

The Construction Pilot in GENIAL: Implementing the GEN Vision in the Construction domain

Philippe Debras, CSTB, France
Jean-Luc Monceyron, CSTB, France
Eamonn Buckley, BIC, Ireland
David Leonard, Taylor Woodrow, UK
Gilbert Carpentier, BBRI, Belgium
Stephan van Praet, BBRI, Belgium
Lars Seifert, Univ. Paderborn, Germany

Abstract

Among the emerging range of new working habits that appear to best preserve companies' position in competitive markets, the Global Engineering Networking (GEN) Initiative has recognised the reuse of internal and external engineering knowledge as one of the very promising approach to be considered by companies elaborating their business strategies.

With that respect, the GENIAL project devotes its mission to the promotion of a new king of market places where actors capture and retrieve on-line a wide range of engineering products and services.

In this paper, the GENIAL architecture is described emphasising its main components. The GENIAL approach allows an information provider to play a role as a Value Added Service Provider. This approach is illustrated by case studies in the construction domain to illustrate the benefits of the GENIAL concepts from a user's point of view.

1. A need for uniform access to information

Talking about business , Change and therefore Change Management, is certainly the main challenge of the turning century through its many aspects and contributing factors.

Technology innovation is often considered as the most important one regarding the fast renewing of business processes it conveys for challenging companies to assess their profits if not simply to survive. Technology innovation and in particular Information Technologies (IT) are widely acknowledged nowadays as the spinal cord of companies looking for a sustainable success within the emerging information era. Building upon Information Standards like STEP [ISO94], IAI [IAI], SGML, XML [XML-ol] or P-LIB, Information Technologies bridge together islands of automation towards the implementation of Information Systems that reconcile the various software applications of companies. Moreover IT now offer wide area communication facilities, mostly but not only thanks to the Internet and the upcoming necessary security features that will ensure the fast and flexible creation of new forms of company alliances.

The growing number of data sources also contributes to a fast changing environment, as data are quicker to elaborate and easier to convey through multiple electronic forms. However much data still face a lack of structure. Component Libraries stands for a typical example of available data that require the necessary conceptual modelling effort turning it into relevant information.

Engineering projects themselves through their increasing complexity also stand for a factor of change. Such a complexity may be due to the size of the projects, the number of actors involved, the time aspect, the requirements in terms of quality, cost and delay or simply in terms of compliance with a wide spreading regulation.



2. The GEN Vision and GENIAL Project as a Candidate Solution

2.1. The GEN Vision

In such a context, companies have to continuously renew their working habits and Change Management really becomes the key issue that will keep the company on the competition track throughout increasing effectiveness, quality, flexibility and response time to the customer. Among the emerging range of new working habits that appear to best preserve companies competitiveness, the Global Engineering Networking (GEN) Initiative has recognised the reuse of internal and external engineering knowledge [GSJ97] as one of the very promising approach that should be considered by companies elaborating their business strategies.

2.2. The GENIAL Project : Putting the GEN Vision into Practice

To implement the GEN vision, the GENIAL project (EP 22 284) [Rad97] devotes its mission to the promotion of a new kind of market places where actors capture and retrieve on-line a wide range of engineering products and services. Therefore the ultimate goal of the GENIAL project lays in the elaboration of new Information Management processes that well comply with the new trends underlying manufacturer-supplier relationships, allowing information or services to smoothly be retrieved where required whilst the succeeding company is concentrating on its core competencies. With such an approach, whether it is through material, performances, manufacturer, regulation or price discrimination, the appropriate component or service is smoothly brought on the designer desk for the best value of the overall project. On the other side of the communication pipe, the supplying partner gains the opportunity of reaching an enlarged audience as IT now commonly break any geographical distance. Such new forms of Value-Added Services appear to be very critical in Europe to enhance the IT integration of a too fragmented economic sector.

2.3. GENIAL at Work : A Set of Complementary Work Packages

In order to tackle the aforementioned objectives, the GENIAL project promotes a user-driven approach that is conveyed by the following set of complementary work packages.

Work package 0 «Project Management, Awareness and Exploitation Stimulation» addresses the managerial aspects of the GENIAL project, from project management itself towards results dissemination and exploitation.

Work package 1 «User Requirements and Pilot Demonstrations» targets the gathering of necessary end-users requirements for WP2 and WP3 IT works to be correctly oriented. Furthermore, GENIAL demonstration and validation are based on demonstration scenarios that are elaborated within this work package in correlation with user partners business knowledge and practices.

Work package 2 «Development of the GENIAL Infrastructure» addresses the specification of GENIAL Logical Framework that, building upon a set of Basic Business Services, is supporting the necessary integration, communication and co-operation needed among GENIAL actors. The Common Semantic Model (CSM) stands for one of the major output of this work package as it is capturing the generic semantic underlying the targeted engineering knowledge and services.

Work package 3 «Development of Generic Toolkits» tackles the software development of generic toolkits that support GEN users in their capturing, retrieval and presentation of dedicated information and services through the means of GEN Objects. At this level, the generic aspect of such mechanisms has to be emphasised, as such GEN Objects remain independent of any domain dependant requirement.

Work package 4 «GEN Integration and GEN Domain Specific Services» reconciles end-user requirements (WP1) and generic software components (WP2 and WP3). In fact, WP4 acts as an

integrator between the two through a specialisation process that brings generic software toolkits towards Value-Added Services supporting the particular needs of given industrial sectors.

3. The Construction Pilot : From User Needs to Evaluation

The business relevance of GENIAL is demonstrated through a Pilot approach addressing the Construction, Electrical, Mechanical and Aerospace industrial sectors. From detailed user specifications to the implementation of demonstrators and their further installation and evaluation on user sites, these domain specific pilots strongly participate to the design and implementation of the GEN initiative. Focus is here brought to the Construction Pilot.

3.1. Needs

Like many other engineering sectors, the end product of construction is a value-added arrangement of standard component parts. The building must be designed for functionality, safety, longevity, and aesthetics. Designers consult regulatory, best practice, pricing, aesthetic and proprietary product information, and design services. The design team comprises up to 7 disciplines: property developers, project managers, civil engineers, architects, surveyors, building services engineers, and contractors. Indeed as AutoCAD have noted: "*Only in the financial industry do you find a similar critical mass of electronic tools and complexity of relationships*".

Furthermore, the GENIAL construction survey has shown that 15% of construction industry professionals time is spent locating information. AutoDesk estimate that another 15% is spent changing the data into a form which is usable. These figures are re-enforced by the Latham report which indicates a 30% increase in productivity is possible through appropriate exploitation of IT.

3.2. Objective

The Construction Pilot aims to demonstrate a global workbench for the construction engineer or architect. Such a workbench shall be regarded as a user front-end which gives the engineer or the architect instant and intuitive access to internal and external information in a manner which is integrated with his decision flow for the particular process to completely solve a particular construction issue.

3.3. Overview

The overall scenario used to demonstrate this pilot focuses on the selection of a window by the engineer or architect. It will facilitate the different stages of the decision flow by providing access to various information bases involved (see Figure 1):

1. Project Description detailing the building type, location, site, but also including required performance criteria associated to the various building elements
2. Standards & Regulations database defining the technical and legal context of the project
3. Product database providing products-trade names-manufacturers related information
4. Technical Approval delivering the compliance certificates associated to products when available
5. Finishes detailing the range of finishes offered by subcontractors
6. Construction Design & Management providing building costs and resources (human, material & equipment) associated with building elements or components
7. Specifications Manager offering technical specifications templates
8. Integrated Workbench allowing automatic viewing of textual, CAD and project scheduling information

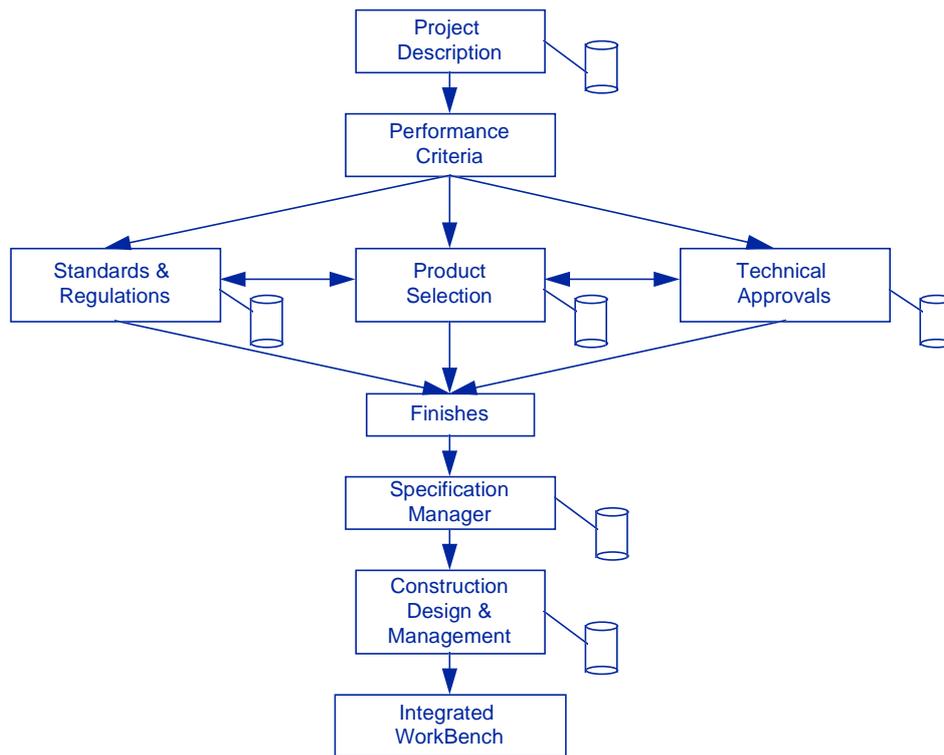


Figure 1 - Overview of Construction Pilot Subsystems

Throughout the different subsystems, designer's information requirements relevant to the scenario, are presented as questions which they would normally ask under each subsystem in order to source the required information. These questions will help to link the subsystems thereby reaching the required window solution.

- The project model subsystem will define the building type, use and location, which define the performance criteria which the window must satisfy. Therefore, the questions, which will be relevant to this subsystem will be those seeking to determine the relevant performance criteria for different building types.
- The regulations and standards subsystem will allow the designer to query the relevant regulations and standards.
- The Product Selector subsystem will allow browsing of catalogues which provides information on sizing and product compliance. It will also give information on available finishes for the products.
- The Technical Approvals subsystem provides a list of technical approvals, which have been granted in relation to the fitness for use of innovative building elements or products. Designers can query this subsystem to see what products have received technical approvals.
- The Construction Design & Management (CDM) subsystem contains regulations which place new duties on clients, planning supervisors, designers and contractors to plan, co-ordinate and manage health and safety throughout all stages of a construction project. Designers will be seeking relevant CDM regulations for the window scenario.
- The Specification Manager subsystem contains a database of industry standard specification templates to help designers in the issuing of such documents.
- Application Invocation, otherwise known as the integrated workbench is concerned with the integration of GENIAL to the worktop of the user.

3.4. Usage

The visionary usage of the Construct Pilot is depicted in Figure 2. The figure evidences the difference between Taylor Woodrow (TW) VASP (Value Added Service Provider) only accessible from TW users on TW Intranet network and GEN VASP accessible by any GEN user. Another ambition of the Construction Pilot is to demonstrate inter-VASP relationships. Its principle is the following. A user connects to a VASP and initiates a session for querying information. The VASP might not be able to answer itself but rather which delegates the query to another VASP of the GEN network which seems more appropriate for handling such information request.

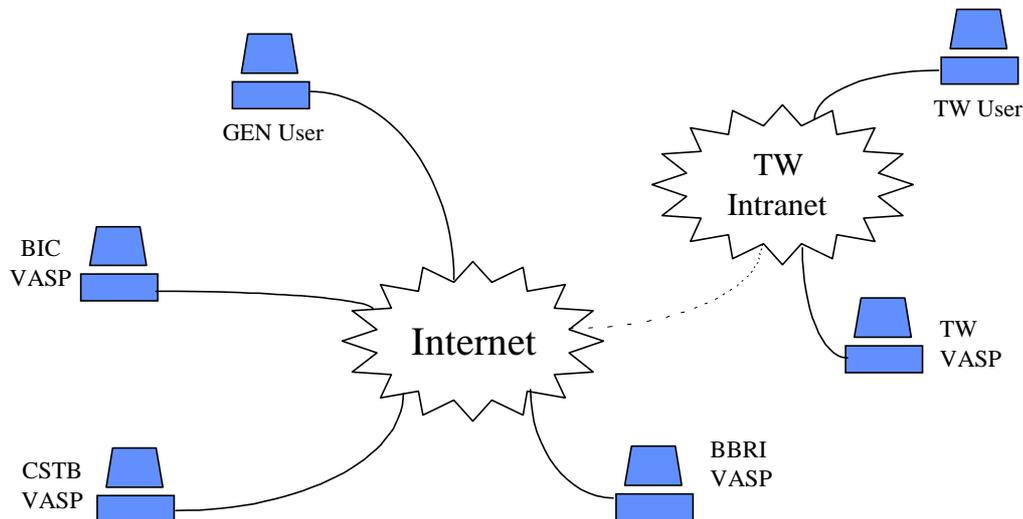


Figure 2 – The Construction Pilot in Use

3.5. Implementation

Various steps need to be accomplished to come up with an implementation of such a vision. These steps are currently being discussed within the Construction Pilot group. However, one can mention that sequential stages of implementation have to be specified in terms of functions to be demonstrated, content information used, software components required and evaluation.

Functions to be demonstrated is here certainly the most important aspect. They mainly encompass :

- **Search** based on classification categories, keywords and synonyms [GRP97], or even parametric search that takes advantage of the properties possibly associated to categories. As there is no standard or commonly accepted classification in the construction industry, the Construction Pilot team has selected UNICLASS and EPIC classifications to support the semantics of the domain.
- **Navigation:** Apart from the classification aspect, the GEN VASP will offer many relations among GEN objects, for instance from a product to the company that manufactures this product, or from a company from its possible distributors. Once GEN objects have been retrieved within a VASP session, navigation will allow to follow the relations associated to these objects.
- **Distribution:** As a very first step, the GEN clients and servers will run on the same machine. However, demonstrators will become rapidly usable on a distributed hardware environment where the client remotely accesses the GEN servers over the network, presumably the Internet.
- **Unique / multiple VASP:** Using potentially multiple VASP in one session, in the sense that a VASP that cannot handle a user request delegates the request to another VASP, is part of the user requirements
- **Security aspects** provides and control access rights to the information for potential users.

3.6. *Expected benefits*

The Genial pilot is aiming at a Win-Win business model for:

- **End-users** who will get instant, intuitive and integrated information at their fingertips. This will provide key benefits in terms of:
 - **Time:** maximising efficiency
 - **Cost:** maximising effectiveness
 - **Quality:** Doing the right thing and doing it right

- **VASPs** who are electronic publishers will gain the following from joining GEN:
 - **More Markets:** GEN will make a VASP's engineering knowledge objects available globally as the VASP's objects can be marketed via other VASPs, to other markets. Therefore it increases the market for a given VASP's information.

 - **More Information:** VASPs can serve their existing customer base with the information resources of other VASPs. Therefore their existing customer base will more frequently access them.

 - **More Value Added Services:** VASPs will be able to combine their engineering knowledge objects with those of other VASPs to provide their users with fuller, more integrated and ultimately more value added information services.

- **Suppliers/Manufacturers** will gain:
 - **Electronic Marketplace** which enables them to be present on the desktop of the right specifier at the right time because such a marketplace will enable just in time information.
 - **Pre/post sales support:** GENIAL will enable effective and efficient pre/post sales support. This is particularly important in construction as customer/supplier relationships are short lived and project based. This places quite a burden on suppliers as they are trying to support running projects while pursuing future projects. It is of concern to specifiers as they often find supplier lose interest as soon as they are awarded the contract. GENIAL will enable suppliers to systemise the technical support and offer it through the Web. Thus suppliers resources can be freed for pursuing future project while specifiers will have instant access to solutions.

- **GEN Technologists** will benefit from proof of re-usability of tools at both generic and pilot level. The benefits will be from the markets opened by the configurability of those tools to provide value added and customised solutions.

3.7. *Target Markets*

Two main markets foreseen at the Construction Pilot level are :

1. **Networking Software Services and Electronic Information Services** *"Total revenues of professional electronic information services and products are rapidly increasing: reached 4212 million ECU in 1992, that is 21.4% more than the previous year, more than 86% came from online services. New multimedia applications and the emergence of a pan-European information infrastructure have created a huge growth potential for the [networking] market. Network services grew yearly by 11.7% between 1992 and 1994, and growth rates of 14.0% and 15.5% for 1995 and 1996 respectively [are expected]."* [EC]
2. **Construction:** *"We are now focussing on what we believe is the world's largest untapped market for electronic information and commerce; the building design and construction industry.. Only in the financial industry do you find a similar mass of electronic tools and complexity of relationships."* [EC]

3.8. Barriers

Several barriers are foreseen at various levels :

- **End Users:**
 - **Specific hardware/software required for GENIAL:** GENIAL will be web-based for the end-user.
 - **Quality of Service:** The web is seen as a huge library with all the books on the floor. As such firms feel that if their designers are using the web for accessing the information they are wasting a lot of expensive time. A solution to this is to have a sector specific VASP which acts as a pointer to useful information.
 - **Liability:** Responsibility for the accuracy of the information. The pilot will support information ownership.
 - **Maintenance** of mechanisms comprising the system. A controller/regulator will supervise such maintenance.
 - **Standards** for transmissions and format.
 - **Cost** of entry, usage and learning: The pilot will be Web based which reduces all of these costs.
- **Manufacturers/Content Suppliers**
 - **Total Cost of Entry Level:** This is particularly important as much will need to be spent in data digitisation and migration. The GEN pilot will demonstrate a scalable path for manufacturers to include their information.
 - **Differentiation:** Manufacturers sell on the basis of the how their products are different, yet searching is based on grouping/standardising products. The pilot will demonstrate how a user can search for products and then view their differentiating features within product catalogues.
 - **Marketing Measurability:** The GEN pilot should enable manufacturers to compare it to current methods of marketing. Our case study should create an analysis to current state of marketing and GEN marketing. Also the demonstrator will show how hits can be measured.
- **VASPs**
 - **VASP Differentiation:** VASP sell on the basis of a differentiated or focussed searching system. This is based on the classification system which VASPs choose to suit their customer base. The pilot will show how EPIC and Uniclass can be used by different VASPs.
 - **Value Addedness:** GEN should not limit the value addedness which VASPs can provide. The pilot will show how GENIAL is customisable and how the pilot data model is searchable and navigable to differing level of sophistication.
 - **Corporate Asset:** Information is a VASPs corporate asset so a distributive system is needed so VASPs do not surrender this corporate asset to a central database
 - **Data Reclassification:** The pilot will show classification mapping from Epic to Uniclass and as such enable legacy data to be made available on GEN.

4. Conclusion

The Construction Pilot in the GENIAL project has been described through its specific needs, objectives, content, expected benefits but also foreseen barriers. At this stage, the implementation of the Construction Pilot is just starting that will demonstrate the interest of the GENIAL infrastructure regarding information representation, exchange and storage. Along with other pilot implementation, the construction pilot implementation will contribute to the validation of the concepts derived so far.

5. References

- [GRP97] Ontology Technology - The Key for Intelligent Migration and Retrieval of Information in Engineering Networks: Prof. H. Grabowski, S. Rude, Zs. Pocsai; In: Proceedings of the 11th International Conference on Engineering Design (ICED'97) August 1997, Tampere, Finland
- [GSJ97] GENIAL: The Logical Framework for the Systematisation of Internal and External Engineering Knowledge: Prof. J. Gausemeier, L. Seifert, M. Joosten, P. Kesteloot, J.-L. Monceyron; In: Proceedings of the 11th International Conference on Engineering Design (ICED'97) August 1997, Tampere, Finland
- [IAI] The International Alliance for Interoperability; <http://www.interoperability.com/>
- [ISO94] ISO/IS 10303-1: Industrial automation systems and integration - Product data representation and exchange - Part 1: Overview and fundamental principles. International Organization for Standardization, Geneva, 1994
- [Rad97] Elke Radeke: GENIAL - Global Engineering Networking Intelligent Access Libraries: White Paper; <http://www.c-lab.de/genial/>
- [XML-01] Extensible Markup Language (XML) 1.0, W3C Recommendation 10-Feb-1998, <http://www.w3.org/TR/REC-xml>.