ABSTRACT

Developed countries have built wealth and prosperity on the strength of their manufacturing sectors, with China's success story of lifting 800 million people out of extreme poverty in 30 years a sterling and most recent example of how manufacturing-led industrialization can foster economic development. Sub-Saharan Africa, unfortunately, find itself today in a similar situation as China did in 1990, with over 50% of the world's desperately poor 719 million people living in the region.

But unlike China, Sub-Saharan Africa is faced with the additional challenge of overcoming poverty in a world with stricter constraints to global trade and climate change limitations to modern-day industrialization. Compounding the challenges further is the region's limited know-how and human capital — a consequence of years of underdevelopment, creating a classic chicken and egg dilemma where the lack of industrialization perpetuates the dearth of know-how and human capital, and vice versa.

Considering these challenges, we investigate how chemical manufacturing and what chemical manufacturing approaches can be leveraged to effectively drive industrialization and economic development in Sub-Saharan Africa. We propose chemicals manufacturing using prefabricated modules – which are constructed offsite in places with available human capital and transported to be assembled in places where they are needed – as a flexible and needed approach.

However, Economy of Scale, which generally favors large-scale chemical manufacturing, poses as a major constraint to such modularization approach, especially given the presently small serviceable market sizes in Sub-Saharan Africa due to low purchasing power parity. We thus utilize mathematical modeling techniques to determine and establish scenarios for economic viability of the proposed approach, providing modeling frameworks and introducing measures for further studies in the process. We also provide and analyze exemplary flowsheets synthesized for a net-zero carbon emissions chemical manufacturing paradigm in the region.

This work concludes with a prefeasibility study of a chemical manufacturing project in Nigeria, as part of the author's quest to build prefabricated modular plants across Africa.

Modular plants are attractive as they can be tuned to market demand of a developing market and region that needs them, putting less capital at risk.

This thesis is intended to be a vanguard of potential solutions to the complex challenges to industrialization in Sub-Saharan Africa. It endeavors to pave the way for addressing these issues through chemical manufacturing, offering valuable insights for sustainable progress.