Shared research about knowledge sharing - the LORNET case

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Abstract: The LORNET project coordinates the efforts of a Canadian academic consortium, seeking to facilitate the inter-operation between various educational service providers and resource repositories- accessible through Internet. The TELOS system put the accent on the lifecycle management of any new resource resulted from the "aggregation" of existing ones and on the chaining of these lifecycles in "production cascades". Educational activities (from the emergent ones - based on resource searching and free operation chaining - to the orchestrated ones- through "functional scenarios") envision knowledge sharing and imply sharing the objects used for knowledge learning and communication. To facilitate this metabolism I have based the system's architecture on "a knowledge layer", used for referencing all the components: persons, documents and activities. But the coordination of LORNET research activities poses similar problems to those it try to solve. Therefore, its organization would benefit from the use ... of the instruments that it produces.

Keywords: Knowledge sharing and management, Web-based services, Learning resources, Aggregation life cycle, Production cascades, LORNET, TELOS, Cooperative research
Categories: H.3.1, H.5.3, J7, K3.0, K4, K6.1, J4

1 A distributed research challenge

At the closure conference of the projects dedicated to the stimulation of Internet usage in Canadian education system financed in the Tele-Learning network (Vancouver 2001 - [PAQ 01]) I observed that, although they had addressed similar or concurrent problems, they had developed autonomously - producing ideas and instruments that were insufficiently correlated. The network had not placed a coherent "pedagogical layer" over the communicational layers of the Internet. The projected systems where like islands in the ocean, with harsh or non-existent communication bridges between them. That is why I've proposed a new cycle, axed coordinating the efforts in order to insure the inter-operation of the instruction and knowledge management systems, reducing unpleasant and costly redundancies. It was undesirable to keep on the parallel developing of a plethora of incompatible tools for academic records management, course authoring, repositories organization, knowledge management, etc. The tendency towards "Web Services" promised a different solution: the interconnection of servers offering various facilities to a community of real and virtual campuses sites. However, new problems were arising: access management and negotiation, confidentiality, intellectual rights, concurrent interests, preservation of an operational and developmental autonomy for the connected systems etc. The architecture for a "distributed pedagogical operating system's" had to be defined: protocols, base services, strategies leading progressively to the inter-operability of the entities connected to the system and respecting its norms.

It was a major challenge. I've assumed it two years ago, because I have already had the occasion to meditate on it, searching for a plan for integrating, in a coherent whole, various systems, components and ideas developed by LICEF: EXPLORA (virtual campus activities management platform), MOT (editor for knowledge structures and scenarios for pedagogical, resource conception and resource diffusion procedures), ADISA (distributed workshop for learning systems engineering-conforming to MISA method), ION (controller and aggregator for network distributed resources), VAL (cooperative pedagogical workflow manager) etc. I had also studied the interconnection between LICEF and other systems (AdapWeb, Sigal, Nomino etc), the transition from the centralized EXPLORA platform towards a service provider position (the SavoirNet project) and the inter-operation between the pedagogical resources repertories, based on metadata records (the EDUSOURCE project).

The conference attendants received my proposition with interest. I was asked to extend my idea. Dialogues followed between the interested universities, lead by Mister Gilbert Paquette. The project's documentation was conceived, every team declaring its intended contribution to the collective effort. The LORNET (learning objects repository network) project was approved and launched (and will last until 2008). I was invited to materialize my ideas, as the conceptual architect of TELOS (tele-learning operating system)- which I donned between 2003 and 2005. From the principles that I proposed in the vision document [ROS 03], I select here some considerations showing the orientation towards a cooperative research, about the facilitation of resource sharing, aiming at knowledge sharing:

"Solving Real Learning and Knowledge Management Problems. [] to examine real educational and knowledge management problems, [] to provide solutions not only in terms of system's tools, but also in terms of processes to use them effectively in real contexts. [] the driving force will be the careful definition of use cases that will guide the design of the architecture [] as well as the future development of the system.

Reusing and Integrating Existing and New Tools [] to integrate technologies from different fields and to develop new ones when they are educationally significant. We will reuse, as much as we can, existing editors, communication tools, interoperability protocols and specifications from norms and standards international bodies []

Concentrate on Essential Developments - Reduce risks [] shifting the accent from tool development to careful analysis, evaluation and well-planned specification.[]

Flexible and Pragmatic Approach. [] flexibility to accommodate a variety of situations, from formal well-planned instruction, to more or less structured self-training, emerging communities of practice or performance support systems integrated with work environments. The success of TELOS will come from its demonstrated utility. Therefore the emphasis will be on the relationship between a model and the phenomena assisted, supported or orchestrated by it

A Society of Human and Computer Agents. [] we adopt a view where humans and computer agents are interacting parts of a unique system. [] we will build or use computer tools only when they are really useful. Sometimes, organizational adaptations, advising, documentation support or human communication activities can be more appropriate (and less costly) []

Build Technology-Independent Models. [] protect the conceptual models (as intellectual capital of the LORNET research community) from devaluation, by technological instability [] These conceptual models are not just prerequisite to the TELOS system development; they are part of the system, maybe its fundamental layer.

Observing, Planning and Supporting Learning Ecosystems. [] tools to model the complex processes involved in a distributed learning system: before the process (to design), during it (to

support users and observe their behavior) and after it (to understand, evaluate and react). They will enable the users to get involve efficiently in pre-planned as well as emerging events.[]
Structural modularization and evolutional segmentation. [] The architecture will promote "horizontal" (structural) modularity (between components) and "vertical" (evolutional) segmentation (layers for various stages: specification, architectural model, prototypal implementation, run-time application, derived versions) . []
Reusable and Interchangeable Models and Components [] alternative tools, classified by their functionalities and grouped in interoperable classes. [] Even at the "kernel" level, the general functions could be covered by one or more alternative modules, accessible on a distributed "services bus" []
An Assembly and Coordination System [] TELOS will not be another huge distributed learning platform or a system to generate rigid platforms [] will be essentially a coordination and synchronization set of functionalities for the interactions of persons and computerized resources that together constitute a learning or knowledge management system."

Starting from these principles, I've elaborated the TELOS conceptual architecture [ROS 06] witch I will present very briefly in the next chapter.

2 The conceptual architecture of TELOS

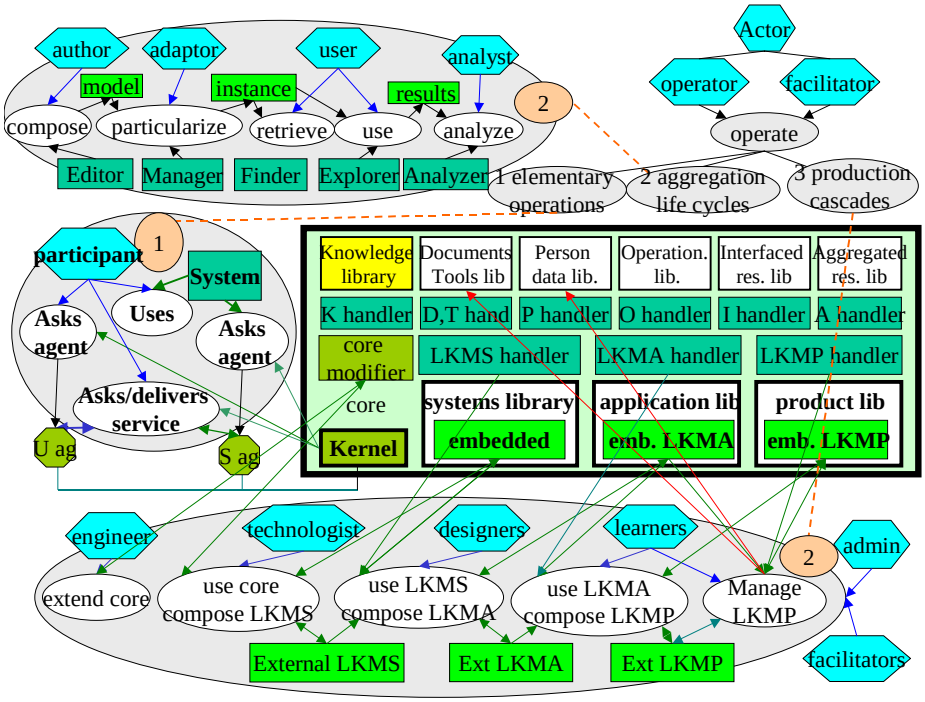

Figure 1 TELOS architecture and behavior

A user can approach the system at three operational granulation levels: 1 chaining freely the elementary (basic) operations, 2 using aggregates prepared by other participants, 3 performing actions of the system main chain.

2.1 Elementary operations (based on the component's semantic indexation)- and their emergent sequencing

TELOS will intermediate the relationship between systems requiring (offering) learning and knowledge management resources and services. It will offer its resources to its own "users", will be able to satisfy requests from external systems and will obtain services from external systems- to satisfy the requests of its own users. These facilities are based on a communication protocol and a controller (distributor, coordinator) of the "interfacing agents"- included in the TELOS "kernel". A user asks/delivers a service by the agent-interface allocated by the kernel (directly to him or to a system that he is using).

Sometimes, users prefer the freedom to order (emergently) the operation chain (resource conception, adaptation, retrieval, use etc). The system offers them refined retrieval instruments for finding the pertinent resources (support tools and persons, previously "published" in the resources repositories). The search facilities rely on the semantic indexation of all components, based on knowledge reference systems (ontology etc.) structuring: the conceptual space of the domain treated by the resource, the technical conditions required for it's functioning and the commercial-administrative usage conditions (rights, costs etc).

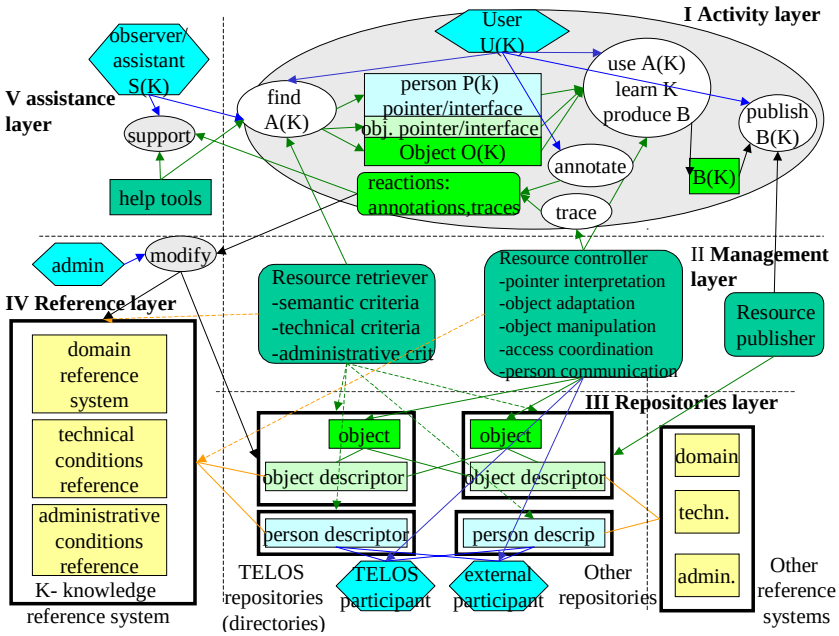

Figure 2 Emergent use, based on knowledge indexation

A descriptor layer (metadata record) is therefore allocated to each registered entity, with fields dedicated to the indexation against the knowledge reference systems [PAQ 04]. They specify the "competence" of the indexed element (person, support document) relative to a knowledge- by a global measure (mastering level) or by decomposition in "abilities" or "pedagogical postures" (to apply, to explain, to teach etc.) [ROS 05]. TELOS allows the use of multiple norms for the organization of knowledge reference and competence systems but it proposes a system common denominator and carefully considers the problems of translation and merging between norms. The necessity to update some references or even to modify a knowledge reference system can arise discovering a bad indexed resource or refining a domain. In such cases, special mechanisms must intervene, to verify, protect or update the indexations that rely on old versions [ROG 04]. Other feeds- back can be decided by a user assistant or by a system administrator analyzing some annotations or some traces -produced by the resources controller's captors. The use of a resource A can generate a new one, published in the system repository or in the user personal portfolio. A human, an instrument or a computer agent may assist an elementary operation.

2.2 Aggregation lifecycle and its management through functions

Instead of loosing time to find resources and order operations, users can sometimes rely on already prepared "aggregates", edited by an author at a previous stage [ROS 02]. These aggregates assemble the required resources for solving a problem, according to various formulas. "The Collection" - is a set of resources, equipped with management instruments (interfaces). "The Fusion" - composes a system from interdependent resources, forming a unitary whole. "The Operation" - aggregates an action, its executor, support actors and support or target resources "The Function" - is a procedural aggregation, the required resources being connected to the operations decomposing the activity that it models or orchestrates ([ROS]/GEFO). The process of structural or procedural aggregation can continue recursively, leading to more and more complex resources.

Some aggregates have all their sub-components precisely identified. An operation prepared in such manner is a "contract" - waiting for its clients. Other aggregates authorize more or less liberty in the choice of some components, therefore allowing the production of derived-aggregates by progressive concretization or the adaptation of the aggregate at run-time. These particularization processes fructify the functional capacity to observe the "competence equilibrium" and to offer support services (selection, matching, alerts, recommendations)

The "life cycle" of a resource (edition, progressive concretization, run-time adaptation and use, annotation and feed-back) can be modeled and managed with "ontogenetic" functions. These ones capture the evolution of the relationship between an assisted system A and a supporting system B: the request, definition and construction of B (from A), the adaptation (particularization) of B for various versions (contexts) of A, the use of B (towards A) and finally the annotations and the eventual corrective reactions. The P(f(p)) process of managing a such a f(p) "functional model" for a procedure p (from its edition to its use) - can at its turn be modeled and orchestrated with the help of a "metafunction" F(P(f(p))) .

2.3 Longitudinal management of production cascades through metafunctions

For the TELOS system, the most important case of functional aggregation is the construction of an application scenario (LKMA - learning and knowledge management application) using an authoring system (LKMS - learning and knowledge management system) and producing the modification of a living-knowledge (learning) or of a knowledge representation placed on some support (LKMP- learning and knowledge management products). Another important TELOS ontogenetic chain is the construction of an LKMS from the instrument toolkit available in the TELOS core, its particularization for various beneficiaries and its use in the conception of LKMAs.

The system engineers participate in the core modification. Some administrators can be involved in the learning results (LKMP) life cycle- by example validating the competence modification due to the learning activities. The correlation of the system lifecycles justifies their aggregation in the main "phylogenetic cascade" of the TELOS system: core-LKMS-LKMA-LKMP- witch a general metafunction can model, demonstrate or manage.

3 Instead of conclusions: recourse to the method?

I've described above the way the TELOS system aims to support activities, resources and knowledge management in a community of Internet connected sites. I still don't know if the need for distributed inter-academic services is bigger than the non-technical obstacles to the practice of sharing. Therefore, in the orientation of the architecture, I have imagined a situation in which the discovery, matching and coordination facilities would be of maximal pertinence: the propagation of knowledge by "free waves" sustained only by the synapses of systems such as TELOS, without institutional support (or obstacle). A similar case would be the one of international scientific cooperation…

As I have pointed out in the introduction, the construction of the TELOS system has required a cooperative activity, based on knowledge and resources shared by the six research teams, in the context of the LORNET project. Thus, the formulas and instruments we wanted to construct could be useful for us too, in the organization of their construction! Each new phase can use the precedent forms of the target system, not only as raw material but also as tools for building new versions. It is a limit-engineering situation, in which the "use cases" don't only describe the system to be developed, but evolve - as part of it. Proceeding this way, the conceivers become a legitimate target population, a sort of "canonical" users.

At the LORNET'04 congress [ROS 04], I used the presentation facilities of the GEFO0 function manager to demonstrate the TELOS0 system. We could have gone further, using GEFO's coordination facilities to actively manage the project, thus testing its utility. However, we didn't ... not only because of its prototypal character, preferring to cooperate in the classical way, through email, newsgroups, the project's web site, telephonic conferences, work meetings. I have resumed myself to schematize the project's management scenario in PowerPoint, as in the figure 3, presenting the task distribution of the six teams (the red circles) proposing a

cooperative research flow conforming to the enounced principles and objectives, and merging the research and development phases with tests made by technical and pedagogical experts (respecting and calibrating evaluation methodologies).

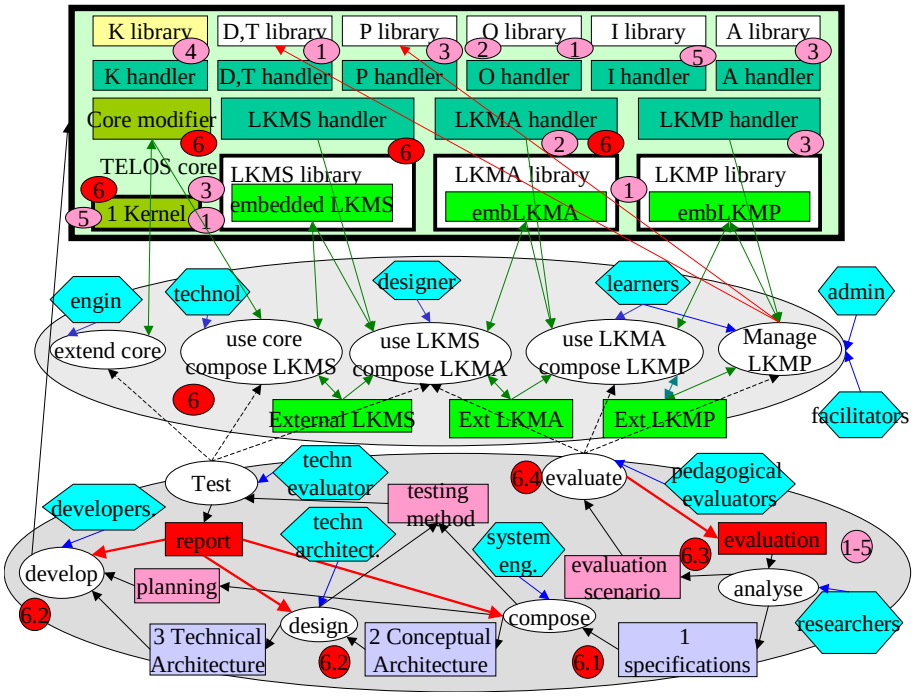

figure 3 Scenario for TELOS development in LORNET

The figure overlaps the chain of TELOS system's production in LORNET to its global physiology (the core-LKMS-LKMA-LKMP chain - see figure 2). Organized as a "meta-meta-function" (with connected research resources, indexed on a research meta-ontology and implementing ordering, coordination and assistance mechanisms) - this scheme could have (can) become a dual- project management tool (instrument and proof of concept). The fact that this formula hasn't be used is only an accident, or does it highlight pragmatic difficulties (high costs or organization risks)?

The LORNET being underway, my observations can't be conclusive. I still formulate them know and here because I feel that they touch an interesting aspect. I want to remind to those who research the facilitation of knowledge management in distributed systems that their activity is itself a process of knowledge, resources and methods sharing- and, therefore ... would deserve to be managed as well as possible This would justify a "self-equipment" approach…

The occurrence of this "vicious circle" can produce a certain epistemological perplexity, but it also opens the way of refined and fertile strategies for ascending the research-development-application spiral. Convinced by the opportunity of "recourse to the method", I've searched for methodologies and instruments sustaining it, in

theory and in practice. But I haven't found yet a satisfying theoretical frame to approach the matter of recursive management and knowledge meta-management (in the sense of managing the conception process… of a system for managing the physiology/evolution… of the A-B pair formed by a system A and a management instrument B. I also haven't assisted often to presentations of new presentation instruments- made with them, descriptions of projects envisioning management methods- that were organized by the proposed methods, procedures of process modeling - modeled by their own formula etc. Why do we invite users to consume medication (instruments) that we do not use- in analog situations? Could it be that some profound causes are hidden here, lacks or limits of the scientific curriculum's structuring, methodology or management? Or an insufficient observation of the costs implied by the management efforts, which could hide some optimization paradoxes?

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Note: These texts detail the considerations presented above.

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