# Practitioners Report on Applied Industrial, Flexible and Sustainable Building in the Retail and Office Sector

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**ABSTRACT:** Building projects which are build in the Dutch Industrial, Flexible and Sustainable (IFD) Building programme usually focus on the design of the project and the application of prefabricated parts. Though this is indeed an important factor in IFD-projects, the paper supports the idea that successful IFD projects rely on three aspects: An industrialised product, an industrialised building and supporting ICT process and the accompanying organisation structure based on industrial paradigms. For the realisation of the 'Runshopping Centres (RSC)' we build in The Netherlands we organise our projects far more innovative than us current practise. We build without a construction company. By contracting the various systems in the buildings to partnering suppliers -who often are shareholders in the project- on a performance contract basis, we create far more durable solutions than normal in this industry and create high quality buildings.

Key to our success is the building system we developed. This 'LEGO'-like building system allows us to be very flexible in the design and construction phase of the projects and promise even re-utilisation of building materials. Our physical building system is closely matched by the ICT and CAD systems we use. For this to succeed it is necessary to use an integrated design and configuration management system around the entire project. This paper describes how this is done.

**KEYWORDS**: Industrial Building, Configuration Management, Comakership, Sustainable Building, CAD, Databases.

## 1. INTRODUCTION

A lot of people think that the Dutch IFD programme is about building with prefabricated parts alone. Far more important is that the sector looks at other industries and organises the way in which one collaborates and sets up the process around the project from inception until demolition. Goal of the entire exercise is to get a nuisance free product for the end-users. This product is space to do business or live in (See [Dame1997]).
This paper describes the way the partners in the AKB de Boele group realise a network organisation, organises the project and control the process during its entire life cycle. Furthermore a description of the integrated database for design, planning and facility management is introduced.

## 2. THE PRODUCT

Core business of our group is the realisation of buildings in the retail sector. Therefore we developed a retail concept for shops in the private building and aligned business called '*Runshopping*'.

The product we deliver is space for retail in the form of large halls at the periphery of urban areas combined with office space and sometimes housing. The end user rents or buys the space per square meter and becomes a member of an association of owners of the retail centre.

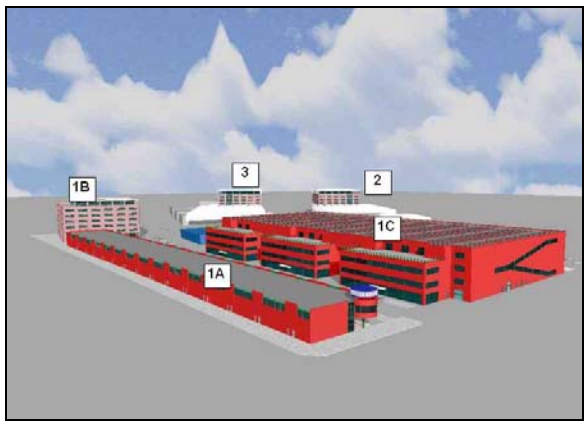


*Figure 1. RSC Oostpoort*

We developed the product in such a way that the cost of the building is optimised for the entire life cycle. This enables us to introduce a lot of sustainable building measure like providing better insulation, use state of the art heating and cooling installation techniques, integrate glass-fibre based networks, etc. The total cost of ownership is in this way lower than for comparable buildings, although the quality of the buildings is higher and the erection costs of the buildings themselves are probably a little higher than normal. This means that we can deliver a better building for a lower price per square meter.

The structure of the buildings is mostly composed of prefabricated concrete parts. The project as depicted in Figure 1 is the Runshopping Centre RSC-Oostpoort which is currently being build near Roosendaal in The Netherlands. This project has won the Dutch IFD demonstration status. With RSC Oostpoort we are now building the 5th Runshopping Centre. RSC Oostpoort is probably the most advanced of our projects, as we are improving project by project. It is a retail area in the first phase of about 65.000 $m^2$.

For the design of the building we worked out a building systems we call internally the 'LEGO[1]-like' building system. It consists of a database filled with standardised building elements which is coupled to a CAD system. The core of the systems is in the details of the interfaces between the elements. The design and specification of the interfaces are laid down in our 'Detail Book' which also defines which partner is responsible for the detail in design, engineering, delivery and operation. The architect may design the building only within the constraints of the detail solutions as laid down in the 'Detail Book'. This means using a standard grid, use of standardised building elements but little constraints in the final architecture.

## 3. ORGANISATION

R&D projects and specific building projects like the project Half-Time and the building of the Westerscheldetunnel have shown that contracting scheme and way in which partner collaborate are key to success in realising state of the art projects. Two levels of partnering can be determined in our organisation. The first level partners are the partners in the WAT (Working Apart Together) concept. These partners, being independent organisations, each performing there own role in the process work close together in acquiring new projects, organising the planning and design and managing the actual building process. This group share their premises, administration, sometimes secretariat and telephone number. They consist of an architect, project developer, real estate broker, an ICT company, a facility management company, a building system developer, building site co-ordinator and a building cost expert.
The second level of organisation is in the partners who are gathered as share holders in the company set up for a specific building project. They provide about 20% of the capital to start the project and usually consist of organisations from the supplying industry working on the project. This means that these companies build for themselves and become owner of the building they supply there products to. This is a stimulus to supply the best material and not economise on quality.

## 4. DESIGN AND PLANNING PROCESS

Core for controlling the process and the configuration of the project is the organisation of the information (flow). Therefore we set up a central database containing all information related to the project(s). Figure 2 depicts the core structure of the database we have set up. The database contains two groups of information containers. The first group contains generic (project independent) data like the library of building elements, a generic 'project procedure planning' in which all tasks from inception, acquisition of permits, erection of the buildings and park management are present.

[1] LEGO stands for 'Low threshold Element oriented Generic Organisation of the building process'. It has some conceptual similarities to the well known Danish plastic building toys in which things are stacked together with well developed interfaces. Lego also happens to be Latin for 'I compose' which perfectly covers the concept.

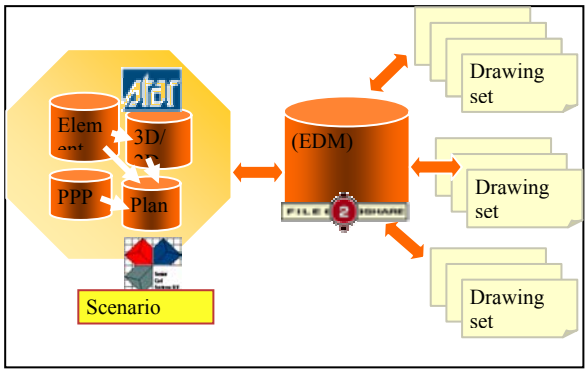


*Figure 2. Database and information concept*

Core of the design process is a CAD system which is build upon a database concept and works entirely 3D. True configuration management can only be based on the concept bases on the product structure as a product model and not on managing a drawing structure (See [Firm2001]). Our way of working is with parameterised objects stored as elements in a library of the CAD database and which are referred to in the specific projects. For this we use the Belgium CAD system STAR (see [Star2003]). The 3D model is used in the earlier phases of the design and planning process. After the final design is ready 2D AutoCAD™ drawings are generated from the 3D model and enhanced where necessary. These drawings are necessary in the communication to other partners and for documentation.
Information exchange to partners is done via a commercial internet based document management system (File2Share™ see [F2S2003]), which by now has become the de-facto standard in The Netherlands.

Because we store both the design as the planning in the database on project level we can produce day to day planning updates in the form of scenario's (see Figure 3.).

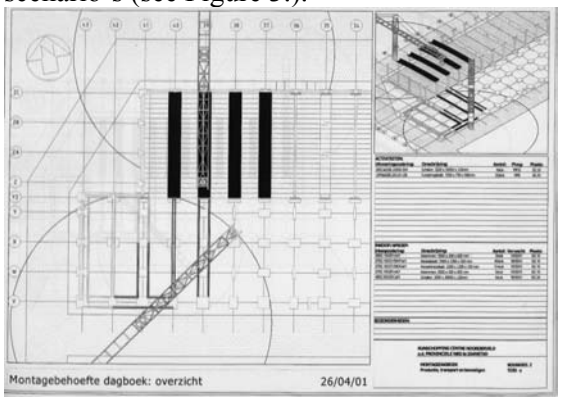


*Figure 3. Daily scenario sheet*

This scenario contains information for the suppliers about the layout of the building site, what is to be done of the specific day and which parts are required for this day. This enables us to work according to the industrial 'Just in Time' concept and avoids large piles of material on the construction site and unnecessary capital binding. We are currently working on an extranet site so we can publish updates to the partners on a real-time basis.

## 5. SUSTAINABLE CONCEPTS

Several sustainable features of the project can be mentioned. First of all the buildings can be taken apart completely where the elements can either be reused or recycled in an environmental friendly way. In the RSC Oostpoort project a special construction is developed to assemble the concrete parts using steel couplings which are bolted together (See Figure 4. In this way the re-usability is very high and also the flexibility during the life time of the building is high because changes can be made at any time without having to destroy parts of the structure.

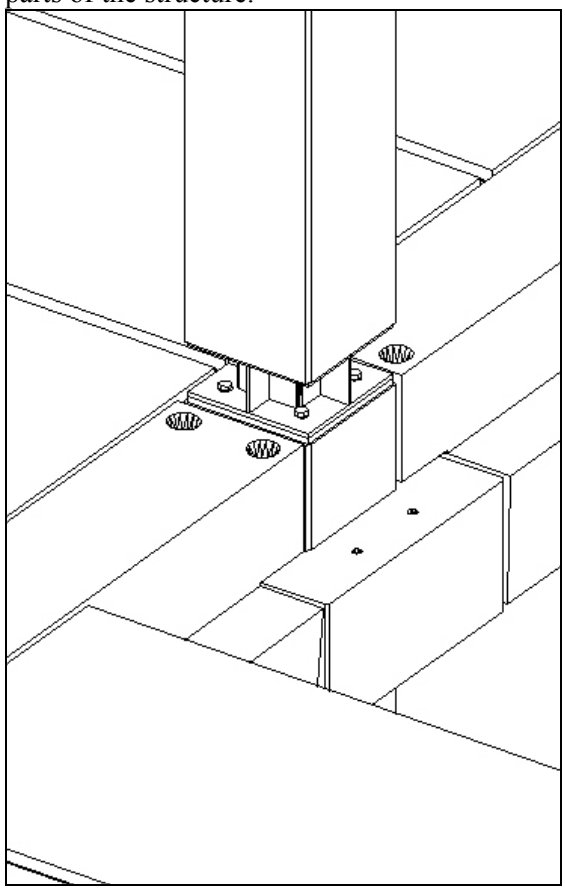

*Figure 4. Hybrid steel-concrete IFD solution*

Another aspect of the sustainability of the projects is the fact that energy efficiency and pollution prevention is optimised for the entire life of the building. In fact by applying state of the art insulation techniques in roofs and walls the energy performance of the project is spectacular. Measurements on one of the completed projects have shown that for a 40.000 $m^2$ retail centre we achieved a $CO_2$ reduction of 380 ton per year and a reduction in natural gas consumption of about 70%. To get these results we used insulation packets of 20 cm thick on the roofs, installed a few aquifers so excess heat in the summer is stored in the ground to be used in the winter and visa versa.

## 6. IMPLEMENTATION ASPECTS

For the ICT minded: The information system described in chapter 4 is implemented around a MySQL relational database system and disclosed to the local intranet using PHP4 scripts (See [Gree2001]). First setup of the database structure was done using MS-Access and some of the front-end applications in house are still using MS-Access forms and reports linked MySQL database using ODBC. We are currently working on migrating the Windows-XP based MySQL server to a Linux environment for cheaper control and possible migration to an external internet service provider.
The database contains tables about organisations, building elements, including their geometric aspects, projects, buildings, planning, drawings, documents, issues, progress, etc. The structure of the tables is such that in the future interfaces can be made according the IFC format of the IAI, and the BAS/Lexicon specification standard (ISO 12006/3 see [Iso2000]). Therefore it will be possible to easily connect other suppliers when a working interface engine to these standards is defined and implemented. Work on this is currently being done in several projects in the Netherlands like iBuild (see [iBui2003]).

Another spin-off of having a centralised database and design system is that it is relatively simple to generate virtual environments models of our products. Together with SARA (Stichting Academisch Rekencentrum Amsterdam) who have a high end visualization environment called a CAVE (see [Sara2003]), we can lead our customers through the building on a virtual real scale an discuss retail concepts, urban planning aspects, etc. Figure 5 shows a picture taken during a session with customers in the CAVE. It is the first floor. The image is rendered in real time from 4 positions in stereo so that the group of users is completely emerged in the computer generated environment.
Simpler portable solutions using only one screen are also very useful. Although the emersion is less a good idea of the project can be obtained and a lot of discussion about the project can be shortened because all parties involved share the same concept of the project.

*Figure 5. Picture from Virtual environment of RSC-Oostpoort shop layout studie.*

Currently we are working on the integration of the building scenarios with this kind of a virtual environment so we can detect all kinds of mishaps in the building process beforehand.

## 7. LEASONS LEARNED AND CONCLUSIONS

Implementing the process control and ICT environment is relatively easy compared to the role out to partners. There is a natural reluctance to accepting the ICT concepts like the Daily Scenario Sheet, the intranet based database and the way of working in 3D in general.
This has lead to some compromises:

- Although we can produce daily scenario sheets on a real-time basis this is not practical. The saying that 'the more precise one schedules the harder coincidence strikes' is very much valid in building construction. Therefore we provide the daily scenario sheets only once a week for the 'building team' meeting which takes place ones a week.
- The role out of the ICT is done in such a way that the users will benefit more than they have to invest in keeping the information up to date. Studies in shipbuilding have shown that measuring progress and matching it to planning is a difficult task (see [Los1994]). Co-operation can only be achieved when a win-win situation is provided.
- Drawing exchange is done on a 2D basis using AutoCAD™ as an intermediate standard. Although collaboratively working in a 3D environment based on an IFC product model would scientifically be very nice, it would require al parties involved to have 3D systems which work
- It is economically not yet justifyable to get rid of 2D drawing altogether, though we hope we will get to the situation that working drawings will become available in 'exploded view' assembly instructions. The level of detail required can only be achieved at great expenses using a 3D CAD system. The trick is in knowing where 3D ends and 2D working starts.

Using an IFD system can be very profitable when applied to improve not only the product, but for all the process of building and the way in which win-win situations are created with co-makers. A classical construction company whose role it is to organise the subcontracting at the lowest price strangles all innovation done by the supplying industry. The normal percentage of R&D by industry is a few percent of the turn-over. This can never be achieved in the traditional way of working in building and construction. Innovation is not only product innovation, but also process and organisational innovation. The Dutch IFD programme supports this idea by subsidizing the added cost of building in IFD.

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