News Article for RISUD Interdisciplinary Research Scheme

		Name	Department
1.	**Principal Investigator**:	Prof. Heng LI	BRE
3.	**Project Title:**	Key Technologies for Developing Offshore Jack-up MiC Factories in Hong Kong	

4. **Annual Progress/Achievement (***in layman's language, no more than two A4 pages, pls attach a few figures***)**

The functional areas required for offshore platforms have been determined based on the Modular Integrated Construction (MiC) production process. These include the Office area, Material storage area, Modular production area, Modular stacking area, Ancillary facilities area, Sewage treatment area, and loading and unloading area. Considering the challenges that may arise during the production process, the requirements, technical characteristics, and interrelationships between each functional area and its surrounding areas have been thoroughly analyzed. To begin, a digital 3D model of the MiC factory was established using a fixed platform to simulate the coordination between different functional areas and identify potential layout issues. Subsequently, an offshore jack-up platform was utilized for the design of the MiC factory. Recognizing the limited space available on the offshore jack-up platform, two options were proposed: a single platform and multiple platform coupling. Finally, recommendations were provided to select the appropriate platform solution based on the specific project requirements.

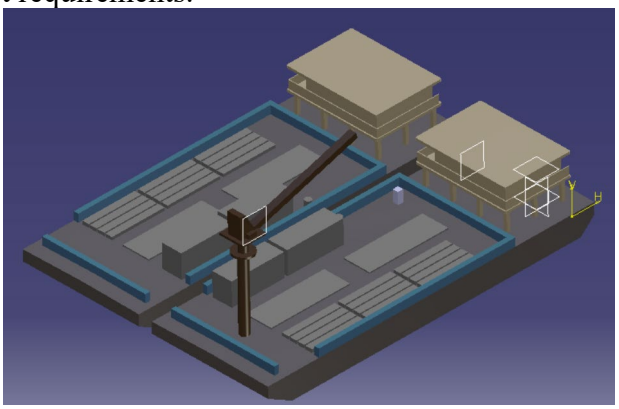

Figure 1. layout of the offshore MiC factory

A finite element model of the offshore jack-up platform has been developed to simulate its structural response in complex marine environments. This model considers wave loads as well as the fixed and movable loads of the MiC factory. It utilizes simplified rigid body modules and flexible connector models to simulate multiple platforms assembled. By modifying different stiffness parameters to simulate various platform connection methods and observing their structural mechanical responses, the appropriate connection methods and platform structural schemes that meet stability and load-bearing requirements have been determined.

Field mechanical performance experiments are currently being conducted on an offshore floating platform to explore its feasibility as a MiC factory. According to the experimental design, the floating platform is moored near the dock in the open sea, and loads are arranged on the platform according to the factory layout. The sensor placement and wiring design for the floating platform have been completed. The installed sensors currently include strain gauges, displacement gauges, temperature sensors, accelerometers, wave gauges, and tension gauges for anchor cables. The data acquisition equipment has been connected to all sensors, and preliminary tests have confirmed its ability to collect data effectively. The floating platform experiment aims to accurately reflect the working loads and wave loads experienced by the offshore MiC factory during its operation, thereby validating its structural reliability.

A preliminary investigation has been conducted to select potential sites, resulting in the development of a selection rule. The PESTEL analysis was conducted to identify critical influential factors for location selection across six categories: political, economic, social, technological, environmental, and legal. Following the analysis, key factors were identified within each category. To represent these abstract factors, specific geographical elements were chosen. To determine the relative importance and preferences of these factors, the Analytic Hierarchy Process (AHP) method was employed. Pairwise comparisons and analysis were conducted using Satty's nine-point scale, assigning a higher scale (i.e., nine) to factors deemed extremely important compared to others. Expert consultations and inputs from experienced professionals in relevant fields were sought to establish the relative importance scales for the six factors. Subsequently, the importance weight for each factor was computed.

To gather data for location selection, relevant map data with the same spatial reference was downloaded. Then, a Geographic Information System (GIS) spatial database dedicated to site selection was established. Thematic maps were subsequently created for the AHP analysis, focusing on three aspects. Firstly, regions that meet the criteria of having service reservoirs and tapping points within a pipeline length of less than 2 km were selected as valid regions. Secondly, buffer zones were applied to suppress regions within a 1 km radius of public facilities and beaches to avoid them. Finally, the AHP method employed Euclidean distance to generate heatmaps for each factor. The final thematic map was created by overlaying the heatmaps of the six factors, weighted according to their respective AHP importance weights. Based on the resulting thematic map, four potential candidate sites were identified. These sites were then evaluated by considering the predetermined exclusion criteria and considering the AHP weights. Through this comprehensive analysis, a final location for the floating platform was determined. The chosen location for the floating platform is near the Lamma Power Station, covering an area of 6512 m^2.

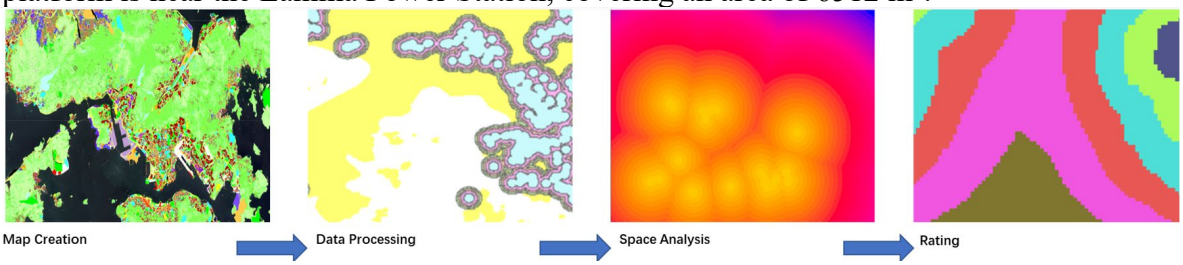

Figure 2. Location selection progress