IT Applications for Construction and Demolition Waste Management

A joint research initiative between Karlsruhe Institute of Technology, Germany and Queensland University of Technology, Australia

Synopsis:

Waste minimization and management is a key component of sustainable construction. Construction industries worldwide are developing innovations to improve such management processes and work efficiency. Information technologies (IT) are proven tools for the management of construction projects. Many computer tools have been well applied in the design, planning, estimation, and the modeling of construction activities. However a study of existing literature reveals that gaps still exist between available IT tools and a low level of application in many tasks and in real project scenarios. The area of managing waste from construction and demolition activities is one of them.

Waste from construction work has direct environmental impacts. Unprocessed waste goes to landfill which potentially causes ecological problems. Recycled materials through better waste management will help ease resource shortages. While wastes are constantly generated during new build projects, demolition work will often generate large quantities of waste within a short timespan. Therefore the appropriate planning, management and processing of waste during different work scenarios are significant steps towards sustainable construction. It is in this context that we will need to investigate the current state of IT applications in waste management and identify priority areas for improvement, if the current deficiency is confirmed. With Building Information Modeling (BIM) becoming a key element of the whole built product development cycle, the study can also explore how BIM may present new opportunities.

This project will relate to the economic and ecological principles in students' programs. It will present a real application opportunity to consider and apply project management skills contemplate the sustainability issues and concerns as a result of construction work.

This is part of a comparative study between the industries in Germany and Australia. Similar work will be carried out in Australia. KIT Master students who choose to do these projects may also have the opportunity to conduct part of the study in Australia, subject to funding applications.

Requirements:

Both Bachelors and Masters students can choose to carry out the projects below, with some different emphasis and requirements.

For bachelor thesis, the following is required:
- Identify problem scope
- Conduct some literature study
- Design and develop questionnaires or interviews
- Conduct the interviews to collect first hand data
- Analyse data and present findings

This needs to be completed between November 2012 and January 2013.

For Master thesis, the previous bachelor problem-setting is extended over the following aspects:
- Expand literature study
- Identify key barriers to IT implementation and factors/areas that will promote new applications.
- Develop a model to optimize opportunities and reduce risks of IT implementation for C&D waste management.

This needs to be completed between March and May 2013.

Students will need to first understand the main processes of waste management in construction and demolition work. Guided by the supervisors, they will then study existing literature to gain the necessary understanding of the key constraints and potential barriers that prevent construction contractors from applying ICT tools in their operation. These issues will be categorized into major issue for further investigation.

Based on this initial understanding, a questionnaire will be designed to survey the local industry to identify critical factors from all major issues, as informed by the industry practitioners.

- Nature of survey: mailed or online questionnaire
- Sample/target audience: construction contractors and subcontractors
- Main work steps: scope identification, literature study, questionnaire design, data collection, analysis and reporting.
- Reporting:
  - A thesis covering problem background, literature, methods and data collection approaches, findings and discussion.
  - Questionnaire design template as an appendix to the project report
  - Electronic submission of thesis and raw data including simple statistical analysis.

  For masters students only:
  - Presentation of research methodologies
  - Model/framework development

Bachelor/Master Thesis

Smart Transport Infrastructure for the Future

A joint research initiative between Karlsruhe Institute of Technology, Germany and Queensland University of Technology, Australia

Synopsis:

To many, transport infrastructure is the backbone of a nation's economy. It also services the needs of our society. Railway stations and bus terminals are unique parts of this infrastructure. They are where buildings and transportation facilities connect through people – the commuters and passengers. They need to function well to meet the demands of everyday users, while delivering the operational efficiency and productivity for organizations that are managing them. Often nestled into a service hub with shops and restaurants inside and hotels nearby, these unique infrastructures also interact with the neighborhood and local economy.

When stations and terminals become older and obsolete, they cannot not cope with new and emerging challenges. These challenges can range from alternative transport patterns, multi-modal transit systems, new user demands, use of smart technologies, the energy efficiency requirements, and the changing service needs of local community. If left unattended, the aging infrastructure may cause serious economical and ecological problems. However, redeveloping railway stations and bus terminals are far beyond simple redecorations and repainting. Many considerations on social, economical, and environmental constraints and priorities need to be made. New technologies may need to be introduced and sustainability principles should be followed. It may also require physical rebuilding, which brings about design, construction, urban planning, service interruption and waste management issues. These facilities often involve multiple stakeholders thus any decision on the redevelopment of these facilities needs to be made on a consultative and multi-criteria basis. But making them smart and sustainable will be an important agenda.

In the course of the thesis, current issues and decision-making patterns surrounding the redevelopment of aging and obsolete railway stations and bus terminals shall be identified. Students will need to follow principles of economics, project management, organizational and optimization theory, and sustainability to identify, investigate and explore the problems before presenting findings in their reports. The collective information and recommendations stemming from the projects will help raise the awareness and promote best practices among authorities and industry practitioners such as Deutsche Bahn and KVV.

This work is part of a comparative study between the industries in Germany and Australia. Similar work will be carried out in Australia. KIT Master students who

choose to do these projects may also have the opportunity to conduct part of the study in Australia, subject to funding applications.

Requirements:

Both Bachelors and Masters students can choose to carry out the projects below, with some different emphasis and requirements.

For bachelor thesis, the following is required:
- Identify problem scope
- Conduct some literature study
- Design and develop questionnaires or interviews
- Conduct the interviews to collect first hand data
- Analyse data and present findings

This needs to be completed between November 2012 and January 2013.

For Master thesis, the previous bachelor problem-setting is extended over the following aspects:
- Expand literature review
- Identify key issues of redeveloping aged facilities into new smart transport infrastructure
- Develop decision support models or frameworks using business engineering principles and theories.

This needs to be completed between March and May 2013.

The overall investigation can be undertaken through three interrelated projects each focusing on a specific element. The students should also consult with their supervisors for guidance and confirmation of work to be carried out.

Thesis 1 – Assessment of current and emerging needs of commuters, passengers and local business operators in railway stations, bus terminals and other transport infrastructure settings.
- Method: Questionnaire survey (mailed, fact-to face, or on-line)
- Sample/target audience: commuters and local business owners
- Main work steps: scoping and literature study, drafting of questions, questionnaire design, data collection, data analysis and reporting.
- Reporting:
    - The thesis covering problem background, literature, methods and data collection approaches, findings and discussion.
    - Questionnaire design template as an appendix to the thesis
    - Electronic submission of thesis and raw data including simple statistical analysis.
    For masters students only:
    - Presentation of research methodologies and results
    - Model/framework development

Thesis 2 – Exploration of problems and deficiencies of existing railway stations and bus terminals, particularly of those older facilities.

- Method: Semi-structured interviews to identify current problems and key issues, for example, any passenger inconvenience and complaints about aging facility; excessive energy consumption, maintenance issues, inability to adapt to smart technologies and new service standards.
- Sample/target audience: commuters, federal, state and local transport authorities; service providers, operators and developers of railway buildings, stations and other facilities.
- Main work steps: literature and scoping study, identification of potential issues, interview structure design, data collection and analysis, report of findings.
- Thesis:
    - The thesis shall cover the problem background, literature, methods and data collection approaches, findings and discussion.
    - Interview design as an appendix to the thesis
    - Electronic submission of thesis and raw data (e.g. recordings) and transcribed information.

    For masters students only:
    - Presentation of research methodologies and results
    - Model/framework development

Thesis 3 – Identification of decision process, policies and work planning for aging transport infrastructure redevelopment
- Method: Workshops or face-to-face interviews to identify perceptions and real experiences on the redevelopment
- Sample/target audience: Federal, state and city/township authorities
- Main work steps: literature study and issue identification, interview framework development, interview conduct, data analysis, compilation of results, and reporting.
- Thesis:
    - The thesis shall cover the problem background, literature, methods and data collection approaches, findings and discussion.
    - Interview design as an appendix to the thesis.
    - A list of interviewees and their organisations.
    - Electronic submission of thesis and raw data (e.g. recordings) and transcribed information.

    For masters students only:
    - Presentation of research methodologies and results
    - Model/framework development