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ABSTRACT

Agile Hardware Development for Direct Manufacturing

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Product development is increasingly taking place under volatile, uncertain, complex and ambiguous (VUCA) conditions. To remain competitive under these circumstances, companies need to find ways to become more flexible and responsive to changes that are happening permanently during product development process. In the agile development methodology, volatility is seen as an opportunity rather than a threat, which has already proven beneficial for dealing with changes under VUCA conditions. From a manufacturing perspective, additive technologies are well suited for this purpose, too, as they can mitigate some of the negative effects of design changes with practically unit-independent manufacturing costs and increased geometric freedom. Combining additive manufacturing (AM) with agile hardware development is therefore of great interest to industry. However, the focus of industry stakeholders and research has so far been solely on accelerating established agile frameworks, such as Scrum, through rapid prototyping. We argue that, in addition to efficiency, the quality of additively manufactured end products can also be improved through the application of agile hardware development. To achieve this, we explore the synergies between the principles of agile development and the current challenges faced by industry stakeholders in developing products for AM – especially focussing on direct manufacturing. This work consolidates findings from a recent industry study and the current state of the art regarding the use of additive manufacturing in agile hardware development to derive a new agile direct manufacturing framework.