3D Knitting Technology: A Decision-Making Model

Karis Foster and Cynthia Istook, NC State University, USA

Keywords: Decision-Making Models, Technology Adoption, 3D Knitting

The textile industry is unique in its slow rate to adopt new technologies. Adoption decisions remain a mystery. It is one of the known "mature" industries of the world with a well-established infrastructure and means of production. However, there has also been great strides within technology innovation in the form of 3D knitting. This type of flat-bed knitting, also called 'seamless', 'complete-garment', 'WholeGarment' or 'Knit'n'Wear' can knit three-dimensional objects or shaped garments virtually in one piece on the machine, with minimal finishing. The objectives of this research were to identify the factors that act as either a driver or a barrier to the adoption of 3D knitting technology. A decision-making model was developed based on literature review and pertinent factors related to flat-bed seamless knitting. This research will be important for researchers, manufacturers, brands and machine manufacturers to understand the factors that contribute towards decisions to adopt this new technology and to help gauge the future state of the industry.

For the purposes of this research, the term '3D knitting' has been used to describe any type of seamless knitted good created using a flat-bed knitting machine. Some of the major advantages to this knitting method are the inherent reduction of wasted material, increased quality, and pattern versatility (Millington, 2000). All making-up of a product is conducted on the machine, which reduces the need for human labor to join pieces together, reducing the overall cost to produce and human error (Choi & Powell, 2005). Disadvantages for this knitting method include: consumers' unfamiliarity of the technology and its benefits, the potential to up-end a supply chain, and cost of adoption.

Organizational research has attempted to synthesize the decision-making phases into systematized models. The purpose of these models is to guide the decision-making process, for wiser decisions that weigh all factors. The Innovation-Decision-Process model developed by Rogers (2003) aids in the understanding of the new technology adoption process. The five stages of the adoption process that every new technology goes through have been outlined in this model. To take this model a step further, Rogers created a related Innovation Process Model specifically for organizational adoption of an innovation. This model expands the implementation phase with additional reinforcing steps like 'redefining/restructuring', 'clarifying' and 'routinizing'.

Three-dimensional knitting is in the "pre-diffusion" phase, not yet diffused into industry. According to Ortt (2010), factors which contribute to this phase, fall into three systems: the main organization, the technological system and the market environment. These systems act as initial influencers (or external variables) to the Innovation Decision Process (Park & DeLong, 2009). Drivers and barriers to adoption can be categorized by advantages or disadvantages that a technology adoption may create.

A model was developed with influencers pertaining to 3D knitting, which was inspired by both Rogers' (2003) innovation decision models and a theoretical framework proposed by Park & Delong (2009). The proposed Innovation Adoption Decision-Making Process Model is shown in Figure 1. Categories of factors may be changed within the 'areas of influence' section as needed. These influencers are divided into drivers and barriers which affect the administrative-level decision making process towards adoption of a technology.

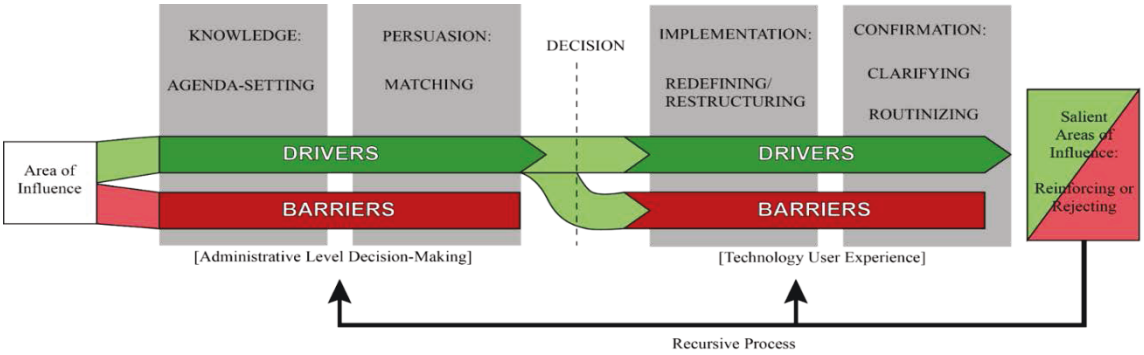

Figure 1. Innovation Adoption Decision-Making Process Model, Authors Own

Technology-users influence the success of the implementation phase by also being impacted by drivers and barriers to adoption. The resulting salient influencers could reinforce or reject the decision to adopt 3D knitting. Further practical research may support adjustments of this model depending on the industry it is used for.

The 'areas of influence' established for the decision-making process for 3D knitting adoption have the potential to affect other industries, as well. These influencers include: managerial, training/personnel, investing/cash flow, plan considerations, size of firm, inception of firm, market/demand for product, perceived benefits, perceived limitations, supply chain flexibility, logistics considerations, positioning of product, sustainability, quality considerations, production processes, system openness and reshoring. This model will be used as a guide to direct research into the adoption decision process of 3D knitting technology by small, medium and large firms and may help provide insight into the adoption of future technologies, as well.

Choi, W., & Powell, N. B. (2005). Three-Dimensional Seamless Garment Knitting on V-Bed Flat Knitting Machines. *Journal of Textile and Apparel, Technology and Management*, *4*(3).

Millington, J. (2000). Complete Garment Manufacture. *Textile Asia*, *31*(7), 32–37.

Ortt, J. R. (2010). Chapter 2: Understanding the Pre-diffusion Phases. In *Gaining Momentum [electronic resource]: Managing the Diffusion of Innovations*. London: Imperial College Press; Distributed by World Scientific Publishing. Retrieved from http://catalog.lib.ncsu.edu/record/NCSU3638293

Park, J., & DeLong, M. (2009). Understanding new technology adoption in the apparel and footwear industry within a social framework: a case of rapid prototyping technology. *International Journal of Fashion Design, Technology and Education*, *2*(2–3), 101–112. https://doi.org/10.1080/17543260903349007

Rogers, E. M (2003). *Diffusion of innovations [electronic resource]* (Kindle ed.). New York: Free Press, Retrieved from http://catalog.lib.ncsu.edu/record/NCSU2248399