

Integrated Waste Management Facilities for Coastal Indonesia at Three Scales - Desa (village), Kecamatan (district) and Kabupaten (region): Technical Feasibility and Multi-disciplinary Virtual Scheme Design Collaboration

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Industry Academia Partnership Programme

2 Years

Indonesia

OBJECTIVES OF THE PROJECT

This IAPP programme addresses the urgent need in Indonesia on tackling plastic waste management infrastructure provision in coastal and rural areas. A vast share of the world's ocean plastics pollution originates in Asia, with Indonesia accounting for the second highest share of mismanaged plastic waste.

The aims are to:

1. Bring together industrial and academic experts, with multi-disciplinary backgrounds, from the UK and Indonesia to enable a best-practice collaborative design process in a practical sustainable development context.
2. Propose a range of innovative sustainable engineering design and technology solutions, such as pyrolysis, for comprehensive integrated waste management facilities to serve rural Indonesia different scales, which can be used for learning and references by other communities across Indonesia. This includes implanting learned knowledge into creating waste strategies in Pangandaran, West Java – the project's case location.
3. Launch a BIM design competition that enable academics, researchers, students and community partners in Indonesia to collaborate and practice engineering design techniques, in the applied context of solving the real and pressing civil engineering challenges with waste management infrastructure in Indonesia.

ACTIVITIES UNDERTAKEN

Feasibility studies

One of the first tasks led by ITB was to compile data for waste quantities and types for relevant scales of facility. The programme derived a meaningful set of benchmarks for the area that would be applied to other locations. Visits were made to Pangandaran Regency area, including villages of Batukaras and Margacinta, to survey potential locations for a 'Material Hub' facility. Relevant local stakeholders were consulted. During our team's feasibility assessment, we identified that due to the operational patterns of local government and responsibilities for waste, it would be logical to consider 'village' and 'regency' scale waste facilities, so any consideration for a 'district' scale waste facility was eliminated from the design competition. We concluded that Bojong Salawe site and the Margacinta village were the two most suitable sites from regency and village level for further study.

Drone Survey

Multiple aerial surveys using unmanned drones were carried out and 3D visualisation of the sites were produced to help inform the design competition process.



Figure 1 Aerial images showing the Bojong Salawe Site (L) and Margacinta Village (R). These two sites were identified as suitable for the design competition case studies to represent the regency and village level.

Pyrolysis Steering Group

In order to conduct an analysis of available pyrolysis technologies at applicable scales for this IAPP, we set up a dedicated pyrolysis steering group. Research findings were summarised into detailed options appraisal matrix, which helped us identify the most suitable available technology at the relevant scales. A gap analysis identified a lack of availability of robust test data for this relatively new technology, resulting in very few recommendable options for relatively small-scale waste facilities. This briefing document brought together the research work from earlier programme stages including waste quantities, site surveys, pyrolysis technology information and precedents studies.

International BIM Multi-disciplinary Design Competition

We ran an international BIM multi-disciplinary design competition for LSBU and ITB students where students were asked to design a suitable waste recycling facility (material hub) for the chosen sites. Around 50 students who took part in the design competition, has background in tourism, planning, architectural technology, architecture, architectural engineering, environmental engineering, building surveying, and landscape architecture. The use of local and renewable materials, such as bamboo, were encouraged as part of the design brief. Four multi-disciplinary groups consisting of a mix of ITB and LSBU students were formed with supporting tutors and mentors assembled.

A series of workshop and BIM training were carried out in ITB campus in Bandung and at LSBU in London on January 2019 to brief participating students. Weekly virtual meetings were scheduled for students from both countries to meet and the associated mentors to discuss the project further. In March 2019, we carried out a dissemination workshop at LSBU and an additional hands-on bamboo pavilion workshop led by Dr Andry Widyowijatnoko of ITB, to raise awareness of the use of bamboo as sustainable materials for tensegrity structure. This workshop brought together other academics from different faculties and various undergraduate and postgraduate students.



Figure 2 Workshop with ITB team and students, January 2019.



Figure 3 Example of Material Hub design: Circle Team (Margacinta site) (L) and Team Divergent (Bojong Salawe Site) (R). By creating partnership that values creativity, innovation and knowledge sharing, we have ensured that the educational benefits of the project were widespread. Participating students have also gained direct experience of industrial-scale problem solving within an international, multi-disciplinary context.

IMPACTS AND OUTCOMES

This project enabled us to carry out ongoing dissemination work in Indonesia, utilising the scheme designs and technical brief to inspire and inform local communities in creating better waste management infrastructure. It has helped in raising awareness among the local government and influencing future policy-making.

We were able to utilise the mentoring framework developed in our team's previous IAPP programme to continue supporting the local community and empower them to manage their waste better. The project brought together different communities, stakeholders and experts from different disciplines to create unique solutions to waste management challenges in Indonesia. The output of the design competition has resulted in a genuinely realistic and realisable design solution, which was fed back into the local and regional government to aid them in the future policy-making.

By offering realistic visualisations of what a 'Material Hub' might look like, the design competition also gave an exciting vision on how a sustainable approach to waste and material management can be both beautiful and functional, and help turn people's perspectives from 'waste' as the end point, into it being a 'material resource' in the middle of a continuous cycle.

The tourism planning and innovative socio-economic enterprise strategies that have been part of the student design competition can help local stakeholders in communities to understand there can also be an economic advantage to managing waste better and investing into waste management infrastructure. There has been many positive impacts on faculty and student engagement enabled by the IAPP programme. A larger number of different faculties were brought together by the programme in order to derive holistic and real-world creative responses.



Figure 4 BIM workshop at ITB (January 2019) (L). Bamboo workshop pavilion at LSBU (March 2019) (R) Students and staff have both had opportunities to work closely with teams they might not otherwise have interacted with, and therefore many exciting learning opportunities have unfolded. BIM training and seminars provided by Jennifer Hardi from LSBU were enthusiastically received by students at ITB and this has contributed to a mind-set of collaborative working. The industry partners on the review panel were impressed by the quality of the student submissions and the level of engagement considering the competition was taking place as an extra-curricular self-motivated activity, which enhance students' employability skills further. By encouraging this innovative international multi-disciplinary working among professionals, students and academics, we have laid strong foundations to a better infrastructure that could be repackaged as an educational tour programme for the visitors.

As part of the internationalisation strategy at LSBU, we have used the sites in Indonesia as part of the undergraduate curriculum where they are required to design a sustainable building within the Construction Practice module. This module consists of over 300 students studying courses ranging from architectural technology, architecture, building surveying, project management, construction management, civil and building services engineering. It enhances students' employability skills as they tackle real-world challenges.

FUTURE PLANS

Members of the IAPP team hope to work together in future collaborations to further support an improved waste management situation for Indonesian coastal communities. We will be looking into future funding opportunities to enable this. We also hope to carry out capacity building activities and collaborating with our contacts in the neighbouring country, Malaysia, to expand our knowledge, share lesson learned and best practices.

ITB has submitted a proposal to the Indonesian government for funding to construct one of the 'Material Hubs' at village scale on the Desa Margacinta site identified by our programme. ITB have also been carrying out follow-on research activities regarding pyrolysis technology using the site of the larger regency scale waste facility sites.

CLEAR Community and Mantra (via MPH Bali) intend to disseminate the inspiring designs as part of their continuing efforts to mentor, support and facilitate communities in Indonesia that wish to take action towards better waste and material management.