Data management in facility management

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Datenmanagement in der Gebäudeverwaltung

Datenmanagement wird in der Gebäudeverwaltung zum Erfolgsfaktor. Der Nutzwert der Gebäuderverwaltung hängt weitgehend von der Form und dem Inhalt der Informationen ab, die aus den Daten der Einrichtung abgeleitet werden. Es gibt sehr intelligente Tools, um die Datenverarbeitung zu rationalisieren. Produktmodelle werden die Plattform auf welcher Planung und Bau basieren. Die Einrichtungen werden mit multiplen Systemen ausgestattet, die von eigens dafür ausgebildeten Teams bearbeitet werden und die Daten können über ein interaktives elektronisches Instandhaltungshandbuch bearbeitet werden. Die anfänglichen Informationen und Instandhaltungsinformationen sollten so gespeichert werden, dass sie auf die Daten anwendbar und übertragbar sind, die im Laufe der Nutzung der Einrichtung benötigt und generiert werden.

Datenmanagement, ITCTools, Produktmodelle, Aktualisierung von Informationen, gezielte Datensuche

1. The data

1.1 Pre-occupancy

In the beginning, there is an idea. The construction process makes the abstract into a concrete building. The original abstract idea has to be documented to make the real, concrete construction phase possible. But the product is not identical with the ideal model, and the difference between the actual product and the documentation is inherent, unless the documentation is updated along with the construction process. Concurrent engineering minimizes the gap between idea and its implementation both in time and content. In other types of the design phase the difference between the product and the documentation of the design is likely to be greater. A major effort should be dedicated to achieve correct "as build" data in some form of accessible record at the end of construction phase. Thereby the owner and manager of the facility should not only demand for the flawless product but also ask for the correct model of the facility at the receipt of the real property.

Each building is a prototype. Product models are a tool to deal with the diversity inherent to such business field.

Product models are usually seen as items focused and useful construction process. This is well visible i.e. in the following figure 1.

As product models are currently primarily aimed at construction process, the main intention is to provide means for making and presenting choices during the design phase. Ideally, product models combine applications for different needs, having these applications linked to each other. The intention is to benefit from utilization of the data, ability to accumulate the data and transfer it; and to maintain the information. The maintainability is prerequisite for life cycle data management in facilities.

The core idea in product models is to deal with a (i.e. 3D, 4D) model of a building in stead of separate documents. The model is structured based on "building products". The contents are consisting of a location in the model, knowledge of type and quantity, and ability to be seen in different views. The motivation for product models is to replace the old practice of having separate documentation for different uses for a product model with separate views for different uses. Key benefits are the ability to combine different design data (i.e. architectural, HVAC...) and the ability to accumulate the data along with the progress of the project. Notably the financial documentation can be included and utilised for comparisons and financial bookkeeping.

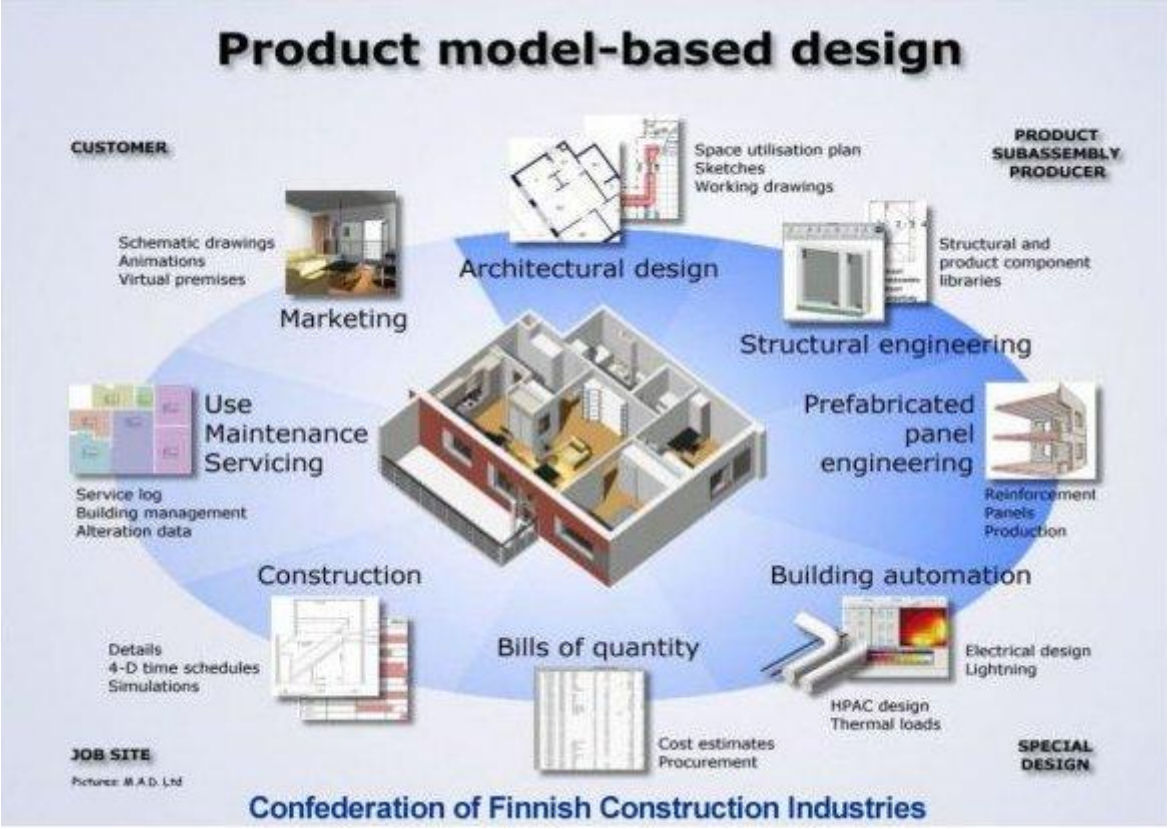

Figure 1. Product model based desing /source: National Technology Agency of Finland, Technology Programme VERA/

It is quite important to document the intentions of construction too. The documentation should include the specifications given to designers as the target of

their work. Having the well specified commissioning at hand makes it possible to check if the product meets the given requirements. Furthermore, it may be used to reflect the need for changes during occupation and refurbishments. E.g. data like the basis for air exchange rate is useful. Some data of the construction phases may be documented by electronic photographs. For instance, waterproofing of the structures with internal moisture barriers may be documented before finishing the structure. Such picture material of the actual implementation of design can be linked to the product model. After construction phase, more relevant for any further information utilization is what was actually constructed rather than what was planned; but to reflect if the solution is good the initial specifications remain necessary for the judgement.

The actual performance of the facility only shows up during the use phase. The latent performance capacities (i.e. thermal or acoustic insulation capacity) remain unobserved until the exposure to real use environment turns them on. At least the specified performance requirements should be verifiable. Usually this is the case: if something can be (in particular numerically) specified, it can be measured too. Most problematic is to observe the internal structural behaviour. Here the novel and rapidly developing sensors, in particular wireless sensors, are extremely helpful.

The best achievable current solution would be to include ample amount of intelligent sensors, and to specify the limit values for the relevant performance parameters.

In addition to monitoring of the performance, the sensor network may be used for other things of interest. Such items as occupant or property safety, monitoring and tuning of properties according to preferences, identification of persons and products, etc are well suited to be in combination with RFID. Identification tags of persons and objects enhances the utility of other (in particular near field) gadgets.

1.2 Post-occupancy

The main software applications used for post-occupancy data management and exploitation in facilities management can be divided into the categories of space management tools and maintenance tools.

Space management applications optimise the use of space, determine how efficiently space is being used, identify profit-earning and leasable areas, calculate space costs and charge backs, draw up tenant and employee occupancy plans, and more.

Maintenance applications are for automation of the full range of tasks involved in maintaining a facility: document and monitor preventive maintenance or repair work, work scheduling, work orders, work requests, and more.

Post-occupancy phase needs specific plans and documents, apart form what is inherited from the design phase. The natural initial content is the specifications for circumstances and conditions set for design. The first post-occupancy evaluation is comparison between the actual performance and the targeted values. First trouble shows up when even the original specifications are missing, and the as-build information is defective or missing the changes made to the initial designs.

The post-occupancy period starts to generate many types of data. The types can be classified according to many principles. There is the initial and life cycle information. Updating may be real time or historical recording. Frequency may be continuous or incidental on intervals or occurrences. The access to source of data may be automatic or manual registration. As may be assumed there really is no standard format for post-occupancy data records. However, intelligent tools (e.g. the logbook as integrated interactive maintenance manual and data record since design phase) have been created to rationalize the data processing.

Not only is the storage of correct, actual data important. The access to data makes it valuable. Means of access vary according to the way data has been stored. Historically manual collection from paper files has been the only means to retrieve data. Product models have made the access electronic. Ambient intelligence makes it wireless; anytime, anyplace accessible. Problematic remain the links to item specific guides and product information. There is a global demand for universal means to retrieve the product specific information from the internet. RFID (tags) in products may be an expedient for the need as seen in figure 2:

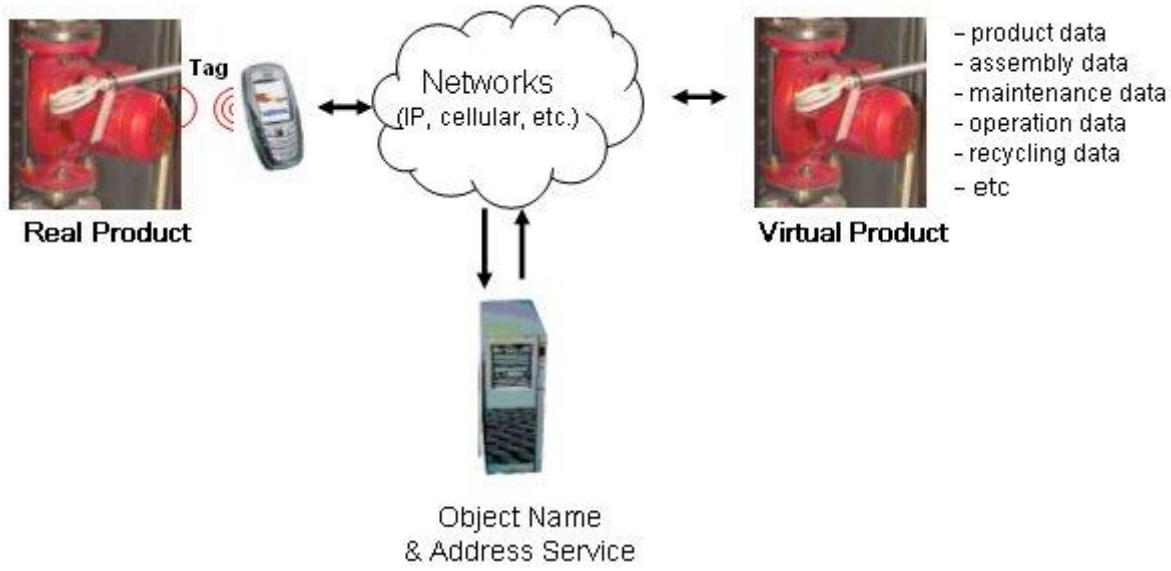

Figure 2. Access to data through networks

Notably, the market mechanism is not effective to support generation of accumulated data banks for facilities. There is no well operating value chain providing continuous business interest. The gaps in value chain turn into barriers to transfer and access even the existing data, not to mention that data banks obviously can not provide enough reward to initiate enterprising.

2. A case: logbook as a tool

Logbook (in the form of as integrated interactive maintenance manual and data record) enables many of the data management and exploitation tasks to be operated on the same platform. The core concept of such logbook structure is shown in the figure 3:

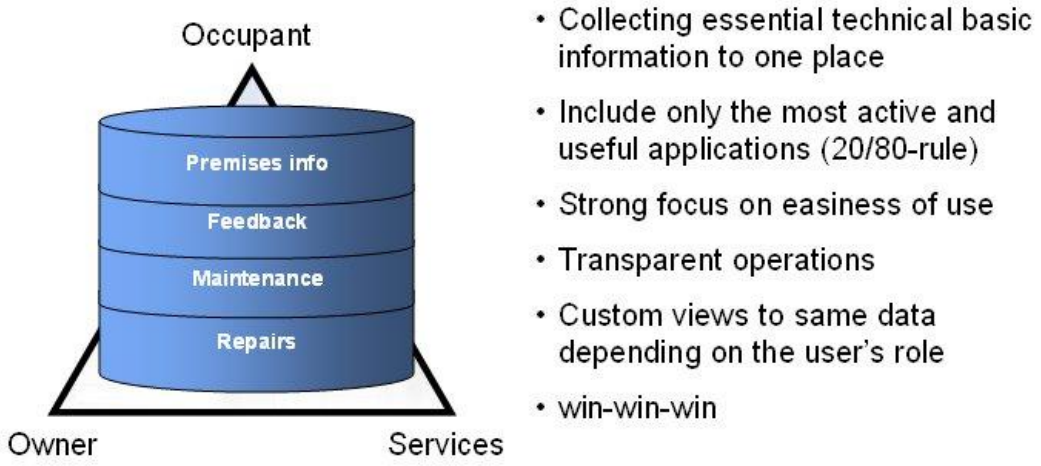

Figure 3. Logbook structure

During occupancy a lot of data is generated, but to utilize the data even as alarms is rare, and even more lacking is the follow up of trends.

Users are a unique source of information concerning the actual performance of a facility. Regarding their potential value as an information source, they are mostly ignored. Yet the perceiving of a facility is completely human activity, and the occupants the only domain of experienced comfort and convenience of the use. From facility management point of view, the occupants also carry the truly important information of their change of needs. Proactive following of the match between the user requirements and space properties is the key to keep the occupants over long periods, and keep them satisfied too. For this purpose, it is important to acquire the user information also from the top level of the occupant organization (which is not necessarily the actual occupant of the facility, but in charge of the upcoming policy) to get informed about the strategic decisions concerning the future needs of spaces and services. The occupant feedback may also provide early warnings of failures in structures and utilities, if such data has a channel to technical personnel.

When asked about the usefulness of log book, the real estate business professionals have given the following scores for different potential uses of the tool (the percentages in figure /source: The Finnish Association of Building Owners and Construction Clients/ show the portion of persons claiming log book to be of great help in the item):

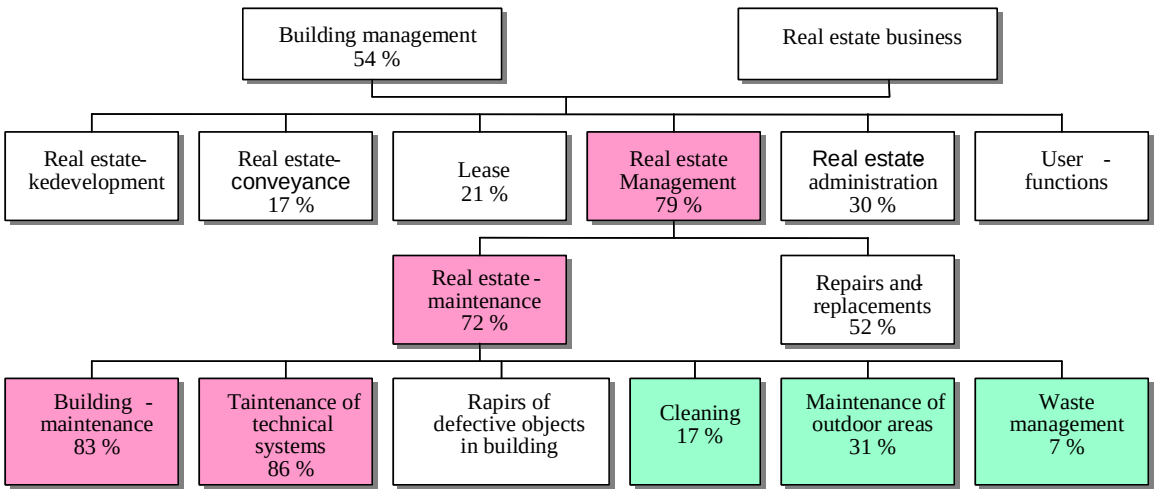

Figure 4. Ways to utilize the logbook

When a logbook is used as the means for data management, the observed failures and defects are recorded into a data bank for future utilization.

The upkeep of the value of the physical property (e.g. the building) is not a concern for the user. It is the interest of the owner, and to lesser extend of the maintenance company. The owner needs active condition monitoring. No theoretical model is a valid substitute for actual condition survey. Service life planning is mainly useful for economic planning, in particular for mid term period, but it will never predict the failures as they occur; there is the natural variance of the components and the exposure to their environment which make it impossible. When the approach is proactive, a keen look at data and rigorous monitoring are needed. The current measuring accuracy and precision should be improved to observe bias and signs of errors in the targeted performance. The deviations from expected values should rather automatically generate an alarm. There is a technical opportunity for such, and it is to quite minimal degree in use. The problem is that a lot of meaningful signal is lost into the noise of normal variations. Indicative data should be pinpointed from normal readings to be able to have instant intervention.

The information content of a logbook needs to be defined, and the data elements need to be fixed: the ability to exchange the data contents between various systems requires an agreed classification. Logbook itself does not insist a fixed form, but the input data needs to be in XML-format to be transferable. Commonly agreed structure of the content enables the transfer from a system into another. Another essential thing is to have well refined ontology of the nomenclature. A product model is an example of such ontology analysed into its constituents. It is quite solvable ICT problem, how such depiction as a product model should be standardized into a transferable form. The logbook itself needs not to adhere into a specific form.

Logbook integrates the actors around a facility. This is a very essential feature in it, in particular for the maintenance process. The logbook is a medium enabling a genuine change in operation culture. In its flexibility, it is quite supportive to new type of service development.

Making things visual is an effective way of communicating. The reporting generated form a facility benefits form images. When the relevant, essential information is actually seen, it becomes more efficient. Tools to visualise in particular things prone to need reactions are at demand.

There is a convergence within ICT and telecommunications. It all becomes ambient, ubiquitous, pervasive... any time, any place. The resources are in exponential growth. They support the nature of a modern human being, homo ludens - the playing man, where the man is playing with the tools by using them for purposes to which the tools were not indented. On WEB HTML and XML even overcome the language barriers.

3. Data mining

Currently document based information is typically human-interpretable. As a consequence, somebody needs to have a motive to start digging up condensed meanings. Document based information is hard to keep consistent, if it is shared by multiple user groups. The documents tend to start separate lives in hands of each user group, and soon they are not compatible any more, and the access to current versions in different locations becomes laborious.

Model based data may be processed and re-entries made automatically, maintaining a single source at the same time with the single information storage. Most prominent aspect however is the possibility for data mining. Model based data may be interpreted automatically. This enables many desirable options. At best, currently the use of product models serves as a base for automation and systems integration allowing user specific presentations. Context aware views to the data provide condensed information to those in need of it. At best, this condensation makes visible such indicators which would normally hide in the abundance of data. Shear making obvious is valuable, but even better is an option to generate automatic alarms when deviations to normal or contrary to expected start to show up. Ultimately maintenance may become proactive (i.e. reaction to chances in derivatives of data mass), but even prompt reactions are worth while (i.e. to start correcting the observed abnormally high moisture contents in structures). Here again the design values and initial specifications are useful to reflect the actual in comparison to the intended.

3. Acknowledgements

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