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Proposal Title: Convergence Accelerator Phase I (RAISE): Product Design and
                 Manufacturing Graph-as-a-Service
Institution: North Carolina State University
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The NSF Convergence Accelerator supports team-based, multidisciplinary efforts that address challenges of national importance and show potential for deliverables in the near future.

The broader impact and potential societal benefit of this Convergence Accelerator Phase I project is to facilitate innovation by lowering the barriers for developers and designers to engage in product design and manufacturing activities. This project will initiate the development of a tool in which algorithmic design bots will assist and collaboratively aid a novice user to design personalized consumer products. The goal of this Phase-I Convergence Accelerator project is to bring together a team of experts ranging from engineering, cognitive sciences, and computer sciences, along with broader stakeholders including industry, non-profits, and government scientists to build a technology roadmap for the design and implementation of an Open Knowledge Network Graph in Product Design and Manufacturing (called M-OKN). Project activities will be informed by input provided by future users through a customer discovery process. The long-term goal of this project is to lower the barriers for students, entrepreneurs, and even experts to design new products without having to rely on significant experience and subject matter expertise in manufacturing. The end goal is to develop a tool that can help improve U.S. competitiveness in advanced manufacturing.

Every object around us that has been produced by humans required extensive design effort, whether it is an everyday consumer product or a large and complex engineered system. Yet, much of the knowledge required to design products and to manufacture them resides primarily in human minds - developed over years of experience or published in the form of books, articles, blogs, and online videos. Such knowledge can often only be gained by intensive study in fields of product engineering or requires extensive research and trial and error. The goal of this project is to make design and product development more accessible by developing a product design and manufacturing knowledge network that links 3-D product model information, including the visual relationships between parts, with underlying meta-data that includes detailed part information and data associated with the manufacturing of the part. A large amount of unstructured, structured, and semi-categorized data will be collected from the web and will be further processed and analyzed using novel geometric deep learning and natural language processing algorithms. The collected data and computational tools will be refined to create a knowledge network that powers design bots that can answer queries and assist design. Ultimately the research community, students, and the general public will obtain access to this open-sourced knowledge network which can help accelerate manufacturing innovation and entrepreneurship. In addition, the M-OKN project will advance new convergence research at the interface of design and manufacturing sciences with informatics and artificial intelligence.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.