

A development lens to resource constrained innovation: Exploring frugality in medical device manufacturing in South Africa

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This study aims to contribute to a better understanding of innovations for and under resource constraint in a critical sector such as healthcare, and to connect it to the broader innovation and development discourse. The lack of affordable and appropriate medical devices for resource constrained setting to meet the needs of low- and middle-income countries (LMIC) is a global health concern. Most medical devices are designed by firms from high income countries with a focus on their home markets. There is an urgent need to better understand firms deeply embedded and appreciative of resource constraint settings as alternate sources of frugal medical devices. Keeping this problem in the backdrop, this research is an exploration of resource constrained innovation with the (medical devices) manufacturing firm in the Global South at the centre of the analysis. It seeks to examine the orientation of these innovative firms, the directionality of innovation towards development and the conditions shaping this directionality.

The overarching question guiding this research is: *How does resource constrained innovation influence the direction of technological change?* In a highly interconnected and globalized world, technological change from innovations mostly originating from resource rich high-income countries has reproduced and magnified prevailing inequalities, further marginalising the vulnerable and creating enormous problems of social justice. Meanwhile, there has been an explosion in frugal innovation literature over the last decade rooted in business and management literature focusing on innovation *for* resource constraint and market-based approaches of innovation diffusion. However, innovation *under* constraint and manufacturing small and medium enterprises (SMEs) in developing countries remain under researched. This thesis focuses on manufacturing firms in developing countries, which have traditionally been intrinsic to the technology and development discourse. It advances a “development lens” to resource constrained innovation taking into consideration both innovation for and under resource constraint. While one enhances individual capabilities by addressing unmet needs through availability and access to frugal innovations; the other contributes to firm level capability through high value engagement of local manufacturing firms in the innovation and production process. The core proposition advanced in this thesis is that the direction of innovation and technological change emerging from these processes is more likely to be inclusive when both these capabilities can be enhanced.

This research studies medical devices from manufacturing firms in South Africa, using both primary and secondary empirical evidence. South Africa is a middle-income country, with a sophisticated industrial base, legacy of biomedical innovation and a growing medical device manufacturing sector. However, South Africa is also confronted with challenges of poverty, unemployment and inequality and economic stagnation. This offers a fertile ground to study the tensions that characterise a resource constrained environment.

Using empirical evidence from innovative manufacturing firms in South Africa, this study investigates frugal orientation and mechanisms to innovate under constraints, in a technology intensive sector typically under the purview of western firms. Systematic analysis of six devices by adapting a global health lens reveals that while some innovations specifically address health challenges of low resource, others are more affordable technological innovations with universal relevance and some frugal elements. Resource constrained innovation strategies involved building advanced internal manufacturing capabilities to overcome institutional voids while forging multiple knowledge collaborations to complement inhouse capabilities. The evidence suggests fundamentally new products were designed in collaborative bottom-up processes. The role of the state and global non-profits in harnessing frugal innovations for public health was found to be critical. These results are published in a single authored article entitled “*Resource constrained innovation in a technology intensive sector: Frugal medical devices from manufacturing firms in South Africa*” in the journal *Technovation* in April 2022.

In another exploration, firm-level innovation processes were analysed by adapting the heuristics of an ‘institutional triad’ to highlight the institutions, interactions, and tensions between the three stages of innovation – generation, production, and diffusion – which are influenced by different policy domains. It discusses the ways in which South Africa – through the harmonisation of policies – can enable its medical device manufacturing sector to reconcile the twin objectives of industrial growth and social development, including lowering its own healthcare cost. Further, inclusion in micro-level processes and capabilities of the firms are investigated. These results are published as a co-authored chapter titled “*Enabling Inclusive Technological Change through Transformative Policies: Frugal innovations from medical device manufacturing firms in South Africa*” in the book “*Transformative innovation in times of change: lessons for Africa from COVID-19*” (forthcoming). This research finds that the relationship between resource constrained innovation and development is not straightforward and the direction towards inclusion, while possible under certain conditions, is fragile.