

A Framework for Systems Approach towards Solving Socially Relevant Engineering Problem

This research explores systems approach to address socio-technical problems of resource constrained communities in rural areas of India. It emphasizes cluster-specific technological interventions where specifications of similar needs vary significantly from region to region, demanding customizable solutions. Designers and researchers from various academic institutions voluntarily invest part of their professional engagements in developing technologies to enhance livelihoods of the resource constrained communities. However, academic professionals face several challenges, primarily due to limited bandwidth in terms of their time and expertise. To improve the effectiveness of technology interventions undertaken by academic institutions, current research was conducted. A qualitative action research method was employed to identify the challenges faced by the academic institutions in developing technologies for resource constrained communities and strategies to mitigate them. The strategies were validated through their implementations in the projects of the Rural Technology Action Group. This thesis proposes Human-Centered Systems Engineering (HCSE) framework as a systematic approach for addressing cluster-specific engineering problems of resource constrained communities. The HCSE framework integrates elements of Human-Centered Design (HCD), Systems Engineering (SE), Methodology for Systems Design for Sustainability (MSDS) and Technology Readiness Level (TRL) scale. It emphasizes the development of Product-Service Systems (PSS) with a strong focus on socioeconomic sustainability. A Rural Technology Intervention Assessment (RTIA) tool is developed based on the HCSE framework to monitor and evaluate cluster-specific technology interventions. The tool provides a structured approach to assess the progress of the intervention and the TRL. HCSE framework was implemented to address the challenges faced by artisans in India who rely on traditional hand-operated lathes to craft beads from the stems of Holy Basil for making garlands, resulting in discomfort, physical strain and fatigue. The present research details two designs of wood-turning lathe specifically customized for making beads: one incorporating a timing belt and pulley and another with an electronic drive mechanism. The effectiveness and performance of the new devices were assessed by comparing them to traditional hand-operated lathes based on productivity, maintenance requirements, earnings and affordability. Results indicated that artisan productivity and earnings doubled with the new devices. The HCSE framework was also applied to the Potter's Kiln project, demonstrating its applicability to address rural technology interventions.