Mapping a classification system to architectural education:
investigating the relevance of classification systems in creative education

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Abstract: This paper examines to what extent a new classification system, Cuneco Classification System, CCS, proves useful in the education of architects, and to what degree the aim of an architectural education, rather based on an arts and crafts approach than a polytechnic approach, benefits from the distinct terminology of the classification system. The method used to examine the relationship between education, practice and the CCS bifurcates in a quantitative and a qualitative exploration: Quantitative comparison of the curriculum with the students’ own descriptions of their studies through a questionnaire survey among 88 students in graduate school. Qualitative interviews with a handful of practicing architects, to be able to cross check the relevance of the education with the profession. The examination indicates the need of a new definition, in addition to the CCS’s scale, covering the earliest phases of architectural work. This paper will suggest a possible approach to these revisions of the CCS.

Keywords: Education; profession; classification.

1. The introduction of standards

Before implementing a new classification system, such as the cuneco CCS, into the education of architects, it is necessary to uncover the actual overlaps between the classification system and the whole education program. This paper explains that process of uncovering and how it ties into a fundamental discussion about the aim and purpose of an architectural education, and the balance of producing graduates, in the face of industry needs, with both practical and aesthetic skills. Through a discussion of the implementation of a specific classification system, this paper will raise a general architectural education discussion seen from a Danish architectural-educational point of view. The CCS tools cover areas in the building industry e.g. Classification and Identification etc. CCS potentially opens new possibilities of establishing a complete information tool for the building process. However, does the rigor of the system add value also in the context of education?
1.1. Cuneco Classification System – CCS

CCS is the abbreviation for Cuneco Classification System, a set of tools developed by cuneco (centre for productivity in construction) between 2012 and 2014 in Denmark. The CCS is a revised version of the now abandoned DBK classification system – a system which was intended to replace the Swedish SfB, but never actually functioned. The CCS tool covers nine areas: Classification, Identification, Pricing, Property data, Levels of Information, Measurement rules, Purpose Grouping, Classes of Information, and Standardized Tender lists. The tools are developed with the intent of facilitating a more structured communication through common standards for enhanced exchange of data throughout all construction processes from initial concept and design over construction to operation and maintenance (Cuneco, 2013).

The work with CCS has been initiated due to a Danish government decree (ICT regulation, 2013), requiring all public construction with a budget above 5 million DKR, roughly 750,000 US$, and applies digital tools for coordination, handling and communication of the digital models and other information connected to the construction project. These digital tools can be cuneco CCS or equivalent tools.

1.2. CCS in the education

An examination of the use of digital tools in the student projects in the architectural education was performed during the spring 2014. The examination focused on the two schools of architecture in Denmark: The Royal Danish Academy of Fine Arts Schools of Architecture, Design and Conservation – School of Architecture, KA, and Aarhus School of Architecture, AAA. The examination was a part of a larger EU Regional Fund project about implementation of new digital standards in education. The examination aimed at finding the level of relevance for an implementation of and teaching in the cuneco CCS tools.

The examination has led to a concrete discussion about the level of implementation of CCS in the schools of architecture, and a general discussion about the relevance of classification in creative educations.

1.3. The Danish schools of architecture

The Danish training of architects meets the European qualification criteria, which among other things provides for the ability to create architectural designs that satisfy both aesthetic and technical requirements (EU, 2013). The education in the two main Danish schools of architecture categorize as artistic educations (UG, 2014) and distance themselves from related educational offers in the universities because of the heightened focus on the aesthetics and reflective practice. This is regarded as a necessary requirements for a fundamental architectural understanding and is the foundation to eventually be able to work creatively in a professional office, municipality or elsewhere. While the purpose of the education is to prepare the students for individual reflection, and find their own momentum in the architectural field, it is not always the case that the content and form of the education are reflecting the more concrete premises of the architectural profession. The education lasts for five years, while the professional phase lasts for the rest of the working life. This gives a relatively short time span in the education, to learn the basic skills and competences for creating architecture. On the other hand, one has the rest of one’s life to train the skills needed for working under the conditions of the construction business. Therefore, there is traditionally an amount of business related training for architects in the professional life after graduation. That divides the training of architects into the
education and post education training, where the former is mostly concerned with the generation of ideas, artistic work, and sketching techniques, and the latter is more concerned with technical, economical, and feasibility aspects. In these circumstances, it is necessary to define if, or how and when, the CCS classification system should be introduced.

2. Motivation for the investigation

The use of CCS will require an additional workload for architects in the beginning of the building project phases, e.g. when the classification of building elements and components must be applied, while the actual savings from its use will appear only subsequently in the lifecycle of the building – thus extra work which does not benefit the architects directly. This extra work can be substantial because projects in the design phase often change a lot during the sketching, and therefore would require re-classification in CCS each time a change is made.

On the other hand, the progressive aspects of implementing a new toolset could also be beneficial for the dialogue between the educations and the profession. Ideally spoken, new dynamics and closer relations could be a result, if a parallel implementation could be done sufficiently meaningful in education and profession. Perhaps an implementation of CCS in the construction sector could also sharpen the focus of the different professions, and actually assign the task of classifying to other professions to whom it is more obviously useful.

3. Methods

The method used to examine the relationship between education, practice and the CCS was divided in a quantitative and a qualitative exploration: A questionnaire survey among students in graduate school, and a handful of qualitative interviews with practicing architects.

The survey consisted of 26 questions that were sent out online and collected online through the service Survey Monkey. 88 students from the two schools of architecture completed the entire questionnaire. Over 90% of the replies received came from students who are partaking in the master's program of study.

The qualitative interviews with five Copenhagen based architects had a supportive function in relation to the survey, to be able to cross check the relevance of the education with the profession. The questions for education and practice focused on allocation of analogue and digital work, information level of study assignments, working methods, loss of information through study assignments.

We have analyzed the processes and traditional forms of work existing in respectively education and profession, while we have also performed an exploration of the CCS tools.

4. CCS tools in relation to existing work methods in education

Of the CCS tools: Classification, Identification, Property data, Classes of Information, Levels of Information, Purpose Grouping, Measurement rules, Standardized Tenderlists, and Pricing, the last four can be screened out, since they are not included in the curriculum and have currently no connection to the work with study projects at the schools of architecture. Below is an introduction to the remaining tools and a mapping of the overlap with education.
4.1. Hierarchical classification of buildings, spaces, and building components

The tools Classification, Identification, Properties and Classes of information enables a standardization of the classification of structures, spaces and buildings for architects. If one views classification hierarchical, with buildings at the top, spaces in the middle, and building components at the bottom, the architect’s work typically begin in the top of the hierarchy and then move down. As the figures in the survey show, for example that 48% of the students have not used a detailed design drawing during the study; it will probably be rare for architecture students to go deep into this hierarchy. On the other hand, there is a rich activity in the top of the hierarchy, as the work with structures and spaces and their properties occupy a significant part of the study tasks. CCS supports the work with space programs and space requirements that could be a connection to the space programming, which is a typical and indispensable parameter in many study assignments. However, 30% of the students organize their own study tasks, and thus even develop delivery requirements themselves.

4.2. Objective and subjective properties

Properties in CCS can be divided into two principal main categories, objective and subjective. The objective can be verified from a measurement (e.g. weight or length) or from an associated custom code, such as life cycle phase or project ID. The introduction of the intended subjective features in CCS are very remarkable and highly relevant for architects, though not yet developed. This could be attribute categories such as sensory properties, experienced spatial quality or experienced comfort. It seems in line with the surveys that education and profession supports this part of CCS, develops and explores how to get the most benefit from these property categories. These categories can be defined at a very early stage. It may also well be that these are subjective features together with objective characteristics could be listed as requirements from the client to the architect, or in architectural competitions.

4.3. Levels of information and classification of projects

The CCS Levels of Information divides the building process into seven information levels from IL 1 to IL 7, representing the process of the building project from the representation of an idea to the fully detailed specification of a physically feasible solution (Cuneco CCS, 2014). In several of the interviews, it was stated that it is most natural to begin the project classification at the end of the sketching phase. But, as shown in the survey, this phase ends only after a thorough shaping and clarification which stretches across 58% of the students' time. The architecture students will thus inevitably work at an information level that is prior to IL 1, an IL 0 if you will. As it is today, this shaping phase is a safe haven where a non-linear creative process is ongoing, and classification does not make much sense. It is therefore the question whether this discipline should be exercised in an environment where the project classification has already begun.

4.4. Mapping between CCS and education

The figure below (Figure ) shows a mapping between cunecos CCS tools and the study work in the schools of architecture. The overlap is limited to the relatively few study assignments in the schools of architecture that moves beyond information level three. It is a minority of study assignments, which reach beyond this level of detail, because the whole education’s aim is inclined towards presentation of the principal architectural idea and not the professional offices’ self-evident focus on building technology, feasibility, and economics.
An interesting point is the subjective properties, which could probably be very relevant in the early phases of a study project. Unfortunately, these subjective properties are not being developed at the time, and is therefore work that needs to be (re)initiated – possibly in collaboration with both education and profession.

Figure 1: Overlap between the CCS tools (light blue) and a typical student project in the Danish schools of architecture (dark blue) mapped sequentially with the Information levels. The graph illustrates that the overlap is relatively small, but could be expanded, if the CCS ‘subjective properties’ were developed.

5. Student questionnaire investigation

The student survey consisted of questions in relation to their working methods addressing

- Distribution between analogue and digital working methods
- Level of information in the study assignments
- Linear versus non-linear working processes

5.1. The distribution between analogue and digital working methods

The part of analogue work in relation to study assignments, as opposed to digital work, represents 45 % (Figure 2). Analogue work includes both analogue drawings and analogue models.

Figure 2: Analogue versus digital work in student projects.

Alternating between analogue and digital work in relation to study assignments is one of the characteristics of the education of architects as an artistic education. That the students are working like this is in good agreement with the curriculum (Curriculum BA/KA, 2014), which over the years has incorporated a balance between analogue and digital approaches. It is of fundamental importance that the students cultivate their perception of space and form based on the mixture of tangible models or drawings and their counterparts in the virtual models or abstract systems.
5.2. Level of information in the study assignments

The CCS Levels of Information from IL 1 to IL 7 spans from idea to fully detailed specifications. The students’ work, however, is very often initiated at an even earlier stage than the CCS IL 1. We had to include this in our survey, why it was necessary to add our own terms to the information levels, namely *shaping* and *clarification*. While clarification will correspond roughly to CCS IL 1, shaping occur prior to this, outside the CCS information level scale, because there is usually no classifiable building information at all. We suggest the term *IL 0*, information level zero, to meet the CCS terminology.

- Shaping is defined as the timespan from when the assignment is given until a set of drafts are created and available for further contemplation. This phase is characterized by exploration, analysis, and experimentation.
- Clarification is defined as the timespan from when a set of drafts are available until a clearer idea of the building can be described in regard to function, light and material conditions. A draft project pointing in one specific direction.

The survey tells that graduate students spend an average of 58% of their time on shaping. This means that 58% of the study related work done at the schools of architecture, is placed outside the CCS information level scale. Of the remaining 42% of time, which is subsequently used for clarification of the drafts, around 33% is analogue work. In reality this means that, out of 100 study days, only 28 have a relevance in relation to CCS. In the remaining 72 days it will not make any sense to introduce classification at all, since the work performed is either analogue or on an information level below 1 (Figure 3).

![Figure 3: Days of study work relevant in connection to the cuneco CCS tools.](image)

Approximately 93% of the students are not using Revit, which is the most common object oriented software used in the schools of architecture, in shaping their student projects (Figure 4). Approximately 90% are not using Revit in clarification of the projects (Figure 5). More than half of the students answer that they have never made a detailed design drawing, or anything resembling a detailed design drawing, in relation to a study project (Figure 6).

![Figure 4: Use of Revit in shaping of project.](image)

![Figure 5: Use of Revit in clarification of project.](image)
Though this might seem disturbing to a more technically based school of architecture, it is nevertheless consistent with the goal of teaching in the main Danish architectural educations. In the schools of architecture, students are trained extensively for proposal making and not necessarily for actual detailed design (Curriculum KA). There are other schools focusing exactly on detailed design, but none other than the schools of architecture are focusing on the preconditions for creating architecture, as an artistic discipline.

5.3. Linear versus non-linear working processes

Identifying whether the individual student’s work process is linear or non-linear was investigated to see whether the students experience a continuously increasing level of information during a study task or whether the process is rather a fluctuating curve where information loss frequently occurs as a natural part of the creative process (Figure 7).

When this graph is compared with the next question about redrawing (Figure 8), it could indicate that having a continuous process is not necessarily considered equivalent to being more efficient and therefore something desirable. It could indicate that sometimes there can be a real value in redrawing and going back in the process in both shaping and clarification during the development of study projects.

When asked about redrawing and redefining of objects due to changing from one software to another, the majority indicates that it is not a big problem. This indicates that the use of several types of software for most students is considered a condition and a necessity for architectural study work. That
only very few don’t know, indicates that there generally is a high use of digital tools and that most students have experience changing from one software to another.

6. Interviews with the profession

Five Danish sketching architects were selected and interviewed. They were from the offices Hplus arkitekter, Zeso arkitekter, C. F. Møller, and BIG. One of the premises for the interviews were that we could only anonymously use them.

The interviews with the professional architects have a supportive character in relation to the survey among the students. The students are usually not given credit for including economics or constructability in their projects compared to presenting an architecturally coherent overall concept. It is therefore clear that the students focus on communicating their overall architectural idea, since that is what they will be assessed on. There is a difference between the projects in education and the profession; thus, the interviews help to determine whether there appears to be a connection between the students’ answers and the attitude in the professional offices. Some benchmark quotes from the interviews are selected to illustrate the professional attitude towards CCS, in the profession, and in the education.

All architects had been working in teams in relation to specific sketching projects. The sketching phase varied from three to eleven weeks, which is equivalent to an average of 7 weeks. An average of 20% of the sketching work was analogue sketching.

Two out of four answered yes to be using Revit in the sketching phase, and everybody were positive to the suggestion that analogue drawing is important for the generation of ideas. It was also the common understanding that information transfer between software was labour-intensive and lowered efficiency.

6.1. Selected quotes from interviews with the profession

“The proportion of analogue drawing in the sketching phase is about 20% - but it is the most important part of our profession, I mean. Its significance for the architecture corresponds to 70-90%. I never directly sketch into the computer. Analogue sketches are faster and brings me quickly to something good” (Architect 1).

“I think it is obvious that young architects come from the school of architecture with a knowledge of cuneco and an understanding of how cuneco code can facilitate the procurement procedure for both client and architect. One could well imagine courses in cuneco towards the end of the study” (Architect 2).

“Overall, I think that the architect education in Denmark should be more technical and furnished with a better eye for what is going on at the offices and in the construction industry. It is as if the architecture education has fallen behind on a technical level, the past twenty years” (Architect 3).

“One must be very careful that you are not going to waste time on something that really does not matter. It may take time to sit down and define these codes. One must be very careful ... In any event, I do not see why there should be taught cuneco at schools of architecture. It does not seem appropriate” (Architect 4).
“Architecture Schools must of course teach BIM [Building Information Modelling, ed.]; it is obvious and very important. However, I think regarding CCS, you can just inform and tell what it is, and give some examples of when and how it can be used. I do not think you have to teach the code language, etc. It does not make sense” (Architect 5).

7. Discussion

As we have seen, the average number of days where students might involve the use of a classification system such as the CCS is only about 28%. When compared with the fact that more than half of the students have never created a detailed design drawing throughout the study, and have had no need to, and that less than 10% work with Revit during shaping and clarification of study projects, it seems that the extension of an introduction to CCS must be very limited. The overlap between student projects and the CCS is simply very small. A brief introduction to classification would be appropriate in equivalence to the current working methods in the student projects.

If one takes the offices’ point of view though, there is a more obvious need. Two out of four use Revit in the sketching phase, and as a design tool. Since analogue drawing in the sketching phase, in our study, only accounted for 20% of the time used, it seems that a link between Revit and other types of sketching software is a good idea to support the implementation of CCS in offices. This could indeed be a task for the education.

Of course, architects must know about classification to some extent, the question here is when and where they will need to learn it. From our investigation, we find three possibilities: 1) During the education as a mandatory course; 2) During the education as an open offer; 3) After graduation as a part of the vocational training in the professional offices.

There is also a need for the development on the software side of the plug-ins between CCS and other common applications. Revit has a plug-in for handling CCS. A similar plugin for e.g. Rhino could be desirable. Such plug-ins may potentially be an important part of the specific handling of CCS for architects, since it will be possible for the sketching architect to communicate important overall classifications and characteristics prior to release for design. This will facilitate communication between architects and designers, and expand the potential for CCS to the other types of software architects use in sketching. This, however, will only really benefit the education if actions are taken to develop and incorporate the use of subjective properties into the CCS. This could be developed as part of the additional information level 0 that includes the shaping definition from our division of the sketching phase.

Subjective property data in a project allows commenting on shapes, spaces and architecture - or even benchmark the experience of these. This could presumably be done, cleverly using building information modelling with virtual reality simulations.

8. Conclusion

From the investigation we have learned that the overlap between education, in the two Danish schools of architecture, and CCS is relatively small, while the profession has more obvious needs for implementing CCS. Therefore, we suggest broad but brief (2 hours) introductions to CCS within the education, in line with the curriculum and expectations of the students. The actual skills in using the CCS is suggested to take place after graduation in a collaboration between the education and professional studios. We suggest that the CCS expands the definitions of the information levels with IL 0 for the
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shaping of projects. Furthermore, we suggest a collaboration project between Cuneco and education on developing the subjective properties in a combination of BIM and Virtual Reality. A proposal has now been submitted in this respect.

The above mentioned conclusions have been noted and already applied in changing the education.

References