The Job Profile of Construction Informatics

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ABSTRACT: For a couple of years construction informatics is in a continuous process of a mutation. For the sake of new topics, traditional areas are loosing their relevance. At the same time severe changes on the market can be observed. These trends are opening the discussion on the job profile of construction informatics. Do we offer the right education to meet the new requirements from industry? What is the proper profile of construction informatics?

1 THE ROOTS

While thinking about the current situation of professionals employed in the fields of construction informatics and guessing future trends, it's probably a good idea to have a look backwards to the roots.

Without any doubts, Konrad Zuse is the father of what is called "Bauinformatik" in Germany or "Construction Informatics" as a global common denominator. During the years, while I was leading software development at Nemetschek, I had the great pleasure to meet Konrad Zuse and had the opportunity to talk with him. He explained to us, that his driving motivation was always to find better ways to operate structural analysis and to unburden humans from being calculation slaves.

First of all, Zuse had to invent a machine, which could help him to meet his goal. He also had to invent a programming language before he was able to implement analysis algorithms. Today we have computers and advanced software development environments, but what are the main goals of professionals for construction informatics? Is it still algorithms for computational structural analysis? Sure, up to a certain extend, but isn't there more in the meantime? Which skills should universities and departments for construction informatics teach in order to provide to their students a pole position for the start into their career? What is the job profile of construction informatics?

2 FROM COMPUTATIONAL STRUCTURAL ANALYSIS TO THE WIDE PLAYING FIELD OF ICT IN CONSTRUCTION

For many years the computational implementation of structural analysis was the main field of construction informatics which had it's peak with the introduction of Finite Elements. During this long phase construction informatics was mainly driven by civil engineers, which resulted e.g. into the German tradition of "Bauinformatik", still being the home base of IT-driven civil engineers.

An important milestone was the moment when CAD became adapted and implemented for the construction sector. Latest at this moment civil engineers lost their exclusive domain and architects entered the arena, claiming their fields of CAAD. While in Germany "Bauinformatik" still is the domain of civil engineering faculties, in other countries architect's faculties started to work on various issues in construction informatics, which then also swapped over to German architect's faculties.

Another important milestone was marked when database technologies left their research cocoon and became usable for application developers. Databases turned out to be an ideal platform for the development of cost estimation applications. This domain, however, again was pushed mainly by civil engineers. Some architects entered this arena implementing software applications to support tendering.

For quite some years, civil engineers and architects were happily developing their applications on their islands, while subtly the integration virus escalated and infected more and more victims. At a specific infection rate suddenly it turned out, that more and more players, like building service engineers,

entered the playing ground and that construction informatics had to deal with the whole mass of complexity of construction projects.

Last but not least the still young profession of facility managers joined the game, realizing that they have to digest what is left at the end of the data food chain. Today they are trying to influence the ingredients of the construction informatics menu so that the meal causes less stomach ache to them.

For a couple of years, web technology is itching to boost the situation and at least achieved the awareness, that information can be shared in a construction project. This cognition, together with the impacts of the integration virus is leading to the understanding, that a lot of time and money is wasted by multiple data-re-entry into the various software applications.

3 SOFTWARE MARKET

The situation on the software market in construction informatics has to be rated very differentiated in each country but in general underwent a dramatic change during the last years. E.g. in Germany the time of prosperity for AEC-software was between 1985 and 1995 providing excellent carriers for "Bauinformatiker", but since then changed into a radical process of consolidation. This was driven by the economic stagnation, which hit especially the construction sector, and it was driven by the fact, that the pioneers of AEC-software companies have about the same age and one after the other went to retirement and had to find a solution for his company, which quite often ended-up in take-overs. Today, in Germany there are much fewer companies, where a construction informatics alumni could find a job as a programmers and the opportunities are reduced even more, as the companies more and more are forced to outsource their programming capacities into cheaper countries. So these careers are still there, but not necessarily in the ancestral countries.

In countries, where the economy and the construction sector is doing well, and where people are proud enough to not only accept software of global players, we even can observe construction informatics start-ups. There are very unique examples e.g. in the European Nordic countries.

4 CONSTRUCTION INFORMATICS IN RESEARCH

One field, where one may find a job in construction informatics is research, however, the number of available jobs is quite limited compared to the numbers of alumni. Trying to find out the job profile for a researcher in this niche I collected the following list of buzzwords while surfing through offers of universities and papers of the known appropriate conferences, like this one. This list does not assert it's claim to be complete, so please accept my appoligies if you do not find your research area there.

- CAD
- CAAD
- CAX
- Finite Elements
- Computational Mechanics
- Conceptual Design
- Facility Management
- Web based virtual ...
- Object Oriented …
- Building Elements/Components
- Product Modelling
- Process Modelling
- STEP
- IFC
- Data Integration
- Building Lifecycle
- 3D
- 4D = 3D + Time
- 5D = 4D + Cost
- Mulit Agent Technology
- Change and Dependency Management
- Knowledge Based ...
- Executive Kowledge Management
- Workflow Management
- Concurrent Engineering
- Ontologies
- Dictionaries
- Constraint Checking
- Education
- Mobile Computing
- Multi Media
- Mobile Media
- …

May I suggest + User Environment Design /Per Christiansson

The reason for this list is to show, that the research in construction informatics is very diverse and with this it is difficult to define a job profile for this field.

In general a candidate should be up-to-date with the State-of-the-Art of current IT-technology, she/he should be able to learn easily any IT-technology she/he is not familiar with, she/he should have analytical skills and of course she/he needs to be very inquisitive.

5 CONSTRUCTION INFORMATICS IN INDUSTRY

As shown above, not only in research but also in industry, the fields of construction informatics are very diverse. So how to define the right job profile for an alumnus? As the market situation is different in each country it's also difficult to define a job profile which fits everywhere.

One source to define the changing requirements from industry, which skills they need, is the evolution of the topics for diploma theses which I received during the last ten years. However, it does only reflect the situation in Germay.

The trend is clear: less and less topics for heavy software development. While ten years ago, software companies quite often hired diploma candidates for real software implementation projects, this is an exception, today. One reason of course is the fact of outsourcing programming resources to other countries, however, the other reason is, that nowadays a programmer has to know much more about the technology around him, before he is able to program the actual application. The entry level has become much higher compared to earlier days, where it was sufficient to write proper Basic or FORTRAN code and just compile and link it. For data exchange one wrote a simple ASCII-file with some key-words and copied it on a floppy, while today a novice has to understand a pretty complex software development environment, and for data exchange he needs to understand XML and ideally SOAP and please also web-services, before he can start to concentrate on his actual application. To write a user-interface using .NET and C# is very effective compared to earlier C++ -days, and much faster than figuring out a console-masque with ASCII-codes in the early days, but again, one has to read quite thick books before one reaches high performance.

Does this mean, we have to get rid of programming skills in our job profile?

For a “normal” alumnus (not IT-driven) finding jobs like construction site manager, quantity surveyor, maybe even structural analyst we could discuss, whether they need programming skills.

However, an other trend can be identified observing my topics for diploma theses: some light programming skills are very welcome. Quite often industry is asking for a solution based on ACCESS integrating some other applications and suddenly the standard assistant is no longer sufficient and some VBA-programming is required. An other upcoming trend is the adaptation of CMS (content management system) which can be done up to a specific level with the standard functions, but as soon as a database has to be linked in, this can only be done with some programming.

With this one part of the profile are basic skills in programming: one should understand data-types, data-structures, the principles of object-oriented code, implementing algorithms, relational databases and how to deal with XML between databases, spreadsheets and other applications.

Another trend in the diploma theses are requirement analysis. More and more companies are eager to implement ICT-infrastructure but do not really understand their internal problems and are overwhelmed by the various offers from the market. Therefore their first step is to make a stocktaking, then develop from this a requirement analysis, followed by a market survey and finally the implementation of the selected system. A student who is performing well by doing this job in the framework of his diploma theses, very often has a job for grant, afterwards.

This brings us to the next part in the profile: skills in structuring complex structures and setting up analysis. In addition so called soft skills are very helpful, because in the role of being a student she/he has to get the information out of professionals, usually overloaded by their daily work.

Other topics in the diploma theses quite often are dealing with problems in data exchange and data integration. This does not only matter the settings for a DXF-data exchange between different CAD-applications, but also which alternative data-formats are available and what can be achieved with them. Quite often the setting-up of a working data-flow between the different participants of a building project is regarded as a real challenge. And this includes not only CAD applications but also the integration of other so called downstream applications like cost estimation, energy simulation, facility management and so on.

Professionals are foreseeing the need for a new job-type: The Construction Informatics Data Manager. A student, who is collecting according knowledge already during his studies and who is performing well in a diploma theses related to such a project, has really good opportunities for a future career. In addition she/he should have profound knowledge of available web technologies.

6 CONCLUSION

Traditional areas of construction informatics, like implementation of analysis algorithms or Finite Elements have lost their weight for the benefit of new areas in this field. Especially the challenges in industry coming from the implementation of ICT in companies and from data integration in construction projects are offering new opportunities for alumni of construction informatics.

Instead of deep and specialized skills in software engineering a list of all-round skills seams to be a key to success:

- Understanding of
  - Basic programming
  - Processes in building industry
- Experience with AEC-applications such as
  - Building component based CAD
  - Cost estimation
  - Project management
- Knowledge in
  - Light weight programming
  - Database-technology

- XML
- Web-technologies
- Data formats for applications in building industry
- Standard data formats

There is the opportunity for a new job-type which is currently required more and more from industry: The Construction Informatics Data Manager.

7 BACKGROUND

The author studied civil engineering and worked for over ten years in the software development of Nemetschek as software engineer and head of development. He was involved in projects of 3D CAD, visualization and animation, building component based CAD, cost estimation, facility management. After he accepted the call to professorship for "Bauinformatik" at the Munich University of Applied Sciences, he acquired many national and EU research projects together with Nemetschek. He is also involved in the International Alliance for Interoperability (IAI) et al. acting as international coordinator for the software implementation of the Industry Foundation Class (IFC).