

# Profiling the professions of production engineer and site master in the development of a degree programme

Antero Stenius

Oulu University of Applied Sciences  
Oulu, Finland

**ABSTRACT:** This article is based on, and bears the same title as, a licentiate degree thesis at a Finnish university of applied sciences (polytechnic). Considerable changes have been seen in construction production education during the last decade following the discontinuation of the lower degree in construction education at technical institutes in 1996. Compensatory education in the form of a Master's level degree in building was introduced in 2006, and this has led to changes in construction engineering in the construction production. This study was derived from construction production projects and site management's tasks and duties, and from these, the professional skill requirements and corresponding learning requirements were determined. Based on these requirements, it was possible to determine the profiles for professions, following the existent degree programmes. Elementary instructions for curriculum development at universities of applied sciences were created based on this study.

## INTRODUCTION

In the Finnish construction industry there are some established titles for construction site management. Those titles (professions) are: foreman, site manager, production engineer and contract manager.

The base elements for workforce competence include qualifications, which are derived from actual work and employees' knowledge requirements. Qualifications determine the content and level of the work performance. Professional competence includes both qualifications and an employee's skills and personal character.

To enhance higher professional education in construction, and to achieve closer correspondence between education and working life, it was decided to find out if specific profiles for various existing professions in construction site management based on a profession's qualifications can be created, what the main differences between those professions are, and how it is possible to utilise those professional profiles in study degree development.

The basis for the development of curricula for universities of applied sciences (polytechnics) is legislation known as *Ammattikorkeakoululaki 2003*, which determines the extent of studies, fundamental requirements for the content of studies and the structure of the programme [1-5].

Construction legislation also sets out requirements for qualifications in some area, which must be outlined in contents. To predict the needs of professional education, trends and visions can be used, and it will be possible to obtain information about the fundamental decisions of education development. The requirements for the different professions can be listed using group work techniques or using qualification pyramids. Professional competence means that an employee has sufficient knowledge, skills and personal character. The level of competence can be evaluated via a fourfold table, where the first axis is the importance of an attribute and the second axis is the depth of the knowledge required. In this study, the open group work technique was used. The basic information was produced in work seminars in which representatives from industry and universities of applied sciences participated.

## SITE MANAGEMENT PROFESSIONS

Professional skills and qualifications in construction management can be split into production, social and normative qualifications. Production qualifications are usually technical basic qualifications, and are based on these qualifications a person can cope with his/her duties. These qualifications consist of theoretical knowledge, the capacity to apply that knowledge and knowing the actual development state [6][7]. A profession is a combination of groups of work, which are of a similar type [6].

As mentioned earlier, in the Finnish construction industry, there are certain established titles for construction site management. In this study, profiling was done for site manager and production engineer.

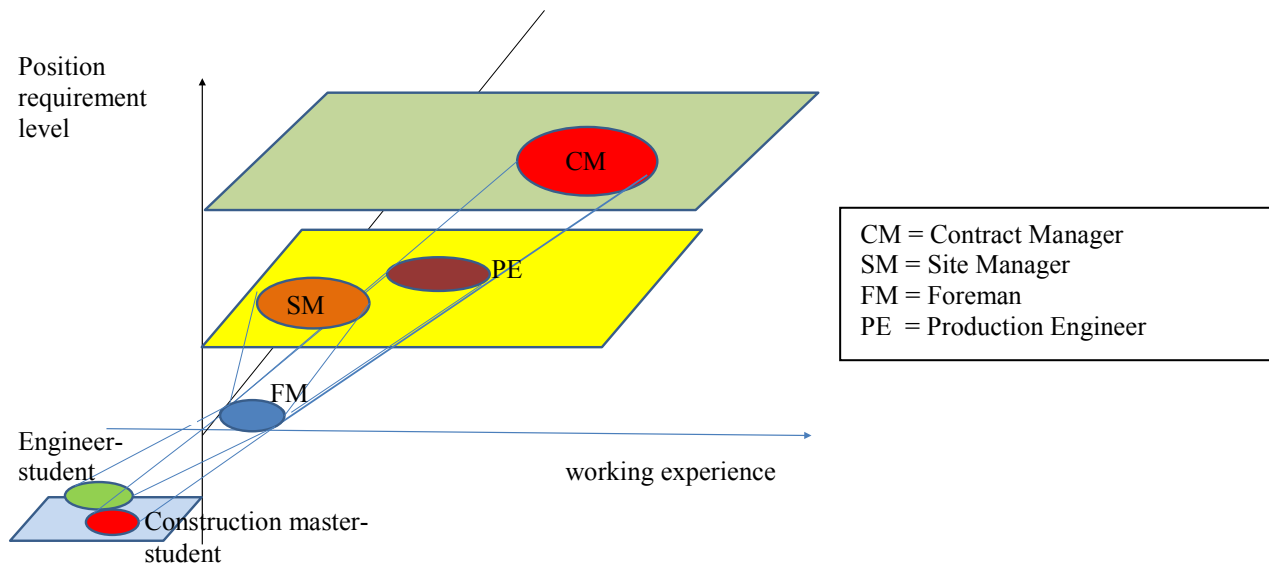


Figure 1: Profession levels [8].

For profiling site managers' and production engineers' professions in the first phase of the study, the basic tasks and duties for these professions were determined, starting with activities at the construction site level. Based on these duties, qualification requirements for each profession were defined.

Site management tasks and duties generally include:

- Time management and control;
- Cost management;
- Quality management;
- Procurement and logistic;
- Task and working method planning;
- Safety and environment management;
- Client and authority relations;
- Customer relations;
- Information management;
- Site management.

A more specific list of tasks and duties was created for foreman/site manager and production engineer [9-11][12]. A site manager undertakes construction works and supervises personnel at the site, and they are responsible for following designs, regulations, norms and good building practice. The site manager is responsible for budgets and execution time.

Key tasks of a foreman/site manager are:

- Organising work supervision;
- Client contact and relations, subcontractor and authority relations;
- Permissions and announcements to authorities, inspections;
- Cost monitoring and control;
- Work scheduling, monitoring and reporting;
- Site meetings (site management);
- Contract meetings
- Procurement according contract manager's instructions;
- Quality assurance (QA);
- Contract payments;
- Additional and changed works;
- Organising occupational safety issues at the site;
- Quality standards (QS) maintenance, activities.

A production engineer usually works under a site manager's supervision in the site office. A production engineer assists the site manager and foremen in site planning, production planning and procurement.

The key tasks for a production engineer are:

- Preparation for site procurement;
- Procurement execution according the site manager's and contract manager's instructions;
- Alternative and tender calculations for additional and varied work;
- Drawing/ design management at the site;
- Time and cost monitoring;
- Project documentation management;
- Cost allocation;
- Site and production information maintenance;
- Preparing client reports;
- Cost reporting;
- Material acceptance;
- Quality documentation.

Based on a review of the literature and group work, it was decided to study these professions according to the general task and duties list to find out, if there are differences between the professions and, if there are differences in educational requirements, taking into account the continuous changing of working life [13][14].

### QUALIFICATIONS AND KNOWLEDGE

In the second phase of the study, profiles of the different professions were created, based on the different requirements of those qualifications, as defined in the earlier phase. In this phase of the study, the qualifications were compared with knowledge requirements. The importance of the qualification as a whole and the importance of that knowledge were studied in the fourfold table.

For each qualification, the importance factors by group working method were determined, and an individual learning factor was determined for each form of knowledge [10]. Evaluations took place in a work seminar, the participants in which were industry and university representatives.

Based on these evaluations, in order to undertake a difference analysis a weight factor based on the product of importance and learning level for each qualification and all types of knowledge were calculated. Furthermore, the factor was multiplied by individual knowledge learning level factors to calculate the difference between individual knowledge in each qualification.

### RESULTS

From the difference analysis, it can be noted that there are clear differences between professions' profiles. The site manager/foreman's profile highlights time management, quality management, task planning and safety, environment management and site management. The production engineer's profile highlights cost management, procurement and logistic, authority relations, customer relations and information management. Results of the study are presented in Figure 2.

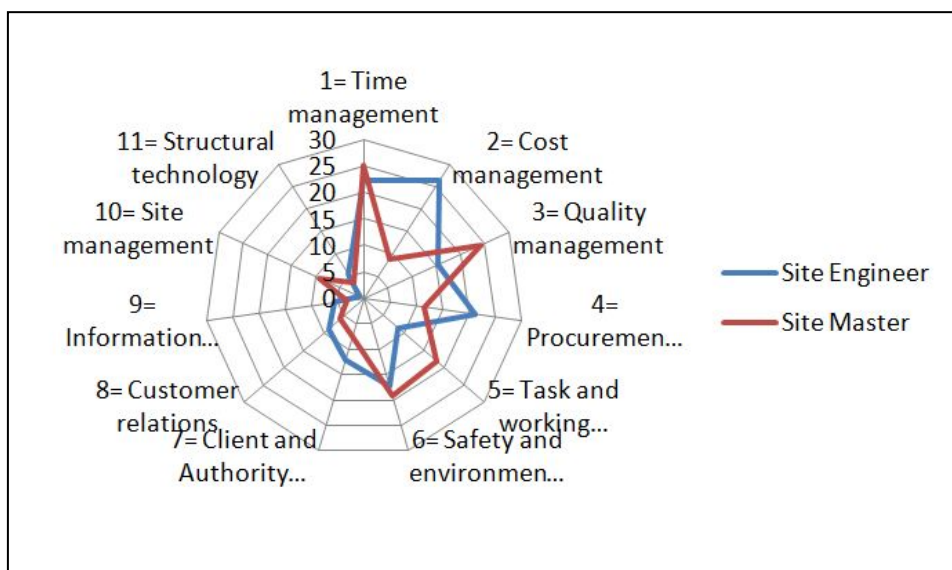


Figure 2: Professions' profiles.

## QUALIFICATION DIFFERENCE ANALYSIS

In this study, qualifications were divided into individual forms of knowledge, and for each of these forms, an *importance weighted learning factor* was defined. For example, in the cost management qualification, clear differences can be found in this study.

According to this study, the site manager/foreman mostly uses information, allocates costs and monitors actual costs. The production engineer in turn produces information for decision making. These results are shown in Figure 3.

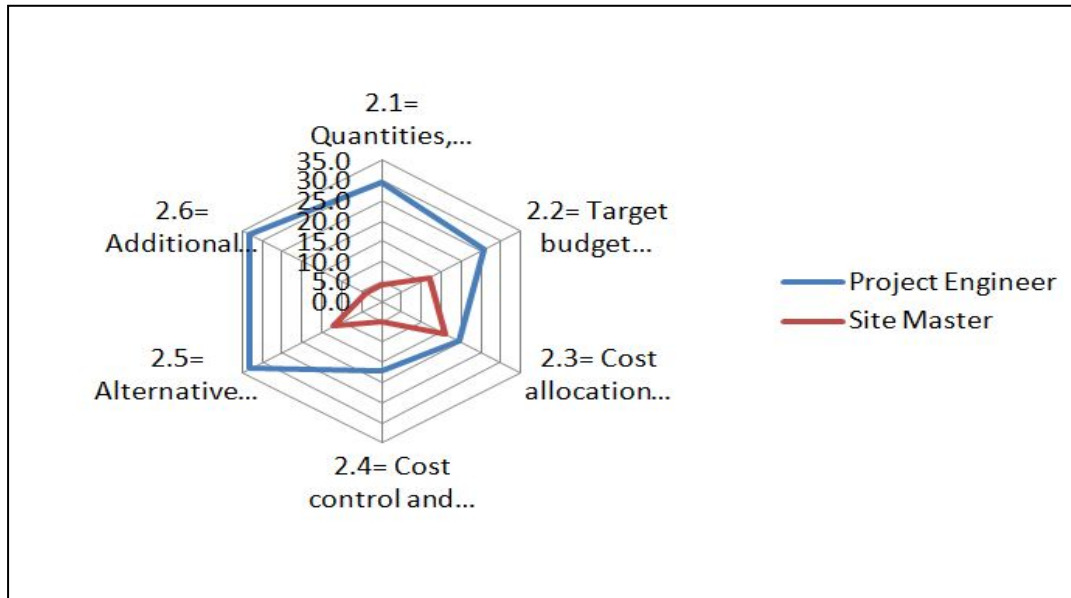


Figure 3: Cost management, difference analysis.

## COURSE DESCRIPTIONS

The results and findings in this study can be used in curricula and course description development, but local requirements from industry should be taken into account. Therefore, the curricula structures and course extents that are created can be used only as a guide in the institutions' education development work. In this study, some examples for qualification requirements in general level were created, and some examples of course descriptions to demonstrate how to use this study in development work have been presented.

## CORRESPONDENCE OF STUDY RESULTS AND REALITY

To assess how credible the study results are, the model to curricula realisations at universities of applied sciences was compared. The model curricula and course extents for profession qualifications that were created by changing the importance of the weighted learning factors to study credits (ECTS) scaling the sum of factors to study credits (on average, 100 ECTS for those subjects). In this study, the scaling means that roughly a three times larger factor is equivalent to twice the number of credits.

The correspondence of results and reality was scrutinised at eight universities of applied sciences. In all instances, the responsible teacher examined their curricula and course descriptions and compared them against the given model structure. The accuracy of the comparison was 0.5 ECTS. The model structure of curricula has been presented as a table of percentage for qualifications and knowledge.

### Building Master's Degree Programme (Foreman and Site Manager)

The coverage of answers were 63% of all study places in Finland, so the sample is reliable. Figure 4 shows the results for four universities of applied sciences. The result describes the deviation of realised curricula from model curricula.

The findings from this study suggest that there are clear deficits compared to model curricula in time management, quality management, task planning and safety, and environment management subjects.

According to this study, considerable resources are allocated to information management, which will not be utilised these days at the construction site. Also, there are considerable resources are allocated for cost management.

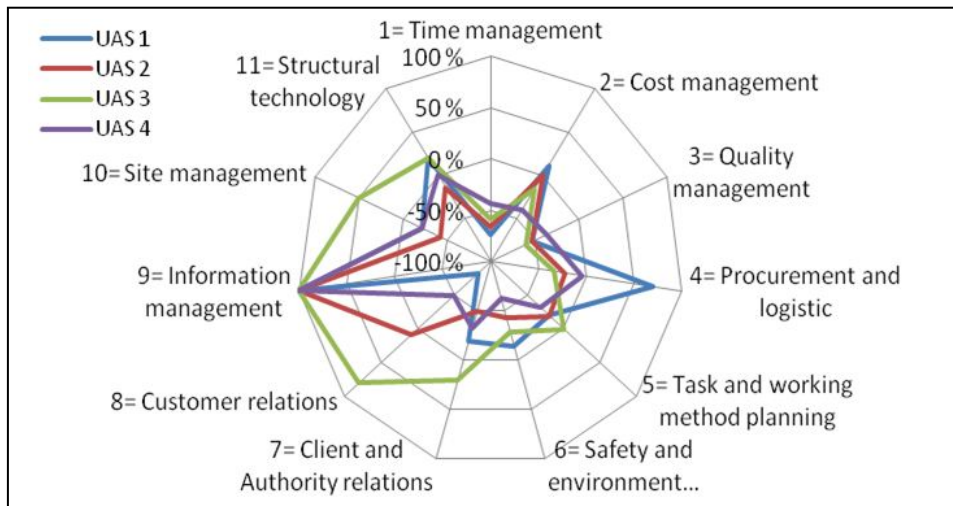


Figure 4: Curricula deviations in site Master education.

## CONCLUSIONS

The results and findings from this study can be used by universities of applied sciences to help them to develop their curricula and study courses. Both professions, production engineer and foreman/site manager can have their own profession specific profile using those differences which were found in this study.

The basis of course description should be based on the qualifications and knowledge which are needed in that subject area. The aim of the content should be derived from the real performance and circumstances in industry using tasks, qualification and knowledge requirements. Courses should be weighted according to the difference analysis presented in this study.

As a result of the difference analysis, it can be noted that there are clear differences between the professions' profiles. The site manager/foreman's profile highlights time management, quality management, task planning and safety, environment management and site management. The site manager/foreman's profession is predominantly supervisory in nature. The production engineer's profile highlights cost management, procurement and logistics, authority relations, customer relations and information management. The production engineer's profession is predominantly that of a specialist. At the very beginning of their career, both professions work in similar positions, with site supervisors at the site level. That is why both forms of education should provide the capability to manage work supervising.

In many cases, foremen end up in the site manager position, and possibly later in the contract manager position. The aim of the building master's education is stay at the site. Production engineers normally work for short periods as site manager, but the normal career progression is towards contract manager or other higher managerial positions. This study provides some guidelines about which courses can be common for both professions. When differentiation is needed, that can be resolved by using on-the-job training and extension courses.

This was a restricted survey in which model curricula were compared with existing curricula in building Master's degrees programmes. Findings were that there were clear deficits when comparing the two curricula in time management, quality management, task planning and safety, and environment management subjects. According to this study, many resources are allocated to information management, but this will not be utilised at construction sites. Also, considerable resources are used for cost management. In production engineer education, there should be more resources for cost calculation, time management, and procurement and logistics.

Professional education at universities of applied sciences has an important role in construction business. The education must be capable of responding to industry requirements today and in the near future. Universities of applied sciences must provide all students with access to complementary studies to develop their qualifications, skills and knowledge during their long career.

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