Technology in Society 51 (2017) 1–7

Contents lists available at ScienceDirect

Technology in Society

journal homepage: www.elsevier.com/locate/techsoc

Moveable social manufacturing: Making for shared peace and prosperity in fragile regions

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ARTICLE INFO

Article history:
Received 19 January 2017
Received in revised form
5 July 2017
Accepted 5 July 2017
Available online 6 July 2017

Keywords:
Moveable factories
Social manufacturing
Distributivism
Fragile states
Fragile regions
Emerging economies
Somalia

ABSTRACT

It has been argued that local people making what they need with moveable factories can improve potential for peace and prosperity. In this paper, moveable social manufacturing is described in the context of fragile regions in Somalia. Moveable manufacturing involves means of production that are designed and fabricated to be moveable. They can be used to carry out a wide range of production work from agricultural processing to manufacturing complicated mechatronic assemblies. Moveable factories have received little attention in the literature, but have already started to be used in challenging environments from Afghanistan to Uganda. Social manufacturing involves people sharing the efforts, means and rewards of production. The reported research involved literature review and field study in Somalia. Study findings indicate that moveable social manufacturing is relevant to fragile regions of Somalia. In particular, study findings indicate that the best opportunities for moveable social manufacturing may be scaling up artisanal production, while seeking to add market value through focusing on brand authenticity and integrity. Moreover, moveable social manufacturing has potential to contribute towards reducing the socio-economic polarization, which has developed in many emerging economies.

1. Introduction

For brevity, different means of moveable production can be summarized with the simple term: moveable factories. This includes production equipment being transported in large carry cases, in the back of a truck or inside shipping containers. Also, production equipment can be skid-mounted. This involves complicated production equipment being mounted on a pallet, onto rails, and/or in a frame [1,2]. Although moveable factories have received little attention in the literature, they have already started to be used in challenging environments from Afghanistan to Uganda. It has been argued that local people making what they need with moveable factories can improve potential for peace and prosperity [3,4].

In this paper, findings are reported from a study concerned with moveable social manufacturing in Somalia. The study comprised multivocal literature review and survey research in Somalia. Multivocal literature reviews extend beyond scientific literature to online reports. Multivocal literature review is appropriate when the topic of a study is developing quickly and/or there few scientific papers on the topic [5–7]. Survey research involved three visits to Somalia between 2015 and 2017, which was then a country with some fragile regions [8,9].

By 2016, there were some moveable factories in Somalia. These included skid-mounted moveable factories for milling, vitamin fortification and sacking of crops; and moveable factories used on construction sites for processes such as crushing rock for concrete, manufacturing drainage pipes, and fabricating joinery. Furthermore, some returning members of the Somali diaspora have experience of moveable factories. In the United States of America (USA), for example, moveable factories are widely used in agricultural production: a sector employing thousands of Somalis [10,11]. Moreover, some mobile factories have been developed in the USA to address the market among Somali immigrants for fresh agricultural goods [12].

The remainder of the paper comprises four sections. In section 2, analyses are provided of findings from literature review concerning moveable factories and social manufacturing. In section 3, findings from Somalia are reported. In section 4, discussion is provided of implications for practice and for research. In section 5, conclusions are stated. Overall, the paper provides two contributions to the

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http://dx.doi.org/10.1016/j.techsoc.2017.07.003
0160-791X/

literature. First, comparative analyses are provided of moveable social manufacturing. Second, moveable social manufacturing is related to the competitive dynamics of efforts to make peace and prosperity in fragile regions.

2. Moveable social manufacturing

2.1. Moveable factories

Moveable factories can cover rough terrain and carry their own power generation. Thus, there is no need to construct extensive built infrastructure, such as factories, power grids and roads, before manufacturing can begin. Hence, moveable manufacturing enables established prerequisites for industrial manufacturing to be leapfrogged over, just as mobile text-based money transfers enable the established prerequisites for banking to be leapfrogged over [13–15]. Detailed analyses of moveable factories have been reported in, within two previous Technology in Society papers [3,4]. Here, a short summary of those previous analyses is stated. Then, three examples of their relevance for fragile regions are provided.

In summary, moveable factories offer lower investment costs, lower operating costs, lower opportunity costs, and lower cultural costs than fixed factories. This is because they do not incur the costs of constructing and maintaining built infrastructure. At the same time, vehicles that would be needed for transportation to and from fixed factories can be moveable factories. Thus, investment in vehicles can be far more productive. Furthermore, moveable factories are culturally compatible with peripatetic pastoral cultures, for example, of Somalia. As well as low costs, moveable factories offer high flexibility by being able to carry out high performance manufacturing where ever and whenever needed. For example, moveable factories can go to where livestock and crops are, and go there when they are most ready for processing. In addition to production at points of supply, moveable factories can enable in-situ production of sophisticated mechatronic assemblies and other components at points of demand. Importantly, very little time is needed for training people to use moveable factories, and the maintenance required for them is no more than that required for the trucks that are kept moving across rough ground in many parts of the world [3,4]. The durable versatility of moveable factories is indicated by their use at agricultural land, conflict zones, and construction sites [16–18]. For example, moveable factories can be built from repurposed cargo containers, which make them easy to transport anywhere [19].

Moveable factories have their limitations. For example, they are not suitable for large-scale heavy industrial processes such as the conversion of iron ore into steel. Also, they are not suitable for the mass production of large consumer goods, such as the cars of global automotive brands. However, their low costs and high flexibility make them particularly well-suited to many types of production in fragile regions. Nonetheless, careful consideration needs to be given to the costs involved in transportation, on-site set-up work such as checking machine calibrations, and possible dismantling for storage if moveable factories are not used all year round [20].

Here, three examples are provided: 3D printing prosthetics far away from medical facilities; making buildings from rubble; and agricultural production without packaging. 3D printing prosthetic hands far away from medical facilities can be done in carbon fibre-reinforced co-polyester material for under 75 US Dollars (USD) on a 3D printer costing less than 2000 USD. This type of moveable production can involve individual manufacturing machines, such as 3D printers, which can be picked up and carried, and/or moveable factories containing a variety of production machinery. Local people can be trained to produce prosthetics and can be provided with 3D printers and materials to do so [21]. Moveable factories can be used to convert the rubble of destroyed buildings into interlocking blocks. This involves crushing, filtering, and liquefaction of rubble into a mixture for making blocks. After preparing the mixture, the interlocking blocks are cast. Then, the interlocking blocks are stacked together securely without requiring cement or mortar. The whole process of rubble conversion, block casting, and building construction is designed to be carried out by local people who do not have relevant previous experience [22].

In agricultural production, moveable factories introduce many opportunities to reduce packaging. The more packaging that is eliminated, the more the health hazards arising from the accumulation of packaging waste can be avoided [23]. For example, agricultural produce, which is processed in moveable factories, can be sold directly from moveable factories. This eliminates much packaging and the transportation of packaging. At the same time, local crop processing with moveable factories can reduce the costs of multiple handling, crop damage, and other post-harvest losses. Moreover, use of moveable can increase yields because harvesting and processing can be done more gradually, instead of all at once when not all of a crop is ready. A summary of opportunities to reduce packaging is shown in Fig. 1. This shows that as well as opportunities to eliminate packaging, moveable manufacturing can better enable no growth of packaging stock, bio hybrid packaging, and bio based packaging. In particular, autogenous milling machines can be transported easily to process existing packaging waste and bio mass. These milling machines consist of rotating cylinders that cause the attrition of inputted materials into smaller particles. Autogenous milling machines can be as small as 1 m long by 1 m wide by one and a half meters high [24,25].

As moveable factories involve far lower capital costs than fixed factories, they offer lower barriers to development. Nonetheless, capital investment is still required that may be beyond the financial resources of individuals. However, the capital costs involved are more economically viable for co-operatives formed by groups of individuals: especially when they are supported by diaspora remittances and associations [26].

2.2. Moveable social manufacturing

Social manufacturing involves people sharing the efforts, means and rewards of production. Social manufacturing has been carried out for millennia. It is related to long established movements in shared ownership such as cooperatives and distributivism [27,28]. Social manufacturing can involve very large scale operations, such as the Arla Foods agricultural cooperative and the Mondragon industrial cooperative [29]. Also, it can involve small cooperatives founded upon manual production [30]. Since beginning of the new century in 2000, social manufacturing has also been related to digitally-enabled social manufacturing introduced by social media and digitally-driven manufacturing machines [31–34].

As summarized in Table 1, the social characteristics of different types of manufacturing can be considered in terms of several criteria including: social purpose, social process, social technology, and how they all contribute to social sustainability. For example, moveable social manufacturing can be considered to have high social purpose and cooperative social processes when compared to corporately owned fixed centralized factories that are so highly automated and employ so few people, if any, that they can be “dark factories” where there is no need for lighting [35]. Fixed distributed manufacturing can be in between these two extremes by providing human employment and some social process in, for example, flexible and reconfigurable manufacturing systems [36]. Whilst there may be little need for use of social media in “dark factories”, social media can be useful in both social and fixed distributed manufacturing to better enable the communication of messages