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Title: Differences in Use of Rapid Prototyping between Novice and Expert Design Engineers

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Abstract:

Rapid prototyping offers engineers the opportunity to explore complex design alternatives more rapidly, and thus more thoroughly, than traditional machining techniques. Yet, we find vastly different approaches to incorporate rapid prototyping into product development by different designers. Practices can differ in terms of approach to the problem or complexity of the component. Some designers may produce simple structural members that position functional elements, while others may pursue complex functional assemblies requiring multiple build iterations. We hypothesize this difference is largely attributable to design experience, that more experienced users have far less build iterations with rapid prototyping. Conversely, we hypothesize that the ease of generating hardware builds afforded by rapid prototyping has enabled novices to rebuild their hardware easily, thereby enabling a practice of perhaps over-reliance on iterative design. This paper reports on a study comparing the problem solving approaches of two different sets of designers. The first is a set of expert users involved in a small-scale robotics project that made heavy use of 3D printers. The second is a novice group working on a class assignment with identical equipment towards comparable design objectives for parallel development of the same robot. We find that while experts use this speed to test competing concepts, novices focused their efforts on iteratively testing and redesigning parts for a single concept. The

novice's iterations were particularly for part-to-part geometric mates, and component strength testing. This evidence supports our hypothesis, and therefore has interesting implications on how to make use of rapid prototyping in design education, depending on the objectives of the course. Courses with an engineering analysis focus to the design process ought to limit the number of prototype builds, so more concentrated thought may be put into each build rather than craft based experimental discovery.