Available online at www.sciencedirect.com

ScienceDirect

Manufacturing Letters 2 (2014) 30–34

www.elsevier.com/locate/mfglet

Research Letters

Mobile apps for product customisation and design of manufacturing networks

D. Mourtzis *, M. Doukas, C. Vandera

Laboratory for Manufacturing Systems and Automation, University of Patras, Greece

Received 30 September 2013; accepted 26 January 2014
Available online 31 January 2014

Abstract

Manufacturing enters a new era, where companies, exploiting mass customisation practices, base their business on mobility and customer integration in product design. These two utterly important activities can be supported by applications deployed on mobile devices, namely apps. However, apps in the manufacturing domain have yet to be widely adopted. Towards that end, the proposed work focuses on the integration of the customer in product personalisation, and aims to support the design of manufacturing networks on the move, through the development of apps for Android devices. The applicability of the developed mobile apps in an automotive pilot case is presented.

Keywords: Manufacturing network design; Product design; Mass customisation; Augmented reality; Mobile apps

1. Introduction – State of the art and motivation

Nowadays, manufacturing industries are called to rapidly and effectively respond to ever-changing market demands generated by globalisation, economy and customer saturation towards mass produced products [4]. Reasonably accurate forecasts and build-to-stock policies are no longer viable solutions, even for traditional mass producing industries like automotive [1]. Mobile and decentralised decision-making on core company activities is becoming the standard practice enabled by Information and Communication Technology. Moreover, value co-creation and customer integration in product design [2] arise as promising means towards capturing the market's pulse and supporting bridging the gap between mass production and mass customisation [3].

Mobile technology evolves rapidly; the last decade the use of mobile applications has outpaced traditional PC-based web-browsing. Nearly 70% of all Internet users access it using smartphones and tablets [6]. The exploitation of mobile devices and applications (apps) is eventually finding its application in a scientific context [7,10]. Apps are being developed for biomedical research [7], photovoltaic installations [8], calculation of sealant O-ring dimensions [9] and pharmaceutics [11]. In the manufacturing sector, a number of mobile agent-based systems have been reported [12–15], together with some consumer-oriented apps [16,17]. However, the adoption of apps focused on core manufacturing processes remains limited [18]. The EU funded project Apps4ME envisages the creation of knowledge enriched apps for supporting various phases of the product and factory lifecycles, ranging from the requirements collections phase, to the product design phase, and up to the short-term production scheduling and even execution monitoring [20]. The necessary components of apps in order for them to be fully leveraged in manufacturing are presented in [19], where architecture, development, infrastructure, security, portfolio and privacy issues are investigated. In the short-term, such "role-based"

* Corresponding author. Tel: +30 2610 997262; fax: +30 2610 997744.
E-mail address: mourtzis@lms.mech.upatras.gr (D. Mourtzis).

http://dx.doi.org/10.1016/j.mfglet.2014.01.002
2213-8463/

apps can boost productivity by 5–10% as experts believe [17].

Although the term mobility may be interpreted as movement of physical manufacturing resources [21], here it is defined as "*the ability of a stakeholder to remain constantly and interactively connected to the company's fundamental activities and make remote decisions*".

Motivated by the above, the proposed work presents two mobile apps integrated on the back-end with a web-based platform that share product design and production information. The first app concerns the customer integration in the products design phase and allows product personalisation and visualisation over mobile devices. The second app concerns the inter-organisational interaction of the company. It provides information regarding the company's partners and the design of efficient manufacturing networks for accommodating customised orders. It aims to enable the OEM to remotely manage the configuration of manufacturing networks in order to serve mass customisation satisfying cost, time, quality, reliability and flexibility performance indicators.

2. Mobile apps description

The overall framework and workflow of the developed apps is depicted in Figure 1. The apps are the *mAR* (mobile Augmented Reality) and the *mDEMAP* (mobile DEcentralised MAnufacturing Platform).

The OEM logs into the application and is presented with a context menu. Primarily, a list of the manufacturing facilities of suppliers, dealers and OEM Plants is visualised. New facilities can be added and existing ones can be modified. The information included under each facility includes contact details (phone, email, etc.) and facility capabilities (type, number, capacity and processing capabilities). The mobile services allow the OEM to contact each partner by telephone call, e-mail or SMS message. The location of each facility is manually selected and stored through the integrated Google Maps API and is utilised during the evaluation of the manufacturing network alternatives for the calculation of travel distance and deriving environmental impact and lead time by the mDEMAP decision making algorithms. The location of each plant is shown with a flag on the map and directions are offered to the OEM from his current location to the plant through the OS's built-in GPS navigator (Figure 4). The activity diagram of Figure 2 depicts a workflow of stepwise actions provided to end-users.

Moreover, the OEM can visualise all the submitted orders. Once a specific order is selected, information such as selected customisation options, estimated cost and customer location, along with the criteria values of the optimum manufacturing network configuration become available. The evaluation of the alternative manufacturing network configurations is handled by the underlying web-based platform described in [3,5]. The best/"good" network according to the selected decision making criteria and their weights is visualised as a sequence of operations. For each operation, the facility, the resource assigned to each task and the transportation routes are calculated. The OEM

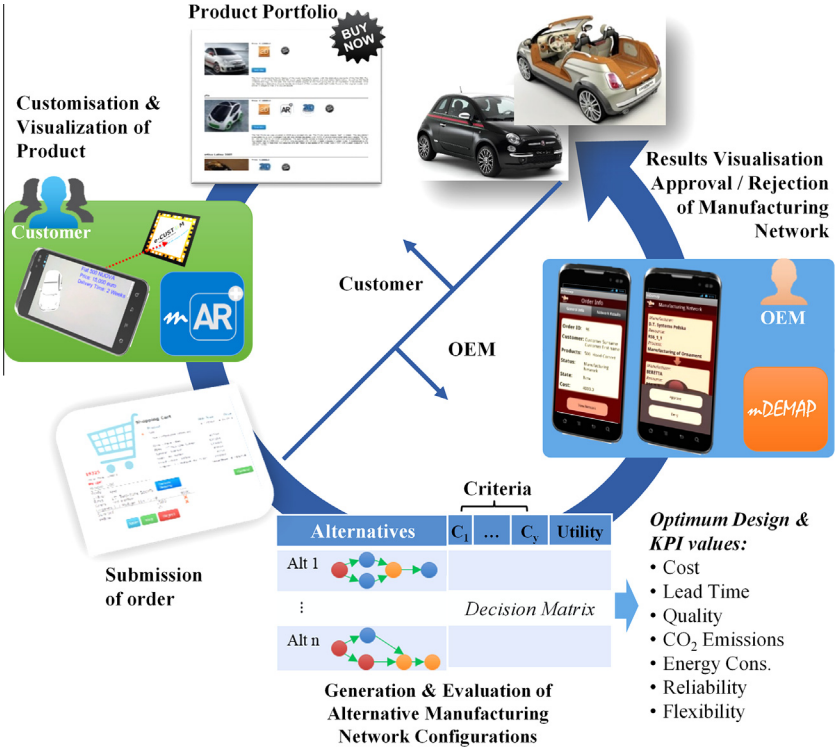

Figure 1. Framework of the mDEMAP and mAR apps.