



Third Wave Do-It-Yourself (DIY): Potential for prosumption, innovation, and entrepreneurship by local populations in regions without industrial manufacturing infrastructure

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ABSTRACT

There is a new Do-It-Yourself (DIY) paradigm that involves ordinary people inventing, designing, making, and/or selling physical goods ranging from jewellery to off-road vehicles. Via websites, this DIY involves combining the read-write functionality of Web 2.0 with computer-aided (CAD) design and additive manufacturing. In addition, the new DIY is carried out at workshops where people use handheld tools together with CAD and manufacturing machines. There have been two earlier waves of DIY: subsistence DIY (First Wave) and industrial DIY (Second Wave). It has been claimed that the new, Third Wave, DIY paradigm is revolutionary for prosumption, for innovation, and for entrepreneurship. Furthermore, it has been claimed that Third Wave DIY could be carried out by anybody at any location. However, much Third Wave DIY involves participants who are literate in a “lingua franca”, and have computer skills. Furthermore, Third Wave DIY is often reliant on infrastructure used in industrialized manufacturing. Findings are reported from a study investigating the potential for Third Wave DIY to better enable prosumption, innovation, and entrepreneurship – particularly by local populations that lack functional literacy in any “lingua franca”, computer skills, and access to industrial manufacturing infrastructure. Study findings suggest that while Third Wave DIY is revolutionary, its expansion may never be fully viable without subsidy of innovation activities. However, in many parts of the world, prosumption of basic goods may be more important initially than innovation of new sophisticated goods. This can be enabled by combining Third Wave DIY technologies with mobile production facilities.

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1. Introduction

In his book, *The Third Wave* [1], Alvin Toffler describes three waves of societies: agricultural, industrial, and informational. There have been three such waves of DIY: subsistence DIY (First Wave), industrial DIY (Second Wave), and the new DIY (Third Wave). Within subsistence DIY, people grow what they eat and make what they need without regularly making purchases in a marketplace. For

example, people build their own houses with local natural materials [2]. Within industrial DIY, people buy made-to-forecast (MTF) kits of goods such as kits of pre-designed boats and furniture. These MTF kits are sold, together with standardized instructions, for self-assembly [3]. By contrast, Third Wave DIY draws upon the read/write functionality of the Internet, and digitally-driven design/manufacture, to enable ordinary people to invent, design, make, and/or sell goods that they think of themselves [4].

Via websites, such as *Shapeways*, Third Wave DIY involves combining the read-write functionality of Web 2.0 with computer-aided (CAD) design and additive manufacturing (AM) [5]. In addition, Third Wave DIY is

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carried out at workshops, such as *Techshops*, where people use handheld tools together with CAD and manufacturing machines [6]. It has been claimed that Third Wave DIY is revolutionary for prosumption, for innovation, and for entrepreneurship. Furthermore, it has been claimed that Third Wave DIY could be carried out by anybody at any location [7–9]. Here, prosumption refers to individuals and communities producing what they consume; innovation refers to new types of physical goods; and entrepreneurship refers to bringing new types of physical goods to market [10,11]. In this paper, findings are reported from a study investigating these two claims for Third Wave DIY: it is revolutionary, and it could be carried out by anybody anywhere.

The claim that Third Wave DIY is revolutionary is investigated through comparative analysis with subsistence DIY (First Wave) and industrial DIY (Second Wave). Resource-based theory (RBT), knowledge-based view (KBV), and transaction cost economics (TCE) are applied throughout the analysis. Within RBT, advantage arises from having resources that are difficult to imitate or substitute [12–14]. Within KBV, advantage arises most from knowledge because, especially when tacit, knowledge can be the resource that is most difficult to imitate or substitute [15]. Within TCE, advantage arises from determining how best to combine internal resources and external resources [16,17]. RBT, KBV, and TCE have their origins in research carried out in the 1930s [16]. Over the subsequent decades, further research has revealed the limitations of initial research; and the three perspectives have been developed. There has been much scholarly debate about the three perspectives. However, they have not been integrated into a single theory; and none of them has become dominant [18,19]. Accordingly, each perspective continues to be applied widely in the analysis of production, innovation, and entrepreneurship [20–22]. Hence, comparative analysis of the claim that Third Wave DIY is revolutionary includes the three perspectives of resource-based theory (RBT), knowledge-based view (KBV), and transaction cost economics (TCE).

The analysis is informed by a literature review encompassing subsistence DIY (First Wave), industrial DIY (Second Wave), and new DIY (Third Wave). The research encompassed the many Third Wave DIY implementations in North America and Western Europe; and the relatively few implementations in regions without industrial manufacturing infrastructure. For example, prosumption of prosthetics in Sudan involving Third Wave DIY [23] was part of this study. Also, it included the investigation of enabling technologies referred to in reports about Third Wave DIY. For example, the survey of technology specifications, such as 3D printer production sizes. Where possible, the scholarly literature was referred to, however, Third Wave DIY is a rapidly emerging phenomenon that is reported more often in magazines, newspapers, and websites.

Also, the research encompassed mobile production facilities. This is because mobile Third Wave DIY production facilities are essential for regions without industrial manufacturing infrastructure. At the time of the research, lorry mounted production facilities are beginning to be

used in Third Wave DIY. However, their use is established outside of Third Wave DIY in a variety of peripatetic applications ranging from raw materials processing (e.g. production of dairy products from milk) to advanced goods manufacturing (e.g. production of helicopter sub-assemblies). Mobile production facilities are engineered-to-order to meet the particular requirements of specific production needs in specific regions, including those without paved roads, mains electricity and piped water. There is little consideration of mobile factories in the scholarly literature or in magazines and newspapers. Accordingly, review of their capabilities was focused upon information from companies that engineer and fabricate mobile factories.

The claim that Third Wave DIY could be carried out by anybody at any location is investigated. In particular, the potential is evaluated for Third Wave DIY by local populations that lack functional literacy in any of the “lingua franca” (such as English), computer skills, and access to industrial manufacturing infrastructure. This is necessary to determine to what extent Third Wave DIY technologies are appropriate technologies [24] for use outside North America and Western Europe where Third Wave DIY has originated. Assessment includes an examination of technical feasibility, operational practicality, and economic viability. These three factors are considered because technical feasibility alone is not sufficient for successful implementation of Third Wave DIY technologies. For example, Internet access may be technically feasible in a region, but frequent power cuts can limit operational practicality and scarcity of access can push up the price of access beyond economically viability. In order to further investigate feasibility, practicality and viability, use was made of a Web-based Third Wave DIY service to make small additive manufactured goods. Also, mobile production facilities were examined using a company that engineers and fabricates mobile factories as a proxy.

The remainder of the paper consists of six sections. In the next section, the state-of-the-art in Third Wave DIY is presented. In the subsequent three sections, the potential of Third Wave DIY are reported for prosumption, innovation, and entrepreneurship. In each of these three sections, there is comparative analysis with established DIY followed by assessment of potential for expansion. In the penultimate section, the merits of claims for Third Wave DIY are discussed. In conclusion, the principal findings from the study are stated.

The paper makes two contributions to the literature. First, a comparative analysis is presented of Third Wave DIY and the established types of DIY. The second contribution is an assessment of potential for Third Wave DIY expansion.

2. Third Wave DIY

2.1. Web-based Third Wave DIY

Third Wave DIY websites enable combination of the read-write functionality of Web 2.0 with computer-aided design (CAD) tools and digitally-driven manufacturing equipment such as additive manufacturing (AM) machines (e.g. 3D printers) and/or computer-numerically-controlled

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