Some related concepts

Action

The reference made to the concept of action allows an understanding on causal aspects and produced effects. The repetitiveness of effects is essential to formalize scientific laws. It is also what allows the distinction between an actor (the person who exercises the action) from a patient (the person who undergoes it). For a practitioner, authority and power should be tied. To act is a way of creating a hierarchy and ends on the question of what legitimizes this hierarchy with the concept of authority (the possession of knowledge justifies the right to act) and power (it is then the position, which justifies the action). Action is also related with efficiency. Action means taking into account the internal feeling of effort, the use of will and the outside demonstration of its effects.

Knowledge and competence

Knowledge is a notion in relation with the action of knowing and the known things. Knowledge is built to distinguish an object of knowledge as separated from other objects of knowledge. The perfect knowledge is, subjectively considered, what leaves

nothing in the dark. To know is to take an object of thought as given but also as seized in its nature and in its properties.

The competence is a capacity of action in relation with a possessed knowledge, this knowledge giving the right to act. But the competence is also connected with situations. The term of competence has induced numerous developments in management science, competence being understood in relation with human resources (the "trilogy" knowledge, know-how, behavior is then available) but also in relation with an organizational perspective. The notion of key competency is relevant for both cases but with different meanings.

Knowledge and practice

Knowledge is also the relation established between a thinking subject and some contents, formulated to be generally available through communicable propositions considered as true for intellectual reasons. Knowledge is opposed to faith, beliefs and ignorance. Knowledge is built on certitudes (or doubts) and induces assurance for someone who knows.

Practice concerns all that is in relation with the application of a knowledge and which aims on concrete action (by opposition to what is theoretical). But can we have practice without theory? Practical things also offer the maximum of advantages regarding the use made of them. There are evaluations (and comparison) among practices regarding the consequences.

Science

Science is especially seen as a set of knowledge and researches with an adequate degree of unity, unity susceptible to bring scholars to dedicate. Its "laws" should be never built on arbitrary agreements, nor interests or common tastes. It possesses a character of exteriority regarding those who refer to it. Science is a set of relations between elements of knowledge coming to make system. Science is separated from Letters, Law and Medicine.

Science is classified through the use of qualifying concepts: exact Sciences (Mathematics, Physics for example), Science of life (Biology), applied Sciences (application of scientific laws for practical purposes, industrial electricity for example), human Sciences (based on observable behavioral characters), social Sciences (which

emphasize the importance of life in societies, social Sciences being a category of human Sciences), moral and political Sciences (based on evaluation jusgments).

But qualifying Science is also to classify “scientific” objects. Science fiction consists in attributing scientific characters to imagined facts. Occult Sciences consider, at the same time, the secret character of these sciences and the mysterious character of the facts they have as object.

Qualifying adjectives serve finally for postures: normative Science (their object is established through evaluation judgments, standards being at the same time imperative and evaluative – for example Ethics, Aesthetics, Logic), positive Science (Auguste Comte's perspective who considered the necessity of entrusting positive scholars - those interested in the utility of things - for theoretical work on social reorganization).

Science is, at the same time, a report and a project by association of an object and “laws”, this set building a theory.

Technology and technique

It is first necessary to underline the confusion generally made between technology and high-tech (with information technology, for example). Technology is a specific fact, a conscious practice. Technology differs from Science by its object, the “technical reality”. But it is also related with Science through its spirit. Science is seen here as a methodical way of raising and answering problems. The concept of technology interferes with that of Science and concerns the study of technical processes in what they are general and in their links with the development of civilizations.

Let us remind three elements related with technology:
1°: The study of tools, machines, processes, methods used in various industrial sectors,
2°: A coherent set of knowledge and practices in a certain technical domain, based on scientific principles
3°: A general theory of techniques.
Technological education is constituted by the means necessary to insure the vocational training of professions required by industry and business.

Technology includes three kinds of problems depending the angle through which techniques can be envisaged:
1°: As an analytical description of the way to do, as they exist at a given moment given in a given society.

2°: As a research of conditions in which each technique is used, to which causes it takes its practical efficiency.
3°: As a study of the techniques, either it concerns the birth, the diffusion and the decline of each of them in a given society, or the evolution of all sets of techniques in the humanity.
The word technology (it is frequent in the use of the terms in "-logy") is also used to consider a set of techniques.

Techniques create what Nature is in the impossibility to offer. Techniques concern a set of actions which include an agent, a material, a tool or a mean of action on the material, and their interactions, which ends in the production of an object or a product. Techniques consist in a complete set of tools employed by human beings to do things with them. But do not forget Cornélius Castoriadis's remark (1975, *The imaginary institution of the society)*, Seuil, collection "essais", n°383) on the parallelism he established between the creation of techniques and that of symbols.

A technique is a set of processes and practical means connected to an activity. It contains also the idea of know-how, the skill of someone in the practice of an activity. It is also relative to the way through which a device, an equipment are functioning. There is the idea of the use of Reason.

To illustrate the duality technology - technique, let us quotes the definitions given Bernard Colasse in relation with accounting (*Comptabilité générale - PCG 1999, IAS, Enron*, Economica, collection "Management", 8 ° edition, Paris, 2003, pp. 8-9). He indicates that technology of accounting is made by "*the study of accounting as a technical object in search of truth and of legitimacy with, notably, the historic, cultural, institutional and socioeconomic dimensions"*. The technique of accounting concerns "*all the notions, methods and processes, based on empirical or theoretical knowledge, practiced by the accountant*".

The technological phenomenon contains the double reference to Science as a rational model and to techniques as objects and means. Numerous authors consider technology as a specifically human production (Marcel Mauss, *Essai sur le don*, P.U.F., Paris, 1950, Jacques Ellul, *La technique ou l'enjeu du siècle*, Economica, Paris, 1990, for example). Technology finds a moral and a political understanding with the concept of " technoscience " today (Hans Jonas, *Le principe responsabilité*, Cerf, Paris, 1993). Technology is also a concept with a very profoundly political contents, as indicated it Michel Foucault for example (*Surveiller et punir*, Gallimard, Paris, 1989). It is possible to establish a parallel between technology and capitalism as a political "order".

Technology (for example with Internet or mobile telecommunication) is profoundly political, as far as we are immersed in “technoscientifical” societies today. Technology and capitalism developed correlatively and ended in a technological ideology since the industrial revolution.

It is through the use of the concept of technology that at unwanted problems are brought ideological and material answers because the “technical progress” comes to solve them. Technology lives and with “abstract characters” tying up intrigues among them (Internet on one hand, the technical revolution of the other one, for example). With the term of “technical revolution”, Lucien Sfez (*Technique et ideologie – un enjeu de pouvoir*, Seuil, collection “la couleur des idées”, Paris, 2002) explains that a bridge is established between a world decreed “former” and another one, then decreed “new". Both worlds are building together a scenario of succession / replacement despite a "reality" nevertheless "always hybrid". He explains that stories are told about techno-political characters. They include “markers" of the technique which arise from the dissociation between a technique (with referents such as "profession", "engineer") and "science" (with referents such as "scholar"). For him, the first "marker" is the acquisition and the transmission of a technical knowledge on the basis of “protocols” which explains the distinction between a creator (engineer) and subordinates (technician) on a common language of signs. Would not it be what is also made with the concept of actionable knowledge? Another "marker" is the systematic aspect of techniques which, in interrelations, build "system", and legitimize the reference to the concept of “technical macro-systems”. Techniques and Politics build "beautiful" stories where it is question of progress like with managerial action. It is here question of "fictions", but “instituting” fictions of a political order. Reduced to "protocols", techniques are the way to do things, *in fine* organization.

Technology and actionable knowledge

In fact, the genesis of the technology comes from an accumulation of techniques and reference to scientific laws connected to these techniques. There is in a sense a "zoom" effect, which operates between techniques and Science via the reference to Technology. That is why there is a kind of vague aspect in the use of such a term. For example, Chemistry is one of the essential disciplines of "exact" Sciences. This discipline is based on associated laws, which are characterized by their repetitiveness when same elements are combined in the same way. From the point of view of techniques, this repetitiveness was remarked empirically like in the metal industry. Technology appears when the accumulation of techniques authorizes a conceptualization on these techniques, beyond the reference to a specific know-how.

Technology, with its suffix "logos", corresponds to a rationalization. It is a discourse on the logic of techniques. The “discourse on” makes understandable the “logic of”. In a way, organization is also an element of this "logic of", consideration important to understand the connection between technology and organization.

Technology has induced the substitution of a theoretical knowledge (like in engineering edication) to the teaching of a practical knowledge. It has also induced the subjection of the talent of the artisan (whose art of doing things is characterized by the superiority granted by know-how) at a theoretical, formalized and scientific knowledge. It is a vision of the human being at work in a world, which is no more that of the artisan. Technology allows the foundation of a world on a scientific rationality. Technology manages and forces action. But it also raises the question of action sensemaking.

Technology indicates a reference to “technical objects” susceptible to concretize it. The technical object is a model, which structures its producing its uses. For example, the machine presents the characteristic to be, at the same time a “full” general object and a particular object (a particular machine like a car, for example). “To think" a technological system does not imply to envisage all its “concretisations” in technical objects. Some are more important than others. The most important objects related with a technology embody it and induces its representations.

The ambiguity of the term "technology" comes also of its today’s American meaning. Our American friends now use the term of technology for that of technique (in an European meaning). Quite as for the Ecole Polytechnique, the project of the M.I.T. *(Massachussets Institute of Technology*) is to develop an education based on engineering techniques (to be able to conceive and to model) and to contribute to the genesis and to the enrichment of technology. But, for what concerns applications, American rather tends to use the term of "engineering" they borrowed Europeans by reinterpreting it. Europeans had created, before the 19-th century, the "military engineering" and, correlatively to the industrial revolution, the "civil engineering" and the "mechanical engineering". Engineering indicates that, to achieve a realization, it is not only a question of applying a technique as far as the scale effect requires the use of a methodology and methods. In other words, and always by continuing this example, to produce aspirin or explosives in mass production, it is necessary to organize their productions. And organization has to be taken into account.

Not surprising that Frederic W. Taylor, engineer, focused his attention on organization with the technological concept of scientific management methods as reference for an

"industrial engineering". It is also in institutions like M.I.T. and in their universities that American created the modern "engineerings" (chemical engineering, electric engineering etc.). Engineering like *re-engineering* take then a completely particular sense. It is interesting to quote the misinterpretations which were made, in Europe, with the notions of *re-engineering* and technologies portfolio, usually used as references in management science. In the same way, with the word *techniques*, American indicate the "flat" protocols of procedures.

More generally, it is possible to assert that, in a sense, the countries of the "German-Japanese model", that of the "industrial capitalism", have a vision which is closer to the first meanings given to the concept of technology. It is also why the so-called management of technology is very important in Germany, in Japan and is delivered in engineer curricula as well as in management curricula. It is partially, what is taught in France under the name of "engineering sciences": methods, how to model, industrial economy etc. On the other hand, these teaching programs are more "anecdotal" in the United States, particularly in management education.

Engineering is an activity: it is not only identified by a knowledge, in relation with a technical domain, as an attribute of the sociological category of engineers, in connection with the idea of adaptability, mobility or other characteristic. It is a precise and identified activity. The term of "engineering sciences" opens the conceptual field of Science to the idea of applied Science, where scientific models and field of applications interact.

Engineering phases and activities are defined in various methodologies of product developments (European and American) and are made of the following activities:
- Specification which is the activity consisting in defining requirements and characteristics expected from the product,
- Conception which is the elaboration of solutions aiming at satisfying the specified requirements,
- Development which is the materialization of chosen solutions,
- Validation which is the qualification of realized chosen solutions in comparison with the original requirements.

Numerous definitions of "engineering sciences" appear in specialized dictionaries, as well as in various official communications describing the functions collectively attributed to engineers. They emphasize, besides the classical engineering activities, managerial issues with the notions of coordination, project etc.

The criteria frequently quoted for engineer's curricula are competencies like conceptualization, analysis and synthesis abilities. These criteria are not really distinctive for engineering. They are shared by all activities in human, social or exact Sciences. Engineering is only specific because it is oriented toward conception and realization of socio-technical systems. There are numerous domains of application: from military to civil engineering, from chemical processes to computer systems.

It is however Frederic W. Taylor who designed a decisive model when he formalized S.O.L. (scientific organization of labor). It is based on three principles: the maximal use of investments, the abolition of useless movements and the division between tasks of conception, preparation and execution. It is useful to remind that S.O.L. is not only a set of principles, a simple method or a mode of organization but a technical and operational system and a project of society, a "doctrine" in a way. The “taylorian” organization is a complete system, which is not only based on tools and techniques (sheets of instructions, standard tasks etc.), but also methods (for the organization, the economic planning etc.) It as also induced an organizational structure separating the mastery, the functional support, the agents of execution etc. Numerous generations of researchers, academics and engineers participated, during half a century, in the elaboration and in the improvement of the “taylorian” system, writing uncountable publications and creating new professions.

The “taylorian” system is complete, reproducible and transposable so that it has been implemented in most companies. It has created an immense demand in organization systems and opened the way to a palette of engineering specialties in companies: production management (M.R.P. systems, the "pulled” streams, *Kanban*, just in time etc.), automation, safety systems, logistics, maintenance etc. giving life to close relations between technology and organization.

The relations technology - organization are studied on the following three postures:
- The technological determinism: the organizational choices are not seen as conscious but as the result of external constraints on which the actors has poor knowledge and they control weakly, the organization being the “product” of the technology. But there is a "soft" version of this determinism, which is often advanced when speak about technological contingency.
- The organizational imperative (inverse perspective): the organizational structure is decided according to the intentions of his designers, independently from technology and choices are supposed to be made through the choice of appropriate means.
These two perspectives are in fact as determinist and can be qualified of “engineering” conceptions.

- The emergent perspective: there is neither technological nor organizational determinism but an interaction of these two aspects with the social context. This perspective is clearly socio-technical.

Do not we have, with these three postures, the "matrix" of actionable knowledge?

It is then question, with actionable knowledge seen as a technology:
- To connect an object (the organization), visible through its technico-economic manifestations,
- With a concept (technology), visible through technical objects (those of information and communication, for example),
- Through the production of a discourse opening the field of realizations going in the sense given by this discourse through the use of creative metaphors like innovation, creativity, entrepreneurship etc.

Conclusion

Like for the relations between technology and its technical objects, most of the manifestations of an actionable knowledge in management science are at the same time object of knowledge and object of action.

It is then without doubt that the concept of technology is relevant for a better understanding of what is an actionable knowledge, on a knowledge perspective (management science) or an action perspective (management education), both being connected.