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DEVELOPMENT OF NOVEL MATERIALS FOR HOME BASED LOW COST ADDITIVE MANUFACTURING USING AI

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ABSTRACT

Greater substance The Third Modern Uprising, also known as assembly (AM) or "3D printing"), enables businesses and individuals to "print-out" durable objects layer by layer based on access to 3-layered PC information. A few creators have raised the possibility that AM can reduce the number of steps in the traditional store network and to fundamentally reform manufacturing activities and supply chains. Proof suggests that AM innovation may achieve precision, speed, moderateness, and a variety of materials as a driver of store network transformation. As a result, it may be possible to rebuild objects with fewer parts and to produce goods nearer to the customers. Aviation, auto, medical, and consumer goods are the main industries where creation uses of AM breakthroughs may be found.

Even though several companies are already utilizing AM innovations, there are distinct issues with the execution cycle. Particularly concerning the inventory network, emphases on AM execution are frustratingly lacking. The majority of analyses of retail networks focus primarily on potential AM disruptions in dispersion/operations and consequently on the assembly site. As a result, it is important to examine the essential AM execution aspects at each stage of an inventory network, starting with the choice of natural substance hardware providers and ending with the customers.

Key: Development, Novel, Materials, Home, cost, Additive, Manufacturing, AI.

Introduction

AM innovation has the capability of improving on supply chains as it is fit for diminishing the quantity of parts in an item and in this manner the quantity of connections in a store network. This is on the grounds that the innovation contrasted and customary strategies can convey new items, which require profoundly particular designs, with less material in different areas. Thus, AM can lessen the requirement for warehousing, transportation, and bundling and in this manner draw out the capability of accomplishing fast creation near the end clients. Thus, AM can empower organizations to accomplish circulated producing (Walter et al. 2004; Khajavi et al. 2014; Durach et al. 2017).

Research approach

The specialist has followed an inductive exploration approach. Thomas (2006) states that this kind of approach starts with the assessment of explicit data corresponding to the exploration region, then an underlying hypothesis starts to arise, which will be investigated later so as to foster an idea or a structure. The creator expresses that the motivation behind the system is to consolidate the vital subjects according to the exploration region (Thomas 2006).

Choice of Technique

The scientist will follow a contextual analysis research related with the subjective exploration approach to have the option to concentrate on inside and out the AM execution factors inside the inventory network. Notwithstanding, the contextual analysis all alone can't give a sufficient approach to the focal examination question thinking about additionally the exploratory idea of the exploration, which showed by the absence of execution concentrates on in the field of AM. In this manner, the contextual investigation will be joined with foundation hypothesis to empower the scientist to utilize existing information on process innovation execution and foster an AM execution structure on store network (Yin 2014). Likewise, Voss et al. (2002) accentuated that when this exploration approach is applied in activities the board it can foster new hypothesis and increment legitimacy (Yin 2014; Voss 2002).

Research Contribution

The main commitment of the exploration is the improvement of the AM execution system from an inventory network viewpoint with specific accentuation on the medical services area. At the hour of composing this is the primary review which analyzes the AM execution process inside the store network of clinical gadget producers. Consequently, AM clinical gadget makers can involve it as an aide to foster their own execution plans.

Added substance Assembling

As per Sealy (2011) albeit that early AM tests date back to the 60s, it was only after the during the 80s that AM could be marketed with the utilization of related advances, for example, PC supported plan (computer aided design) programming, lasers and regulators. Wirth (2014) brings up that the historical backdrop of AM begun in the year 1986 with Charles Structure who licensed an innovation for printing actual 3D items from computerized information. He named this cycle 'Stereolithography' and established the organization 3D Frameworks, which later became one of the main organizations in the AM business (Sealy 2011; Wirth 2014).

Besides, Wallenius and Decade (2014) underline that Stratus' was the second key part in the AM business with fundamentally the same as starting points. Scott Crump with his development of melded testimony displaying (FDM) established the organization in 1989. As per the creators the field of AM is overwhelmed by the two business pioneers, Stratus' and 3D Frameworks. This is on the grounds that they produce AM machines in every one of the three innovation classifications, sell an extensive variety of AM materials destined to be viable with their machines, and proposition support administrations for their clients (Wallenius and Decade 2014).

Fused

The second most regularly utilized AM innovation after SLA is known as FDM and utilizations of the cycle can be tracked down in prototyping, displaying and make applications. Chua et al. (2003, p.114) depicted the FDM framework as follows: "the computer aided design document is cut into level layers after the part is situated for the ideal form position, and any vital help structures are naturally recognized and created. The cut thickness can be set physically to anyplace between 0.172 to 0.356 mm (0.005 to 0.014 in) contingent upon the requirements of the models. Apparatus ways of the form cycle are then produced which are downloaded to the FDM machine. The demonstrating material is in spools a lot of like a fishing line. The fiber on the spools is taken care of into an expulsion head and warmed to a semi-fluid state. The semiliquid material is expelled through the head and afterward kept in super slim layers from the FDM head, each layer in turn. Since the air encompassing the head is kept up with at a temperature beneath the materials' softening point, the leaving material rapidly hardens. Continuing on the X-Y plane, the head follows the apparatus way created by Fast Cut or Understanding producing the ideal layer.

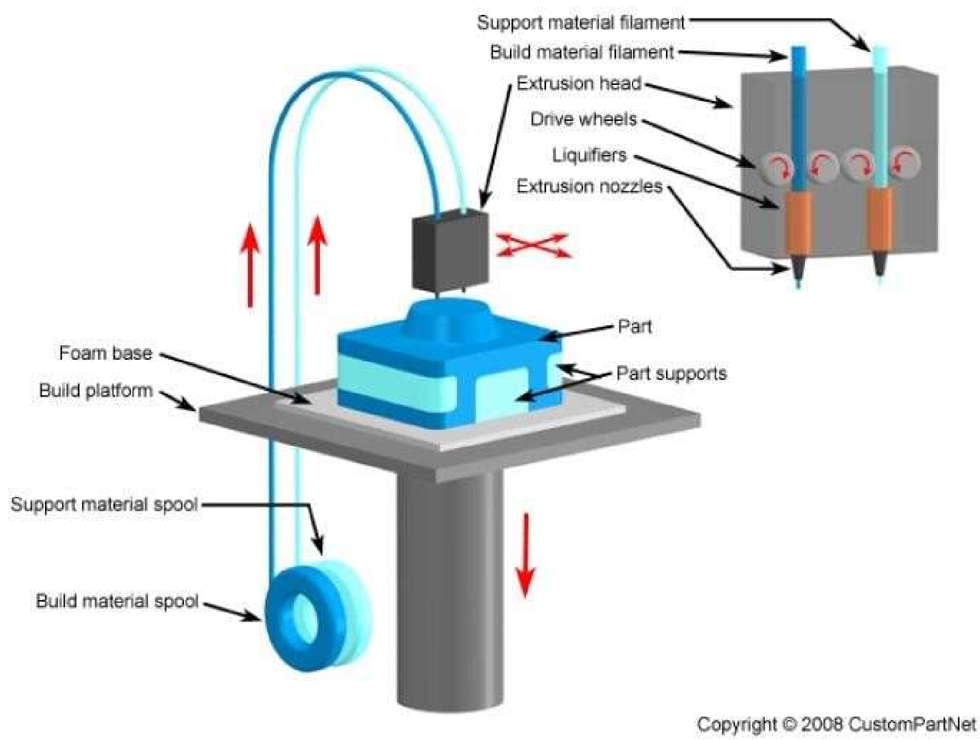

Figure.1: Fused Deposition Modelling (FDM) Source**: Custompartnet (2008)**

Inkjet Printing (IJP)

(2010, p.673) depicted the 3DP cycle as follows: "The cycle basically includes the launch of a decent amount of ink in a chamber, from a spout through an unexpected, quasiadiabatic decrease of the chamber volume by means of piezoelectric activity. A chamber loaded up with fluid is contracted in light of use of an outer voltage. This unexpected decrease sets up a shockwave in the fluid, which makes a fluid drop discharge from the spout. The launched out drop falls under activity of gravity and air opposition until it encroaches on the substrate, spreads under energy procured in the movement, and surface strain supported stream along the surface. The drop then dries through dissolvable vanishing. Late examinations show that drop spreading and the last printed shape firmly rely upon the consistency, which thus is an element of the molar mass of the polymer. All the more curiously, the previously mentioned bunch likewise found a printing level reliance of the last dried-drop width, which was a component of the polymer focus" (Singh et al. 2010, p.673).

Kruth et al. (2007) noted that although, IJT offers accuracy and surface quality the slow build speed, the few material options and the fragile finished parts makes this technology almost solely suitable for prototyping and investment casting (Kruth et al. 2007).

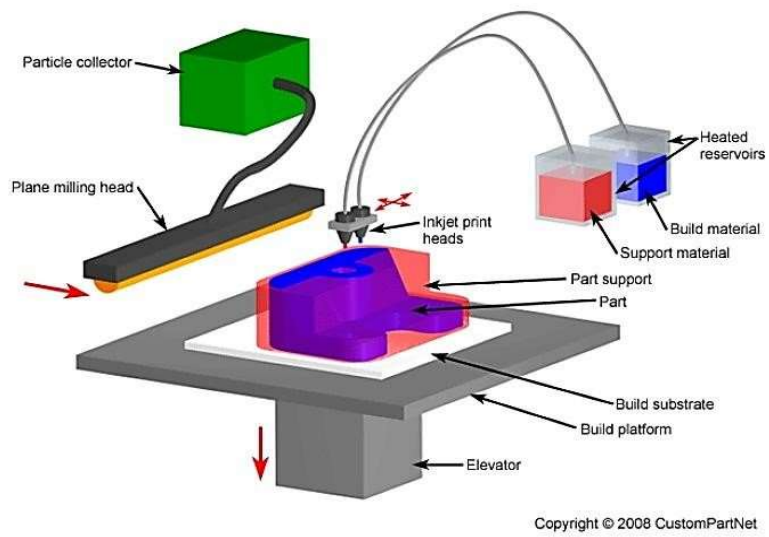

Figure 2: Inkjet Printing (IJP) Source: Custompartnet (2008)

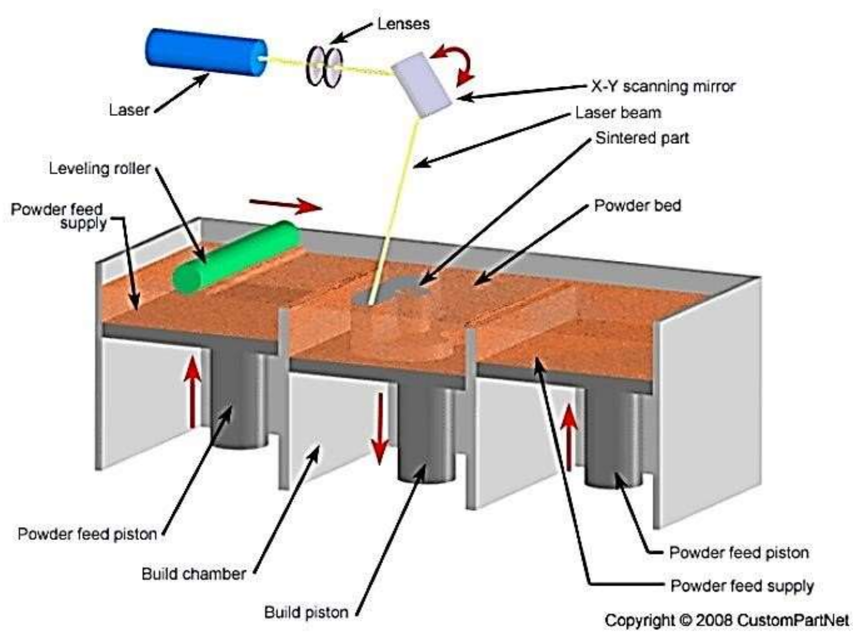

Figure.3: Selective Laser Sintering SLS Source: Custompartnet (2008)

Arcam, the owner of EBM patent, claims that their machines provide parts with excellent properties for strength, elasticity, fatigue, chemical composition, and microstructure'' (Aliakbari 2012, p.22).

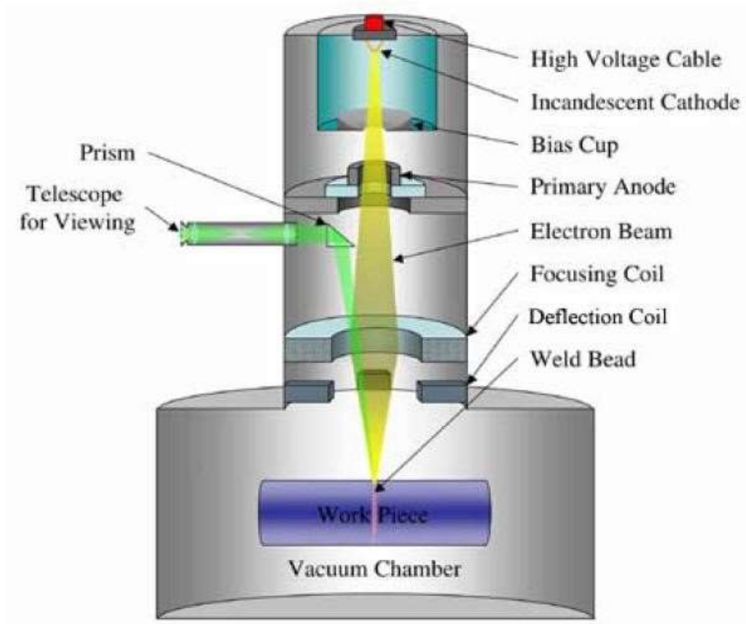

Figure:4 : Electron Beam Melting (EBM) Source: Custompartnet (2008)

Results: Implications of the Study Some of the key implications based on the AM implementation framework and results can be summarized as follows: Suppliers need to develop a comprehensive knowledge of how the medical device industry works in relation to AM equipment and materials as there are certain materials which are biocompatible and relatively new in their use in medical devices and compared with the evolution of AM. Collaboration with medical device manufacturers through acquisition and vertical integration could result in co-development of materials and process efficiencies and eventually reduce restrictive practices which constrain the AM implementation process on supply chain. 228 The choice of appropriate software applications and data transfer depends on decisions on the technology itself. Medical device manufacturers should develop an integrated software solution which involves data capture, product design and process planning. The possibility of tailored software can also be examined depending on their in-house capability to offer software solutions and manufacturing services in the healthcare market. AM technology enables device manufacturers to build a combination of different products at the same time which would not be possible through traditional manufacture and therefore flexibility of manufacture is one of the main advantages of the AM process. However different processes produce different results and surface finishes and when considering volume manufacturing, AM process can be expensive as the cost associated with running the machine are high. The technology can be advantageous in the creation of the initial part, however when examining volume manufacture its contribution is quite limited at the moment where traditional manufacturing methods are also advancing and still seem to be the preferred choice. Here, comprehensive cost models to address some of the challenges related with machines, maintenance and materials should be utilised. Medical device manufacturers currently tend to follow an in-house approach to AM as they can acquire a better knowledge of the process. The idea of outsource manufacturing seems quite appealing; however, there are several constrains cultural and technical which restrict the implementation of this concept. In this case, issues regarding post – processing and support equipment need to be considered and a functional supply chain is required to manage all costs across their supply chain along with an increased demand in a particular location. There is no urgent need at the moment for the concept of distributed manufacturing in close proximity to the hospital or patient as the product can be delivered in short times. For this to be feasible technologies and materials need to grow with the patient to be applied in a more effective way and particularly in emergency cases, where manufacturing next to the patient will be more applicable. In relation to the scenario of allocating machines to the hospitals there are several constraints regarding the validation of the process including a clear allocation of responsibilities to the different parts such as hospitals, suppliers and manufacturers for the different parts of the process. In the healthcare sector the decision - making process regarding AM technology can be quite complex and therefore the extent to which hospitals utilise the technology propositions will play a predominant role in the evolution of the supply chain. Decisions on choosing a 229 technology are based mainly on the cost rather than the technology itself and therefore when a new technology is introduced with the potential to produce better results over a long period cannot easily be accepted especially when it is more expensive. The utilisation of different tools such as Web 2.0 technologies to engage with healthcare, 'cloud – based design and manufacturing' (CBDM) which can be leveraged for both generic and patient specific devices to assist in product development as well as the open source software along the 'Maker culture', which involves the combination of traditional mechanical skills to create new devices for increased design participation, can increase awareness and enhance the implementation process. The case studies have stressed that strong collaboration with healthcare centres are key in growing the supply chain. They have also reported limitations of the technology and therefore further improvements in relation to AM process are required especially when it comes to volume manufacture. The case studies have not mentioned any major issues in relation to software; however; they recognized that software improvements would be beneficial for the industry. Finally, although they have found interesting the case of distributed manufacturing they have not proceeded to implement this scenario as there is no urgent need at the moment. 8.2 Contributions of the Study The contributions of this research are several and provide both theoretical and practical insights to the operations and supply chain management field. From a theory - building perspective it constructs an AM implementation framework and provides an insight concerning the AM implementation process of the adopting organisation. At the time of writing is the first study which examines the AM implementation process of medical device manufacturers on supply chain and proposes an implementation framework. Therefore, this research contributes to the body of knowledge by bridging the gap on AM implementation studies from a supply chain perspective. The research framework focuses on the healthcare sector. The practical insights of the study can be found on medical device manufacturers as well as for healthcare centres and practitioners. Concerning the medical manufacturers, the research provides insight to further assist AM managers with the implementation process throughout their supply chain and thus use this AM implementation framework as a guide to develop their own implementation plans. Examining the practical implications for healthcare centres it has been underlined that the industry is highly complex and regulated when it concerns the adoption of new technologies. Here healthcare centres, by utilising this technology, can plan ahead and better understand the situation of the procedure involved in the surgery, particularly in complex cases, reduce operation times, improve success surgery rates and thus improve significantly patients care. At the same time, as the technology can assist in pre - surgical planning and during the surgery, it can lead to an increased capacity for hospitals and ultimately reduce costs within the healthcare sector. 8.3 Limitations of the Study Limitations of this study can be found on the fact that although a multi - case approach can increase validity of results (Eisenhardt, 2007), still care is needed in drawing generalizable conclusions. Therefore, further research should examine the application of the AM framework to more case studies to further increase the validity of results. However, taking into consideration that a robust research methodology has been employed and saturation of the implementation factors was reached and most importantly that the framework is the first of its kind, still provides a valuable insight to the AM implementation process from a supply chain perspective. A significant limitation of this study concerns the amount of time and resource spent gaining access to the case study sites. This limited the researcher from undertaking further work with regards to the implementation framework and further explore on each of the framework constructs and the implementation implications for the adopting organisation. However, the framework has captured the key implementation factors and thus provides a solid foundation for further research. Another limitation of this study again due to time and resource constraints concerns the fact that the researcher did not include in his study data from the supplier's point of view and procurement construct as well as data for the customers construct and healthcare centres. This study has focused on examining the implementation of the technology for the adopting organisation and thus further data collected from the participant members within the broader supply chain perspective could potentially enhance the implementation framework. However, still the research case studies and the informants have provided a considerable amount of information for the members of the supply chain and the various implications concerning the implementation of the technology.

Areas for future research this study has not addressed implications for the end users although that many issues have been examined in the customers (healthcare centres) construct. Thus, further research could take place to integrate end users in the implementation process when examined from a supply chain perspective. Additionally, the potential of distributed manufacturing near to the hospital or to the patient or the possibility of allocating AM machines within healthcare centres should be further examined. The study has proposed a process diagram for the adoption of technology in clinical settings; however further research needs to take place in relation to the barriers of adopting the technology within healthcare centres as it is an essential requirement for the evolution of supply chain.

Conclusions

This last part of this proposal will initially examine how the goals of the review have been satisfied, trailed by suggestions, commitments, constraints of the review and regions for future examination. The goals set out for this study have been satisfied. Comparable to the primary objective which was to explore the effect of AM process on production network, a few investigations have been introduced as a component of the writing survey section which have plainly shown the likely ramifications of innovation when is inspected from a production network point of view. The ends have recommended that AM innovation as a driver of inventory network change it can accomplish accuracy, speed, reasonableness, and materials range. Hence, it can possibly upgrade items with less parts and to make items close to the clients. The aftereffects of the principal objective have additionally shown that concentrates on AM execution on store network is disappointingly missing, where most examinations on inventory network center fundamentally around the likely disturbances of AM in appropriation/coordinated operations and subsequently on the spot of assembling. Consequently, an examination on the key AM execution factors inside the different phases of a production network from the determination of unrefined substance gear providers towards the clients should have been inspected.

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