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Knowledge Crash and Knowledge Management

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Abstract:
Population ageing is a phenomenon that is quite new and irreversible in the history of mankind. Every country, every organisation (public, private, international etc.) is concerned. It is not certain that all the risks and challenges have been clearly identified. Clearly, there is a risk of massive knowledge loss ("Knowledge Crash"), (due, for instance, to massive retirements, but not exclusively for this reason). This risk is surely not evaluated at the right level.
This article, by including the problem of "Knowledge Crash" in the more general framework of "Knowledge Management", enlarges the concepts of knowledge, generation and knowledge transfer. It proposes a global approach, starting from a strategic analysis of a knowledge capital and ending in the implementation of socio-technical devices for inter-generational knowledge transfer.

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Keywords: Population Ageing, Knowledge gap, Knowledge Loss, Knowledge Crash, Inter-generational Knowledge Transfer, Knowledge Transfer process, Knowledge Transfer devices, Knowledge Management

1. *Introduction*

Inter-generational knowledge transfer is a recent problem which is closely linked to the massive number of retirements expected in the next few years. These retirements are caused by "population ageing", which is the situation of societies where the ratio of elderly people is growing. This phenomenon has two characteristics that are not well-known, and hence not really integrated into the solutions currently being put forward (OECD, 1996; UNFPA 2002):

- *The phenomenon is worldwide:* one often wrongly thinks that this phenomenon (often assimilated with the so-called « Baby Boom » phenomenon, which is just a particular case) is only occurring in developed countries with a low birth rate. But nearly every country in the world is concerned: it is sufficient to have a growing average lifetime, or a decreasing birth rate to have a population ageing phenomenon.
- *The phenomenon has never occurred before*: this is the first time in the history of mankind that ageing is growing like this, and, according to the UN, the process seems to be irreversible.

This phenomenon is worrying a lot of international, national, regional and local social groups, regarding the social, economical, cultural, political consequences. It will certainly change many things for investments, consumers, job markets, pensions, taxes, health, families, real estate, emigration and immigration etc. (Harper, 2006; Kohlbacher, Güttel & Haltmeyer, 2009).

A consequence of population ageing is, of course, ageing of the working population. Employment policies (especially for seniors) will greatly change. If nothing is done, the number of retired people will grow rapidly in the next ten years, and conversely the number of employed people will stay constant. According to the OECD's studies, this will pose a great threat to the prosperity and the competitiveness of countries.

Related to competitiveness, population ageing raises an unexpected problem. We now know that we have entered the "Knowledge Economy" where the main competitive advantage is an intangible asset in organisations (private or public), called "knowledge", the definition and the status of which is still being discussed (Foray, 2004). The massive retirement of a lot of employees is also accompanied by the loss of a lot of knowledge and know-how. The Knowledge Management discipline says that nearly 70% of useful knowledge in companies is tacit. That means that knowledge and know-how are compiled in the employees' brains and are very little elicited by using information bases, documents, databases. There is also a theoretical difficulty to elicit this kind of tacit knowledge. If this knowledge, which is not well

known, is critical in order to carry out some processes in the organisation, its loss must be considered as a major risk for this organisation. One must say that, nowadays, very few organisations in the world are considering this risk. Three levels of risk (and risk perceptions) are possible:

- Knowledge Gap, due to a re-acquisition of knowledge which is not sufficiently fast. This implies more cost for acquiring knowledge, loss of efficiency, delays in evolution etc. This is not perceived as a major risk
- Knowledge Loss, due to a partial loss of the organisational memory. This implies loss of production, quality decreasing, loss of market shares or clients … This is perceived as a serious risk, and has been already experienced by a lot of companies (DeLong, 2004)
- Knowledge Crash, due to a loss (often sudden) of a strategic capability of the organisation. This is a major risk for the organisation

Very few organisations are considering those risks, and envisage a catastrophe scenario from Knowledge Gap to Knowledge Crash (Streb, Voelpel & Leibold, 2008).

However, some sectors are very preoccupied. The nuclear domain worldwide has been especially concerned since 2002 (IAEA, 2006). It is in fact seriously exposed to knowledge loss, because it is "knowledge intensive" (i.e. based on complex and varied know-how), because it has experienced a "knowledge gap" due to the non-interest of the young generation and a long period of non-recruitment. Moreover, the safety and geo-strategic constraints, which are well known in this domain, add to the criticality of a "Knowledge Crash".

The public sector is also very concerned, as population ageing is growing faster than in other sectors (OECD, 2007). Regarding the number of public agents retiring in the next decade, maintaining the capacities for delivering the same efficiency and quality in public services is a very complex problem, and is closely linked to the risk of knowledge loss.

This issue is not really addressed in knowledge management literature (See for instance (Ebrahimi, Saives, & Holford, 2008); Joe & Yoong, 2006; Slagter, 2007). However, this is a true challenge for this domain (Kannan & Madden-Hallet, 2006).

Integrating the problem of the "Knowledge Crash" in the more general framework of "Knowledge Management" gives a new dimension to the inter-generational knowledge transfer problem. KM is a global approach for managing a knowledge capital and will allow a risk management in a reasonable, coherent and efficient way.

This is in fact a "symptom" of a more general and complex "disease". It gives new visions for the notion of generation and Knowledge transfer process: the risk of Knowledge Crash is also linked, to a lesser extent, to the phenomenon of staff turnover , the notion of generation is not only linked to age, for instance (Bourdelais, 2006) shows that the notion of ageing is a social construct, and that in our normalised societies, chronological age is unfortunately more and more a determining factor in the definition of the stages in a person's life ; the problem of knowledge transfer is very close to the problem of « Knowledge Sharing », which is a top issue for Knowledge Management .

This article addresses the question of using Knowledge Management methods for knowledge risk prevention. The main contribution of this research is a global methodology, starting from the highest level in the organisation (the strategy) to build step by step some operational solutions, in a coherent KM roadmap for the organisation. This methodology is complete, from strategy to information system, and then its implementation requires a important effort of the concerned organisation; It can be also partially implemented depending the problem addressed. In this paper, we just give a brief description of the methodology.

That methodology has been experimented worldwide and continuously refined during the last ten years. Some experiments have been documented in different languages, and we give at the end of the article some selected published case studies in English. This approach, built with a constant cross-fertilisation between theory and practice, is now robust enough to be deployed on a very wide range of knowledge problems in the next few years, including especially inter-generational knowledge transfer (Van Berten & Ermine, 2006); Boughzala & Ermine 2004).

2. Description of the method framework

The proposed method to implement an inter-generational knowledge transfer approach is based on three principles that give a sound basis for the three basic phases in an inter-generational transfer plan. These principles are:

Principle 1: Any organisation has « organisational knowledge » as a specific sub-system.

This knowledge is much more than the addition of all individual knowledge and it is more or less preserved through time in training materials (documents, data-bases, software etc.) or through individual and/or collective exchanges/transfers. This organisational knowledge is accumulated within the organisation throughout its history, and constitutes what we shall call the « Knowledge Capital ». The concept of Knowledge Capital as an intangible sub-system of the organisation is still controversial, because it contradicts the classical vision of the organisation as a system that processes information for operational actors or decision makers. This new vision for an organisation, seen as a « knowledge processor », is formalised in a

systemic and mathematical model, called AIK with the subsystems: A for Knowledge Actors, I for Information System, K for Knowledge Capital, which includes the knowledge flows circulating in the organisation. The full theoretical justification of that principle and complete model are given in Ermine (2005).

Principle 2: The organisational knowledge (the sub-system K) is a complex system.

The concept of "complex system" is the one given by the "General System Theory" (Von Bertalanffy, 2006). It is then intelligible and « manageable » by considering several essential points of view. We claim that these points of view are not numerous, and generic enough to be applied to any knowledge corpus, regardless of the domain of application. Moreover, as already said, the major part of the knowledge corpus is essentially tacit.

Principle 3: Knowledge transfer is a binary social process depending on the learning context.

Knowledge transfer is more complex than one might imagine at first sight. It must be defined according to two points of view (cf. for instance Argote (1999) or Szulanski (2000))

- A process based on a bilateral process between a transmitter and a receiver (individuals, groups, organisations) with an expected result and a given content as input.
- A social emerging process, depending on context and environment.

Based on these three principles, the inter-generational knowledge transfer approach must include three phases:

Phase 1: Strategic analysis of the Knowledge Capital:

The Knowledge Capital of an organisation is now considered as one of its most strategic assets. As we have seen, this asset is vulnerable and threatened by a Knowledge Crash (a massive loss of tacit knowledge, essentially). Therefore, a large plan of preservation and transfer must be designed and integrated as a strategic process of the organisation. But it asks a lot of « touchy » questions: what are the knowledge domains that are really threatened? Are they really strategic? Who has this knowledge? What are the possible and pertinent operational actions? How do you ensure the action plan that will be put into place in the medium term is aligned with the strategic objectives of the organisation etc?

To answer these questions, it is therefore necessary to perform an audit of the Knowledge Capital, guided by the strategy of the organisation and to propose a plan of action for knowledge preservation and transfer that is aligned with this strategy. This is this first phase, called the "strategic analysis of the Knowledge Capital", whose objective is to identify the knowledge domains that are "critical" in the organisation.

Phase 2: Capitalisation of the Knowledge Capital:

Among the critical knowledge domains identified in the first phase, a large number are candidates for a capitalisation action. This phase concerns critical and strategic knowledge domains with an important tacit component, where the tacit part is primarily owned by identified experts. In this case, the capitalisation means the collection of knowledge from experts, in order to formalise their non-written knowledge, with the objective of sharing with other people having the same or very close activities.

Phase 3: Transfer of the Knowledge Capital:

Capitalisation allows the added-value content of a knowledge domain to be collected and structured and thus to constitute a knowledge corpus (or repository) of the domain. One needs then to transfer this knowledge corpus to a community which must use it for its operational practices. The real problem of transfer arises here: how to design transfer devices from the capitalised knowledge corpus, depending on the objective, the target, the environment etc.?

In the following sections, we detail the three phases of the method, with the description of modelling tools and processes related to each phase.

3. *Phase 1 : Strategic analysis of the Knowledge Capital*

First tool for the strategic analysis: the cognitive maps

The strategic analysis is based on the modelling of the different components of the company, as described in AIK representation given above. The system A of knowledge actors is classically divided into two systems: the decision system (D), including the decision makers (especially top management), and the operating system (O), including the actors in the operational processes. In the proposed methodology, we give modelling tools for the subsystems A, O, D and K. We do not consider the information system I, because this system is fully analysed in information management or information engineering methods, which are complementary to knowledge management methods.

In the approach, we choose mapping as modelling tool. Mapping is an abstraction process which involves selection, classification, simplification, and symbolisation. When we want to represent our thinking, our experience, or our knowledge, we can construct a metaphorical map that adequately represents what is by nature invisible and intangible into something visible, concrete, and meaningful, which we call a cognitive map. The development of a map, in a general sense, is therefore the transcript in a graphic system of a set of data, processing these data to reveal the global information needed, and the construction most suited to communicate this information. The approach proposed here, for the strategic analysis of

Knowledge Capital, uses representations by "cognitive" maps, built on these principles, and validated by ergonomic studies.

To build a map from « cognitive » information, there is a famous methodology, called « Mind Mapping », created and popularised by Tony Buzan (Buzan & Buzan, 2003). This is the area of "Mind Maps", sometimes called mental maps, or heuristic maps or cognitive maps. This is an approach that permits the mental representation of one or several persons concerning a specific problem to be visualised graphically. Our method uses principles of Mind Mapping, but in a very controlled manner. There are four maps in our method, used within a strict framework, and with a strict use mode. Each map corresponds to a specific problematic, has a defined semantic and its own graphical symbolism.

In the strategic analysis of the Knowledge Capital, we build the cognitive maps of:

- *The strategy, supported by the decision system of the organisation (D).*

The strategy map is a simplified visual representation of the strategy of the company, as recommended in Kaplan & Norton (2004). This map is built from a central node, divided into different branches, called « strategic axes ». These strategic axes are then divided into sub-axes representing the "strategic guidelines", each being divided again into "strategic themes". The objective of this map is to represent the main strategic axes, guidelines and themes in a synthetic, mnemonic and intelligible way that is the best possible corporate strategy formulation.

- *The processes, supported by the operating system (O).*

The process map is a visual and tree-like representation of the business process of the organisation. It starts from the central node which symbolises the business of the company, split into the different business processes, split again into activities and sub-activities. The objective of this map is to represent the main current activities of the organisation. It takes into account the different business processes existing when the cartography occurs.

- *The strategic capacities, supported by the knowledge actors system (A)*

The strategic capacities map is a tree-like representation of the capacities required by the organisation in a business process to achieve a strategic objective. It is the result of the confrontation between the strategic objectives (symbolised by the strategy map) and the business processes implemented in the enterprise (symbolised by the process map). It is obtained by identifying and classifying the capabilities required by the strategy in different processes. The objective of this map is to highlight the capabilities required to achieve the strategic objectives of the organisation.

- *The knowledge, available in the Knowledge Capital of the company (K)*

The knowledge map (or knowledge domains map) is a representation, given by the knowledge actors, of how the knowledge domains are structured, the know-how or skills (the vocabulary is not yet set) which are useful and necessary to operate the different business processes. This map is broken down into knowledge axes (or themes), domains and then sub-domains. This map has the objective to represent the different knowledge domains (the « knowledge portfolio ») in the organisation in a clear and easily understandable way.

These four maps (strategy, processes, strategic capacities, knowledge) are key tools in our approach (see one example in figure 1).

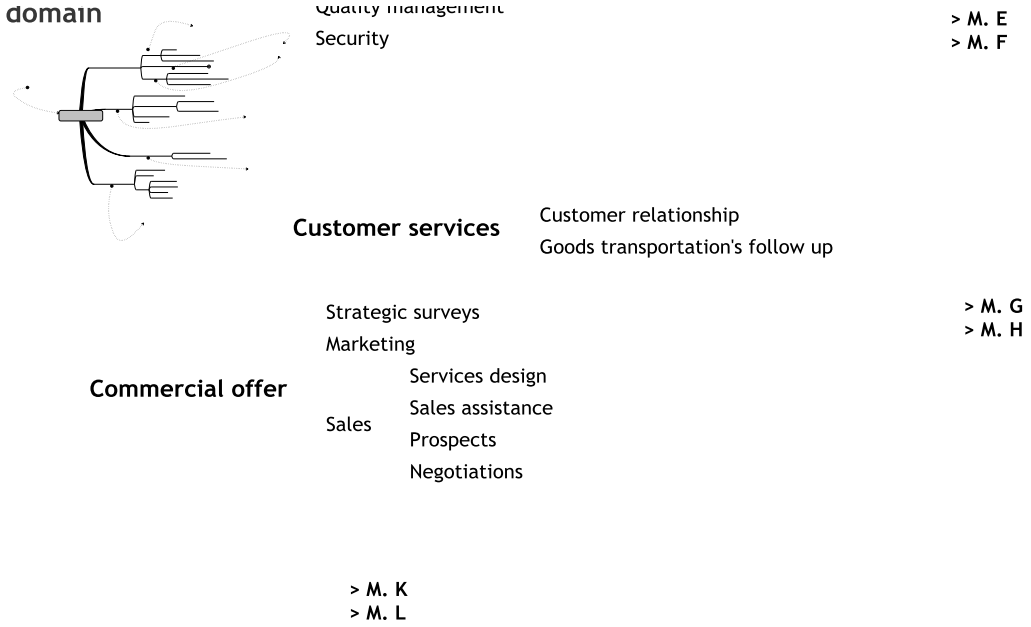

Figure 1: Example of a knowledge map

(with the names of referring people for each domain – so-called "name dropping"-)

Second tool for the strategic analysis: the critical knowledge factors

Our approach uses a set of critical knowledge factors, developed by the "French Knowledge Management Club". This set is composed of 20 criteria, grouped in 4 thematic axes. (cf. figure 2).

Each criterion is evaluated on a scale from 1 to 4. To facilitate the analysis and the notation, each level of each criterion is described briefly. It is not a normative description, but only a rating description (see an example in figure 3)

Evaluation of the criticality of one knowledge domain consists in rating every criterion for that domain. The higher the rate, the more critical the domain. Each domain is evaluated independently of the others. The method may lead to heavy implementation, regarding the number of domains and criteria used and if there are many evaluators. It is why we use tools to facilitate the evaluation task. Results are graphically synthesized in a "radar" (also called Kiviat) diagram and other Excel representations.

Finally, each knowledge domain is assigned a score that represents its criticality.

Thematic axes	Criteria
Rareness	• Number and availability of possessors • Specific (non- subsidiary) character • Leadership • Originality • Confidentiality
Usefulness to company	• Appropriateness to business operations • Creation of value for parties involved • Emergence • Adaptability • Re-usability
Difficulty in acquiring knowledge	• Difficulty in identifying sources • Mobilization of networks • Tacit character of knowledge • Importance of tangible sources of knowledge • Rapidity of evolution
Difficulty in exploiting knowledge	• Depth • Complexity • Difficulty of appropriation • Knowledge background • Environmental dependency • Internal relational networks • External relational networks

Figure 2: Grid of critical knowledge factors

TOPIC *DIFFICULTY OF USE OF KNOWLEDGE*
Criteria 17 *Complexity*
What is the degree of complexity of the knowledge domain?

Level 1 **Complicated**
The domain is very specific to a scientific discipline. It handles many but well identified elements.

Level 2 **Low complexity**
The control of the knowledge domain involves the control of many parameters which come from various disciplines.

Level 3 **Complexity**
The control of the domain is not reduced to the control of variables, even if they are many and varied. It requires a total and qualitative comprehension, which is expressed by various points of view giving sense to the domain.

Level 4 **High complexity**
The study and the control of various points of view are essential for the control of the knowledge domain. Methods and models are used to explain and make the various points of view coherent.

Figure 3: Example of evaluation of one critical knowledge factor

The process for the strategic analysis

- *Step 1: the strategic capabilities analysis*

The first draft of the strategy map is drawn up by using corporate documents (e.g. the strategic plan). It is then completed and validated by some actors of the strategy, such as heads of units or members of top management. The process map is drawn up by using quality documents describing the business processes.

Identification and evaluation of strategic capabilities consist in interviewing actors (2 to 3 hours) of the corporate strategy who have been identified and solicited beforehand (usually the members of the executive board).

The strategy and process maps are presented to the interviewee; they are used as tools of mediation. Then the interviewee is asked to consider each strategic axis, and indicate, axis by axis, what are the capacities involved in the operational processes (described in the process map), according to his/her own perception, in order to achieve the strategic goals. At the end, each capacity identified is qualitatively evaluated by its criticality level (is this capacity very critical, moderately critical or little critical?), based on the themes of the criticality grid described above: a capacity is more or less critical if it is more or less rare, useful for the company, difficult to acquire, difficult to implement. At the end of each interview, a synthesis of assessments and arguments is written up and submitted to the interviewee for validation.

When all evaluations are finished and validated, a summary is made to eliminate the redundancies, to homogenise the language, to group and to classify the capabilities. These capabilities, thus classified, are represented by a strategic capacities map, and each capacity is assigned a coefficient of criticality, developed through criticality assessments during the interviews.

This step of strategic capacities analysis corresponds to the new theories of strategy, called CBV or KBV (« Competence Based View » or « Knowledge Based View ») (Kogut & Zander 1996; Hamel & Prahalad, 1990; Teece, Pisano, & Shuen, 1997)

- *Step 2: The critical knowledge analysis*

The construction of the knowledge map begins by identifying the knowledge domains. Identification is performed from documentation reference and interviews, to highlight domains of knowledge (know-how, generic professional skills etc.) through successive analysis of activities, projects, products, etc. Formatting the map must be adequate to the

operational vision of the people concerned. This map will be used as support for the interviews during the evaluation of the criticality of the knowledge domains.

Subsequently, for each domain of knowledge, one has to designate reference people that will be interviewed for the analysis of their domain criticality. This step (called "name dropping") may be difficult, especially in large organisations. The credibility of the analysis is based on the legitimacy of the people asked. A knowledge map can be very detailed, but one must choose a level of granularity in the map that does not require too many interviews.

Criticality analysis takes place systematically with the criticality grid and rating procedure described above (Ermine, Boughzala, & Tounkara, 2006).

- *Step 3: Strategic alignment and action planning*

This step aims to compare strategic visions and business visions, and make relevant recommendations on Knowledge Management actions/devices to be implemented. These recommendations stem from cross-analysis of the strategic capabilities analysis (characterized by the strategic map of the capacities and their criticality) and the critical knowledge analysis (characterized by the map of the knowledge domains and their criticality). This cross-vision between strategy and business is called the strategic alignment. It allows "strategic dissonances" to be identified: from one side cognitive biases in the representation that business and knowledge workers have of the strategy and, on the other side, the representation the actors of the strategy have of the impacts of the objectives on professional knowledge in the business processes. Furthermore, the large amount of information collected during the interviews with stakeholders in strategy and business can be summarised, according to this strategic alignment, into recommendations for a Knowledge Management action plan.

This step involves several phases.

- Development of the influence matrix

To identify the influence potential of the strategic vision on the business vision and vice - versa, one writes a double entry array, a "matrix of influence" in which the correspondences between the knowledge domains and the strategic capabilities are marked.

Each domain and each capacity having a criticality score, a simple weighted average can be attributed to each item. This score is characteristic of the strategic importance and of the criticality of the item. If a strategic capacity is critical, if it impacts numerous critical knowledge domains, then its importance is high. Similarly, if a knowledge domain is critical, if it is affected by numerous critical strategic capabilities, then its importance is high. Finally, one can classify knowledge domains and strategic capacities in ascending order of importance.

- Identification of knowledge management actions

The arguments collected throughout the analysis at the knowledge or strategic level are of a great richness, and comprise many suggestions. The axes of reflection concerning the actions of Knowledge Management to be set up are defined for each knowledge domain and each strategic capacity.

These axes are argued:

- For the knowledge domains, on the basis of synthetic documents produced during the critical knowledge analysis and by striking points identified (they are about recurring elements highlighted during the interviews and which characterize the criticality of the domain: need for a knowledge sharing, tool, unsuitable training device, absence of knowledge capitalisation device, strong technicality of the domain, etc.)
- For the strategic capacities, on the basis of arguments collected during the interviews with the actors of the strategy.

To provide better visibility, these various work axes can be grouped in topics:

- Organization, when they are managerial actions
- Training, when the actions relate to training devices
- Capitalisation-transfer when they are actions of safeguarding, collection, division, documentation etc.

Within each topic, the actions of knowledge management are prioritised according to the rank of importance of the involved knowledge domain (or the strategic capacity according to the case)

In the next paragraph, we are interested, within the framework of inter-generational knowledge transfer, in the actions of capitalisation-transfer.

4. *Phase 2 : capitalisation of the knowledge capital*

In the audit conducted in phase 1, it very often appears that critical and strategic knowledge domains where the crucial knowledge is tacit, is embedded in the heads of a group of critical knowledge workers. That knowledge is threatened (by the departure of some people, for example) and must be transferred to other people. Our proposition is to collect this knowledge in an explicit form to obtain a “knowledge corpus” that is structured and tangible, which shall be the essential resource of any knowledge transfer device. This is called "capitalisation", as it puts a part of the Knowledge Capital, which was up to now invisible, into a tangible form. Therefore these actions require a process of converting tacit knowledge into explicit knowledge. This process, also called "externalisation" by Nonaka is central in the creation of

organisational knowledge as Nonaka noted: "it is a process that is the quintessence of knowledge creation because tacit knowledge becomes explicit as metaphors, analogies, concepts, assumptions or models" (Nonaka & Takeuchi, 1995).

The tools for the capitalisation: the knowledge models

Our approach chooses to use graphical models. This is a method based on knowledge elicitation with knowledge models. Knowledge modelling is a technique which started in the 1970s and ‘80s for artificial intelligence purposes, and has now been considerably developed to constitute a new kind of engineering discipline, called "knowledge engineering". Our approach uses and adapts well-known knowledge models and offers some others that are more original. This is a CommonKADS-like approach (Schreiber & al., 1999).

To analyse, represent and structure a knowledge capital with templates, the method is based on a theory of knowledge (adapted to the engineering) that is described in detail in Aries , Le Blanc & Ermine (2008), see also Matta & al. (2002). The knowledge is perceived as information that takes a given meaning in a given context. There are therefore three fundamental points of view to model knowledge: information, sense, and context (symbolised by the equation K = ISC). Each point of view is split into three other points of view: structure, function, evolution. This yields nine points of view. For information, the three points of views are classical: the structural aspect is modelled by the data structures, the functional aspect by the data processing, and the evolution aspect by dating and "versioning". Our method focuses on the other six points of view. From the point of view of meaning (sense, semantic), the structural aspect is modelled by concept networks, the functional aspect by cognitive tasks and the evolution aspect by lineages. From the point of view of context (pragmatic), the structural aspect is modelled by phenomena, the functional aspect by activities, and the evolution aspect by historical context. Here is a simplified description of models; an example is given in figure 4.

- *The phenomena model*

This is a description of the domain of expertise with general phenomena which is the basic knowledge related to the activity. These phenomena are the events that need to be controlled, known, triggered, optimised, inhibited, or moderated in the concerned business activity.

- *The activity model*

It is built by an analysis of the activity of the system that uses or produces the knowledge. The *activity model* is broken down into major phases (sub-activities) of the business under consideration, these major phases being linked by exchanges of data flow, material flow, energy flow etc.

➢ *The concept model*

The *concept model represents* the conceptual structuring of an expert, accustomed to working in a particular area. This structure is given in the form of a classification of concepts, the domain objects.

➢ *The task model*

The *task* model is a representation of a problem solving method implemented in specific know-how.

➢ *The history model*

The *history model* corresponds to the desire to learn more about what happened at certain times in the evolution of knowledge. It integrates the evolution of given knowledge in a context that is explanatory for this development, and allows the overall guidelines that led the knowledge to the currently perceived state to be understood.

➢ *The evolution model*

The *evolution model*, linked to the previous one, describes the evolution of ideas, concepts, technical solutions etc. in the form of a genealogical tree that keeps the memory of the causes and reasons that led to these developments.

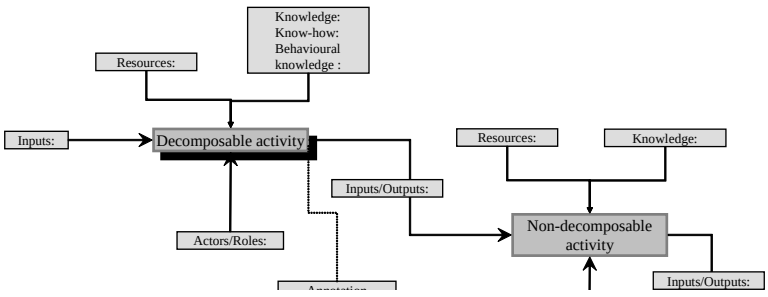

Figure 4: An example of a knowledge model: the activity model

The capitalisation process

The final product of the capitalisation process is called a "Knowledge Book", a metaphorical term which designates a set of structured elements of knowledge, essentially diagrams representing knowledge diagrams, and the associated text, but also publications, electronic documents, references and all kinds of documentation, digital or not.

The development of a Knowledge Book follows a specific process:

➢ *step 1: Framing*

The purpose of the framing phase is to delimit the knowledge domain on which the Knowledge Book is built, to identify modelling phases that will be useful to the objective. It allows the feasibility of the project to be validated and a work plan to be set up.

➢ *step 2: Implementation of the Knowledge Book*

The realization of a knowledge book is a complex process. It takes several tasks:

- Co-construct the knowledge models with the knowledgeable stakeholders.

Interviewing the knowledge holders provides a set of models with possible attached documents or references. Grouping some knowledge models and diverse elements of knowledge, one builds "knowledge chunks".

- Build consensus between the knowledge contributors.
- Design and produce the Knowledge Book.

This is an important work to design the architecture of the book and its presentation.

- Legitimise the Knowledge Book's content.

The knowledge capitalised in the book must be legitimised by a Peer Committee composed of peers recognised by the company

- Approve the Knowledge Book.

The Knowledge Book must be finally approved by the hierarchy. This is important to ensure that the capitalised knowledge is well and truly recognized as the company's knowledge and that it must be used as such.

➢ *step 3: Share the Knowledge Book*

The phase of sharing is fundamental for the success of the knowledge transfer operation. It ensures that knowledge is available to those who need it, so that they can use it in their business practices and can make it evolve.

➢ *step 4: Evolution of the Knowledge Book*

Knowledge is always evolving, it is necessary to implement a supervising process for the Knowledge Book's evolution. It is a specific process that is not reducible to a simple classic maintenance operation. It requires several tasks:

- Identify new emerging knowledge
- Submit and validate the new knowledge to be integrated into the Knowledge Book
- Modify the Knowledge Book and validate its evolution

5. *Phase 3: transfer of the Knowledge Capital*

<u>The transfer process</u>

Once the knowledge is capitalised in a Knowledge Book, which provides a consistent, structured and high added-value corpus, this book must not stay "on the shelf". The knowledge needs to be transferred to some specific people in the organization. As we have said in §2, knowledge transfer is an exchange process based on a binary relationship that depends on the contexts in which the actors act. A knowledge transfer action is therefore characterized by the target, the source that provides content and participates in the transfer, the knowledge content that is transferred, the description and the characteristics of the environment (technical, social, organisational, cultural etc.) in which this transfer takes place. A transfer process is easily described by a model (one of the models cited in the §3), and therefore provides a reference model for the approach of transfer operations. It is given in figure 5.

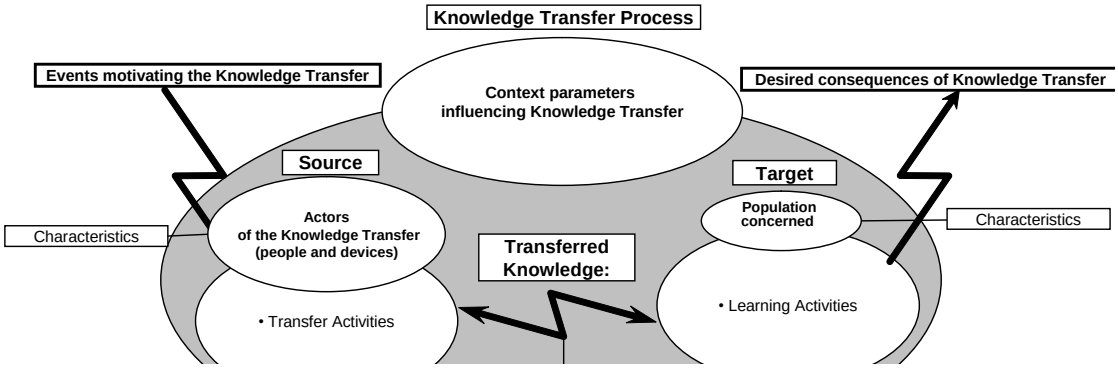

Figure 5: The knowledge transfer process model

This model allows for any transfer action, to be very precise concerning what items are to be taken into account in the implementation. It is extremely useful for the success of the transfer. It is possible to use a large number of criteria to characterize these processes. We shall give two examples.

- *Generational profiling in an organisation*

A study, made with the French Knowledge Management Club, has determined several classes of generational characteristics of the populations that may be source or target in a transfer process that can determine successes or failures depending on the terms of the transfer device used (Figure 5).

It is remarkable to see that the characterisation of a generation is far from simply being a reference to the age. This contradicts a persistent idea. According to this idea, a generation would be a set of people with approximately the same birth date. The generations follow one another at determined intervals; each generation would be characterized by a major innovation, destructive of the old corpus of innovation constructed by the previous generation. Then, the criteria for the characterisation of a generation would be the year of birth and the technical contribution, but this so-called positivist vision has been challenged for a long time (Manheim, 1928). A qualitative, non-measurable approach can define a generation as a set of people with the same structuring trends. To identify a generation, it is necessary to have a unified unit of generation, with a socialisation based on structuring principles. This definition of a generation has an economic aspect, which is a factor of social dynamic, and a significant socio-spiritual aspect.

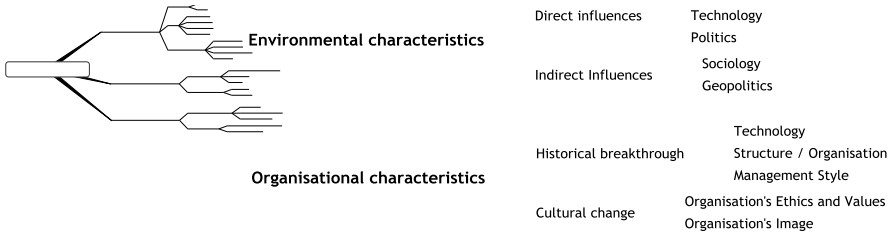

Figure 6: Generational characteristics

Thus the generational characteristics grid in figure 6 includes quantitative and qualitative criteria, related to the individual (age, of course, but also training and professional background), related to the social environment, and related to mutations or changes people have experienced in the company. In some projects this grid was used to build the "generational profile" of a company and to determine the key success or failure factors for knowledge transfer factors between various generations (according to the meaning of the grid) in this company. “Generational profiling” in a company is still a little explored idea, but is very promising (for knowledge transfer, but also for internal communication, management of human resources etc.).

- *Key Factors of Transfer (KFT)*

In an action of knowledge transfer, it is important to characterise the difficulties specific to the knowledge flow from the source to the target. This characterisation of the transferred knowledge (cf. figure 7) is to identify the difficult points in the involved knowledge domain.. This identification is essentially made with domain experts, who have always transmitted some knowledge to less experienced people, and who are familiar with the difficult points that generally cause problems for novices. To help this identification, one uses a grid which classifies so-called "Key Factors of Transfer". One example is given in figure 7. These items are listed according to technique, practice or theory and are split in general into two classes: most frequent errors and key points to be learnt (Castillo & al., 2004). Identification of these characteristics is invaluable to any transfer device.

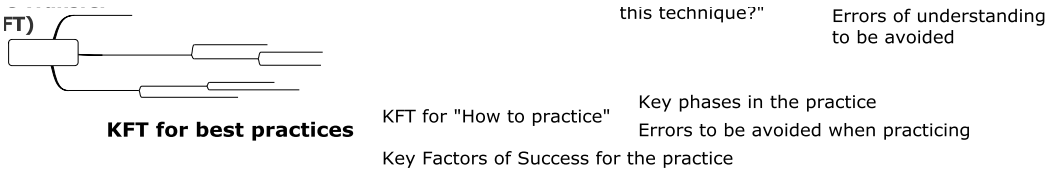

Figure 7: Key factors of transfer

The transfer devices

The transfer of knowledge is a rich issue that has many tools. There are many methods for knowledge transfer (mentoring, tutoring, community of practices, training, learning etc.) supported by many technologies (CMS (Content Management System), blogs, shareware, e-learning platforms, portals or knowledge servers, etc.). Unfortunately, there is often confusion between the process, the method and the technology.

The approach proposed here is interested in transfer processes that use the Knowledge Book as the main support. It requires the design of a "socio-technical" system, modelled by the process described in figure 7, and which uses a Knowledge Book as a basic corpus. It adapts often classic devices to the context of the Knowledge Books. This phase of the approach is currently under development and is the final brick. We give three significant examples:

- Transfer process based on the socialisation of a Knowledge Book

Two separate processes can be implemented:

- expert/novice co-modelling: an expert and one or several novices are together (with a knowledge engineer as moderator), with the aim of using modelling techniques (of § 4, for instance) to capitalise on the expert's knowledge. The expertise is represented on a common basis, which allows novices to learn.
- direct transfer of the Knowledge Book: models created during the design of the Knowledge Book provide a "condensed", intensive and rich structure of the knowledge corpus to be transferred. This is a representation of the expert's knowledge and it is useful to explain this knowledge in a structured and logical form. From this representation, the expert can easily and in a short time explain to novices, during training sessions, most of his/her know-how. This can be done with the help of a knowledge engineer. The knowledge engineer who drew up the Knowledge Book could even make a direct transfer session to the audience without the expert's presence.

More generally, a Knowledge Book, built with experts of a given knowledge community, may be entrusted to this community to ensure dissemination, maintenance and the sharing. The Knowledge Book is then fully socialised.

- Transfer process based on a Knowledge Server

A Knowledge Server is a website that provides a knowledge community with a knowledge corpus (a Knowledge Book for example) and provides access to all knowledge resources related to the corpus, in the framework of a profession (URL links, documentation, work groups, databases, software, collaborative spaces etc.). It is also known as a Knowledge Portal or a Business Portal.

The design of a Knowledge Server raises specific challenges compared to the design of a classic website. The problems are essentially cognitive usability problems, where browsing the site must follow mental schemes that match business logic. Design methods used currently have two steps: first designing a knowledge repository, where all resources are encapsulated (in the sense of object-oriented languages) in "knowledge chunks", then organising the knowledge chunks according to one business logic (or several, if one needs several websites for several use cases). It is only when implementing the site that one includes items for "usage", which cannot be encapsulated in knowledge chunks.

- Transfer process based on a learning system

The Knowledge Book, built with knowledge modelling, is organised to represent know-how in a specific domain. This is practical knowledge acquired from problem-solving experiences. In general, the Knowledge Book is not enough to ensure the transfer of the

knowledge that it has capitalised. As often, the transfer can be classically done by an associated training device. The way that the book was designed greatly facilitates the pedagogical engineering necessary to design a training device (see for example Benmahamed & Ermine (2007)). It allows:

- the learning tracks to be designed for the learners according to their levels, the evolution of their learning etc.
- teaching materials to be created from a Knowledge Book, in the form of quizzes, level tests, assessment tests, etc.
- pedagogical tools to be specified that can be integrated into learning supports of e-learning type.

6. Conclusion

The ageing population is a phenomenon which few people or organisations have measured the extent and consequences of, nor envisaged answers proportional to the challenges.

One of the effects expected from this phenomenon is the "knowledge crash", which is the risk of losing a massive amount of knowledge, which may be strategic, or even vital, for all kinds of organisations (private, public, international) and social groups.

The integration of the "knowledge crash" in a "Knowledge Management" framework allows a general approach to be taken, at the macro-economic or (and above all) micro-economic level. This also allows the re-examination of the notions of knowledge, of generations, of knowledge transfer in operational and pragmatic perspectives.

In this paper, we proposed an approach built on three phases:

- *Strategic analysis of knowledge*. It identifies the strategic and critical knowledge in an organisation, proposes operational actions sets, and prioritises them. It is based on the strategy maps concepts (Kaplan & Norton 2004), and the « Competence Based View » or « Knowledge Based View » theories (Kogut & Zander 1996; Hamel & Prahalad, 1990; Teece, Pisano, & Shuen, 1997). The tools for that phase are inspired by the Mind Mapping tools (Buzan & Buzan, 2003)
- *Capitalisation of knowledge*. It provides a structured method, based on knowledge modelling knowledge, to elicit the most critical tacit knowledge. It is based on the externalisation process of Nonaka & Takeuchi (1995). The tools for that phase are Knowledge modelling tools like in the CommonKADS-like approach (Schreiber & al., 1999).

- *Transfer of knowledge*. It develops inter-generational knowledge transfer devices based on the knowledge corpus capitalised in the second phase. It is based on the knowledge transfer vision as an exchange process based on a binary relationship that depends on the contexts in which the actors act (Argote (1999); Szulanski (2000). Various tools are used in that phase: IT tools like Knowledge Servers, learning tools like e-larning, socialisation tools etc.

We have given a very short description of that methodology. Implementation of that methodology is an important project that requires strong commitment of the concerned organisation, even for a partial implementation.

That methodology has been elaborated since more than ten years and applied and refined in numerous projects in public or private, international or national, small or big organisations. It being added value for the organisations by structuring their Knowledge Capital, in order to align their strategy with their knowledge resources, by preserving the tacit knowledge, hence reducing the knowledge risks (especially knowledge loss or crash), and by enhancing inter-generational knowledge transfer, in order to face the "baby boom" phenomena or the ageing population process (knowledge gap).

That methodology is now robust, and an industrial and commercial phase is planned for international deployment: creation of start-ups, development of a KM workbench, and commercial offers. In term of research, there is still a lot of domains to explore: the design and automatic generation of knowledge servers from the results of the capitalisation phase, the design of learning systems (using IMS-LD) from the knowledge models, the connection of the strategic analysis to HR-database (like PeopleSoft or HR Access) etc. Research programs are planned in those directions.

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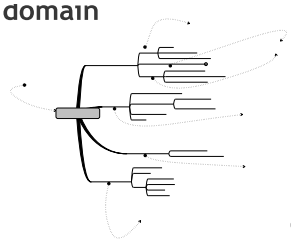

domain
Quality management
Security
> M. E
> M. F
Customer services
Customer relationship
Goods transportation's follow up
Strategic surveys
> M. G
> M. H
Marketing
Commercial offer
Services design
Sales
Sales assistance
Prospects
Negotiations
> M. K
> M. L

Figure 1

Thematic axes	Criteria
Rareness	• Number and availability of possessors • Specific (non- subsidiary) character • Leadership • Originality • Confidentiality
Usefulness to company	• Appropriateness to business operations • Creation of value for parties involved • Emergence • Adaptability • Re-usability
Difficulty in acquiring knowledge	• Difficulty in identifying sources • Mobilization of networks • Tacit character of knowledge • Importance of tangible sources of knowledge • Rapidity of evolution
Difficulty in exploiting knowledge	• Depth • Complexity • Difficulty of appropriation • Knowledge background • Environmental dependency • Internal relational networks • External relational networks

Figure 2

TOPIC *DIFFICULTY OF USE OF KNOWLEDGE*
Criteria 17 *Complexity*
What is the degree of complexity of the knowledge domain?

Level 1 **Complicated**
The domain is very specific to a scientific discipline. It handles many but well identified elements.

Level 2 **Low complexity**
The control of the knowledge domain involves the control of many parameters which come from various disciplines.

Level 3 **Complexity**
The control of the domain is not reduced to the control of variables, even if they are many and varied. It requires a total and qualitative comprehension, which is expressed by various points of view giving sense to the domain.

Level 4 **High complexity**
The study and the control of various points of view are essential for the control of the knowledge domain. Methods and models are used to explain and make the various points of view coherent.

Figure 3

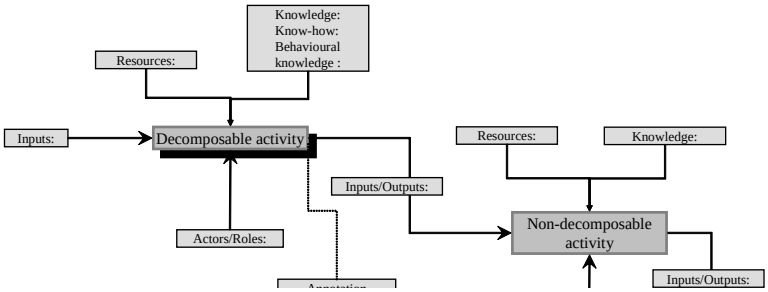

Knowledge:
Know-how:
Behavioural
knowledge :
Resources:
Inputs:
Decomposable activity
Actors/Roles:
Inputs/Outputs:
Resources:
Knowledge:
Non-decomposable
activity
Inputs/Outputs:

Figure 4

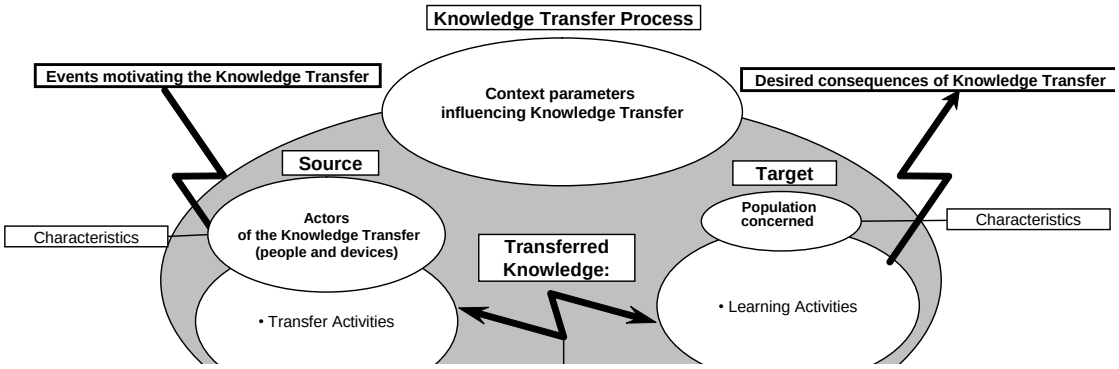

Knowledge Transfer Process
Events motivating the Knowledge Transfer
Context parameters
influencing Knowledge Transfer
Desired consequences of Knowledge Transfer
Source
Target
Actors
of the Knowledge Transfer
(people and devices)
Population
concerned
Characteristics
Characteristics
Transferred
Knowledge:
• Transfer Activities
• Learning Activities

Figure 5

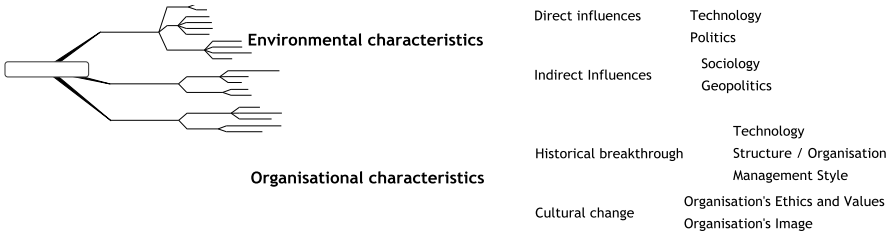
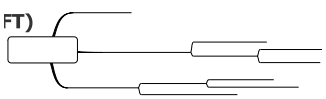

Environmental characteristics
Organisational characteristics
Direct influences
Technology
Politics
Indirect Influences
Sociology
Geopolitics
Historical breakthrough
Technology
Structure / Organisation
Management Style
Cultural change
Organisation's Ethics and Values
Organisation's Image

Figure 6



this technique?"

Errors of understanding
to be avoided

KFT for best practices

KFT for "How to practice"

Key phases in the practice

Errors to be avoided when practicing

Key Factors of Success for the practice

Figure 7