

## **Feasibility study on product design and development via online customisation: a case study**

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### **Abstract**

The paper investigates the appropriateness of virtual reality and online customisation through e-product development (E-PD), which allows the designers to utilize the internet's communication with the customers along with a great speed and global reach. The paper informs about the state of play patterns, which assist how manufacturing firms can employ advancements in information technology (IT) and the internet for product development for the successful transition en route towards the mass customisation. It identifies pertained opportunities, possible barriers for the E-PD establishment embracing online customisation and the virtual reality tools for potential enterprise manufacturing.

The paper focuses on the furniture industry, which could benefit from virtual reality and online customisation features to understand consumer needs, and in turn could implement the mass-customisation production more efficiently. In particular, the E-PD feasibility and effectiveness is analysed for the office furniture segment of India. The collected data is used to examine the readiness of the office-furniture industry for adoption a suitable E-PD prototype in order to facilitate understanding of the current Indian market and moving towards responsive production. The data analysis is based on the designed questionnaire surveys and the semi-structured interviews.

### **1. Introduction**

With the arrival of 21<sup>st</sup> century, manufacturing industry has been facing increasing challenges from the global markets. Today's manufacturers have to cope with problems arising from: greater product mix, smaller batch sizes, shorter lead-times, and shorter product life cycles. Changes in products and demands can happen faster than ever before. Therefore, manufacturing organisations should provide sufficient flexibility to produce a variety of products on the same system. The need to respond rapidly to demand changes for sustainable competitiveness in global business environment creates a need for new strategies and tools for customised product design and development.

Customisation is possible in part because of the interactivity afforded by the Web (Ansari and Mela, 2003). IT and automation are a crucial component of mass customisation; as they establish the link amongst the consumer's requirements and the capability of a producer to produce the goods accordingly.

Many processes can be re-engineered to utilise IT, resulting in substantial cost savings and reduction in lead times. According to Higgins (2001), nowadays, many on-line approaches are in acting to improve product development processes throughout a variety of industries. Amongst those, the E-PD approaches have speedily evolved from simple email apportioning

of design iterations between teams to real-time alliances between geographically detached design teams. As a greater part of a product's final cost and time-to-market is decided in the design process, in short run, the internet offers enormous potential for creating value by cutting down this time. Many industries from automotive to software, firms are utilising E-PD to drive down the cost and time drawn in product development. E-PD makes it possible to incorporate the voice of the consumers into all product design and development phases, promoting market approval of products beyond the 50% success rate broadly experienced today (Higgins 2001). Further than the cost and time economies, E-PD through faster communication can assist in diminishing transactional costs and augment the scope of collaborations. Salespeople, customers, retailers and suppliers are progressively calling for real-time access to firm's databases in order to get respond to their product-related queries. As the internet allows such an access, it can assist firms to commercialise their merchandise more efficiently and effectively.

Internet can improve the collaboration of people involved in product development process, improves the speed and the quality of product testing and validation and ameliorates efficiency and effectiveness of manufacturing planning. Avlonitis and Karayanni (2000) claims that internet had a positive impact on product management activities, which includes the faster detection of users requirements and superior product customisation. According to Ozer (2003), since the internet can be accessed from a broader range of locations, businesses can reach out to a wider span of ideas and thoughts for the product development. Individuals for instance customers, experts, and salespeople in different parts of the world can participate in the concept generation process and hence augments the ability of firm to yield a wide range of ideas from a broad range of idea sources. Mendoza (1999) states that by employing the internet's animation features, firms can carry out virtual prototype tests without essentially manufacturing a prototype. Thus, numerous design meliorations can be completed in the electronic prototype prior to a much costly physical prototype and test them in much shorter period of time. As animated prototype can be created and communicated with all the concerned parties in a short period of time, the internet can considerably increase the speed of testing and validation. In addition, as creating an online prototype is usually much economical than building a physical prototype, the Internet can also diminishes the cost of testing and validation. Due to the reduced costs, firms can carry out the various tests early in the product development process and can effortlessly repeat them. In view of the fact that repeated testing is coupled with more accuracy, the internet can also boost the quality of the tests (Ozer 2003).

## **2. Mass Customisation and Reconfigurable Products**

What distinguishes mass-customisation from simple customisation is the integration of computer based information systems with advanced production systems such as flexible manufacturing and reconfigurable manufacturing. The market and manufacturing are then linked to provide unique products for each customer (Bardakci and Whitelock 2003). Reconfigurable manufacturing is designed to employ the necessary flexibility (no more no less) of manufacturing facilities which require the right capacity and functionality in order to quickly create products that meet customer expectations for customisation, variety, low cost and high quality. For reconfigurable manufacturing, products need to be grouped within families according to their operational similarities (Abdi and Labib, 2004). Standard products with fixed configurations, i.e. only some predefined types are offered. Customers merely can choose between these types, but no changes or extensions (at least at the system unit) are possible. Customised products must be fully configurable for the designated variety. In this case, the customer specifies which components he wants to get from what supplier or at least the options of the components he wants to get. The manufacturer tests whether the requested configuration is technically feasible and calculates the price. Because of the ability to

combine many different components – again obtainable from several alternative suppliers – an incredibly large number of possible final items is given.

Duray, R. et al. (2000) in their report comments that modularity is the key to accomplishing low cost customisation. Modularity is multifaceted concept and is generally portrayed either in relative terms or as a classification.

With shifting the market towards the mass customisation, product life cycles and development cycles are invariably reduced. Tseng, M. et al. (1998) mentions that mass-customisation paradigm facilitates the higher profit margins for designers and manufacturers, enhanced customer satisfaction, in addition with high-value added business opportunities.

Mass-customisation extends the opportunity to comprehend and acquire potential market niches and also aids in development of technical competences to endure diverse demands of target customers. Therefore, we loom towards mass-customisation from the product development perspective. The basic strategy for it is to embrace customers in the product development life cycle by proactively associating consumer’s requirements to the competencies of a company.

According to Helander and Jiao (2002) with the flourishing of internet growth of internet, E-commerce and mass-customisation conjectures, typical company which pursues design, manufacturing and logistics processes will become rare. As shown in Fig. 1, a systematic model of E-PD-enabled mass customisation can be derived through three pillars underlying the model, viz. the integrated product lifecycle, mass customisation, and supply chain management. As it’s a dynamic system with feedback loop thus for every new product or product customisation, process have to “go around the loop”. The business is capable of trading merchandise to distributors and/or directly to consumers via e-commerce. Products are designed in consensus/by customer himself thus customer requirements are captured directly through their preferred electronic-design

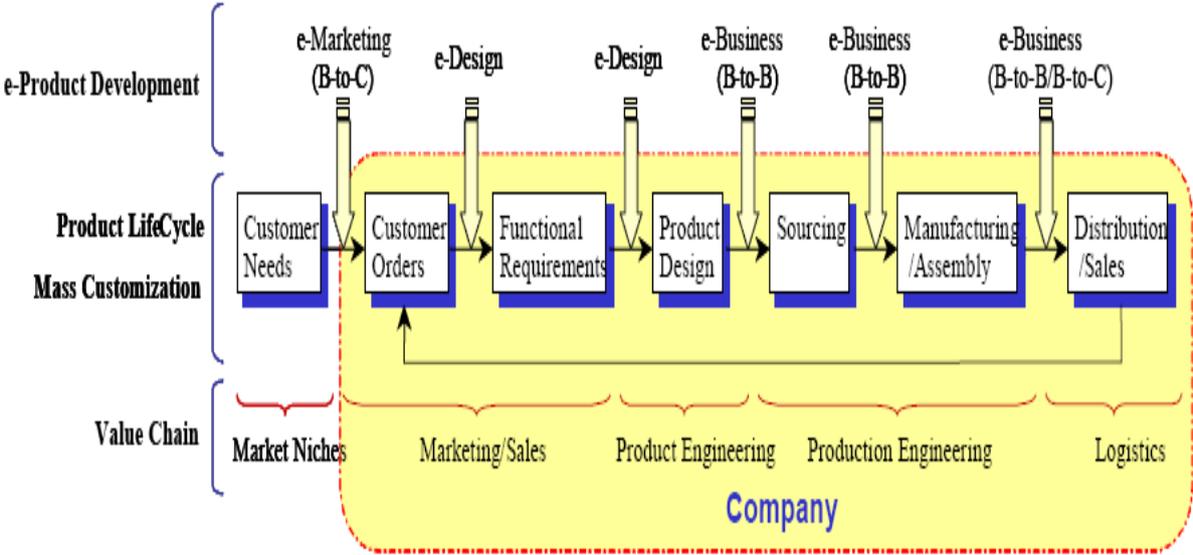
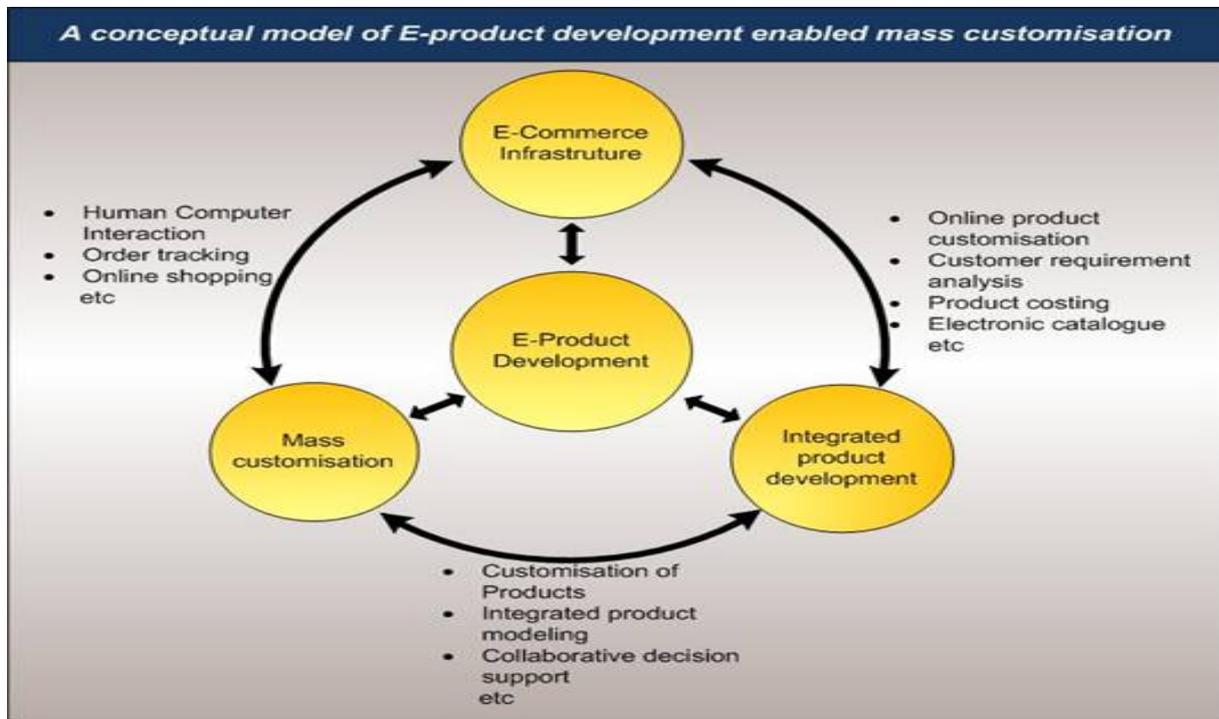


Fig 1. Implications of E-PD for mass-customisation- from customer needs to sales

### 3. Conceptual Model of E-PD

As revealed in Fig 2 (adopted from Helander and Jiao (2002)), by employing the online customisation via E-PD on the doctrine of mass customisation, a greater level of customer satisfaction can be achieved. Consumers can take advantage of self-guided selection and configuration tools to choose products and options.



**Fig 2. Conceptual model of E-PD enabled mass-customisation**

As shown in Fig 3, (adopted from Fuller and Matzler, 2007), by involving the customers in designing could help the firms to gain insight to the decision-making process and with the valuable the feedback from the customers regarding their choices. It is crucial to provide customer feedback so that firms should manufacture furniture that will be acceptable to buyers. The apprehension of customer's decision processes and impediments that customers confront during the processes is decisive to the success of the industry.

In addition, realising what designs are refused by customers could add enormous value to companies since it reduces costs by minimising inventory and distribution clogs. Informed design and management are vital for the office furniture industry to survive and succeed. In conjunction with the online customisation, web-based virtual reality (VR) can also offer indirect but realistic visual feels for accessing office furniture to visualise if it matches other furniture items and decoration.

The main objective of the paper is to investigate the feasibility of the E-PD implementation embracing online customisation and virtual reality tools for the small and medium enterprises (SMEs) of the Indian office furniture sector to improve the customer satisfaction and to enhance operational requirements in order to compete against big firms.

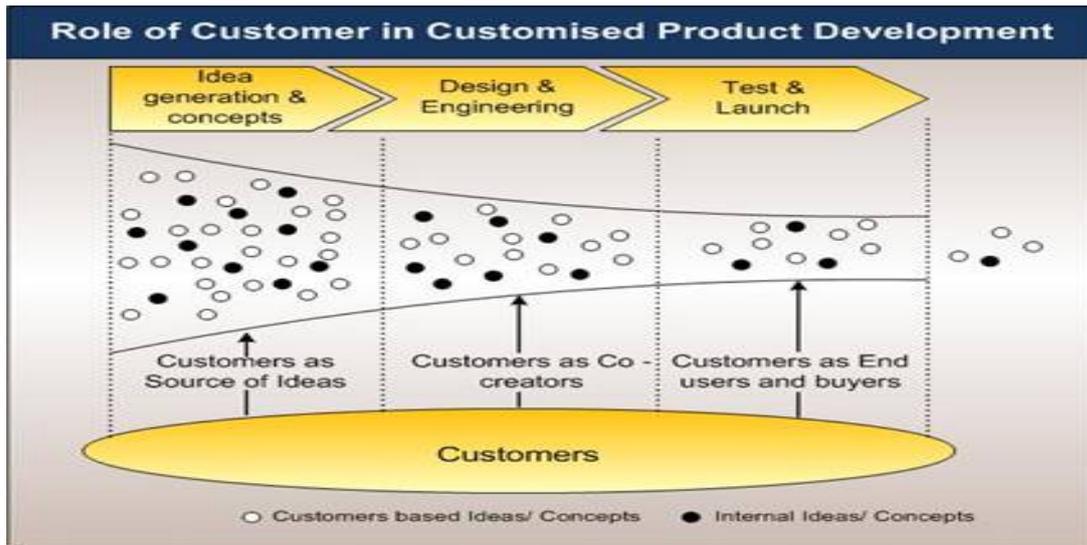


Fig 3. Role of customers in E-PD

#### 4. Case of Indian Office Furniture

Indian office furniture is one of the industrial segments boasting the most significant companies, both from the standpoint of size and of the technological innovation of the production. There is a excessive consumption of office furniture in the western and the northern markets of India, namely, Mumbai and New Delhi, New Delhi being the leader. As represented in Fig 4 (Indo-Italian Chamber Commerce and Industry 2007), Indian manufacturers employ a three-tier selling and distribution structure, i.e. distributors, wholesalers and retailers. The gross profit margin for a retailer varied from is 10- 15 %, followed by distributor (4-5%) and wholesaler (3-4%).

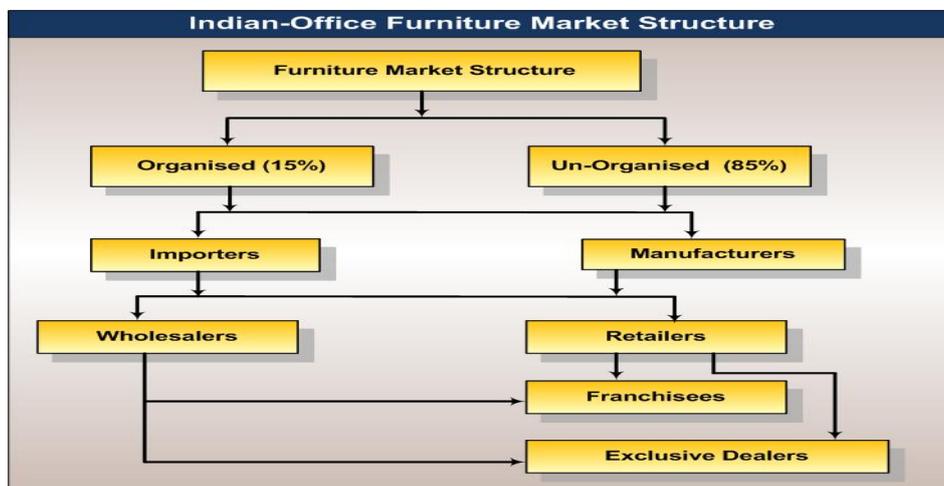
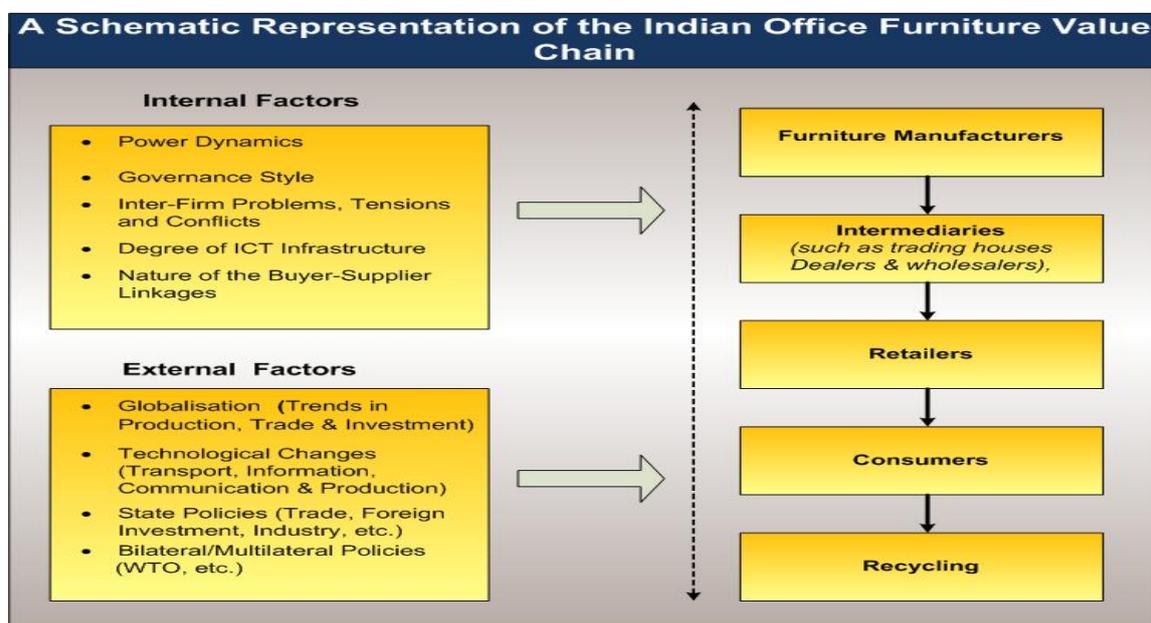


Fig 4. Distribution chain for office Furniture industry

Indian companies sell furniture through distributors as well as sell directly to the consumers. The leading office furniture importers also manufacture and sell their products via their own commercial offices and showrooms in all the large cities in India. Globalisation has seen imported furniture make serious encroachments into the Indian markets, which has been a wakeup call for the office furniture manufacturing industry. (Indo-Italian Chamber Commerce and Industry 2007). Fig 5 represents the schematic diagram of the value chain of Indian office furniture industry highlighting some of internal and external factors associated with it.

Since the Indian office furniture industry cannot compete with imports on cost only, the industry must become more proficient at responding to customer's tastes and personal requirements by the incorporation of efficient marketing and supply chain management. Except for a few big brands, industry altogether does not understand consumers' furniture buying behaviour. Consequently, the industry is facing difficulty in exploring market to realize what office furniture users like and dislike and why.



**Fig 5. Indian office Furniture value chain**

In order to evaluate the firms' implication of E-PD, a questionnaire has been designed in two main parts. The first part has been focuses on demographics of the selected samples for the research. consumers' and stake holders motivation for implementation of E-PD by employing online customisation, the second part has been concerned with their opinions on implementation E-PD by employing online customisation & virtual reality along with the evaluations of the benefits and pitfalls of the same. The questionnaire comprised 90 percent of closed-ended inquiries embracing five-point interval rating scale questions ranked from "Strongly Disagree", "Disagree", "neutral", "Agree" to "Strongly Agree". In addition, semi structured interviews have been scheduled as informal interviews with the architects and dealers of the small office-furniture businesses. Prior to semi structured interviews, four pilot interviews were conducted to examine the research approach and the findings derived from the literature review. Pilot interviews also assisted in exploring their reaction and opinions towards online customisation and virtual reality.

The firm's selection aimed at the smaller dealers/architects who are successfully operating in the Indian office furniture market. Eight different small firms and three independent architects were selected as to be appropriate for the study; since they were not reluctant to share the postulated

information. The project attempts to employ the firm’s valuable experience in order to explore the viability of online customisation and virtual reality in E-PD to improve customer satisfaction in office furniture segment.

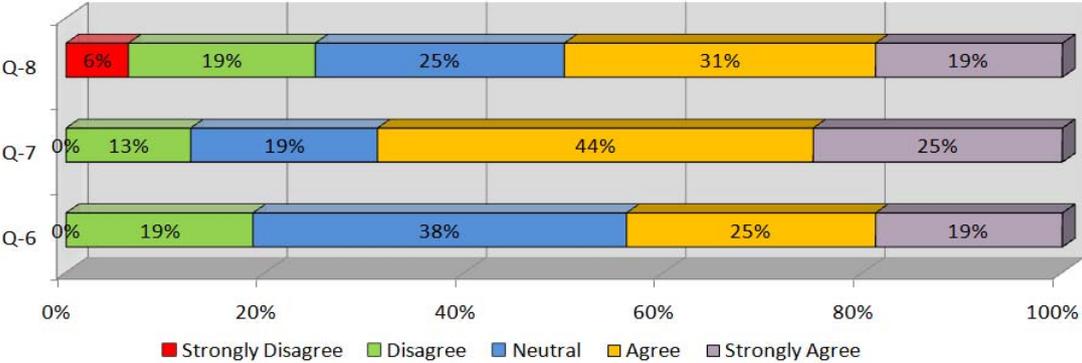
The interviewees were selected among the professionals:1) managers/architects who do the business development for the firms, and 2) designers and the IT professionals who work in the office furniture industry. The motivation for reaching these professionals was to tap into the knowledge and “privileged information” which they share as a consequence of their extended years of experience in advising and working with a range of small office furniture manufactures and consumers.

**5. Data Analysis**

According to the questions and the responses shown in Table 1 and Fig 6 respectively, only 19% from the total responses disagree with statement 6, which indicates that most of the firms already know the benefits offered by the mass-customisation towards the customer satisfaction while guarding the business interests in this competitive environment. Yet again 69% of the respondents for statement 7 clearly elucidate the requirement for the customisation in office furniture designing. Although respondents share the different views if the customers should be allowed to actively participate in the designing of the furniture, as clearly evident from the responses of statement 8 in which 21% responders disagreeing and 25% communicating the neutral view on the approach. This section of the survey again highlights an opportunity for the office furniture firms to induce the customisation approach in designing of the furniture to improve customer relations.

Statements	
Q-6	<b>Employing Mass customisation in the office furniture market could extend service and could help achieving a greater level of customer satisfaction.</b>
Q-7	<b>The firm should launch furniture aimed at customisation for developing customer loyalty.</b>
Q-8	<b>Involving customers into designing their own furniture could enable firm to respond quickly to customer needs.</b>

**Table 1. Strategic statements**



**Figure 6. Business policies (responses for table 1)**

Statements	
Q-9	Internet can be proved as an economically feasible device for the customisable 3D modelling which can enhance the efficiency in the collaborative furniture designing.
Q-10	With the support of appropriate information technology and e-business solutions organisations can realise extensive cost reductions and time savings, by integrating all aspects of the supply chain.
Q-11	E-product development could assist in interpreting customers' preferences and decision-making behaviour which can lead to better product development, marketing, and distribution management for the Furniture industry.
Q-12	Virtual reality posses peculiar features which grant users to analyse products closely and allows in quick decision making, all of which are valuable for customer satisfaction
Q-13	Internet coupled with virtual reality tools can speed up the testing and validation while diminish the cost of same for new customised products.

Table 2. Feasibility statements

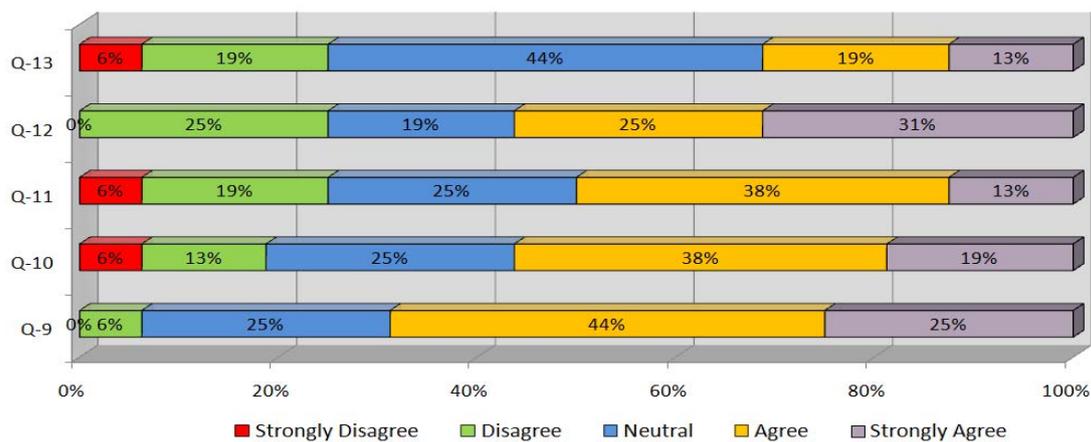


Fig 7. Feasibility of online customisation and virtual reality (responses for table 2)

As represented in Fig 7 majority of the respondents (70%) responded positively to statement 9 saying that Internet could be employed as a handy tool for the providing the customers with the economical designing portal. In response of statement 10 regarding the utilisation of the IT and e-business solutions, 19% of the respondents inferred the negative replies coupled with 25% neutral responses one of the reason for these responses can be the lack of awareness of the respondents towards the core benefits of the e-business. About 52% of the respondents agree on benefits offered by the E-PD in terms of their overall business strategy, as clearly indicated by the responses collected for the eleventh statement. More than half of the respondents indicated that they agree with statement 12, which points towards the value added by the virtual reality towards the consumer behaviour while taking the purchasing decision. 44% of the neutral responses towards statement thirteen elucidate some concerns relating to the amalgamation of virtual reality and online customisation in the E-PD of office furniture.

## 6. Conclusion

Customisation along with virtual reality technologies enables the users to have the dynamic interaction with objects. The main issue in office-furniture leverages is the inability of customers to view their self-designed products in their own premises settings. Demonstrations

at brick-and-mortar stores do not resolve this crisis as consumers still cannot match options with their currently owned site decor. However, close inspection of individual furniture with personalised environment, can be obtained when the furniture prototypes are rendered in three-dimensional real-time computer graphics. Thus, customisation and virtual reality are viable tools which offer eventual resolutions to many identified problems smothering current office furniture industry of India. The research outcome foresees the future of office furniture industry as follows. Consumers go online, try novel/innovative furniture items, analyse the aesthetics of their own site with new furniture items before making a decision. The furniture selection made by customers will be installed at customer's premises after physical testing.

In conclusion, adoption of E-PD and virtual reality tools embodies a viable option for small office furniture selling firms seeking to augment their customer base, boost customer satisfaction, and place themselves alongside big firms and small niche players. However the costs of enforcing these technologies are a big prohibitive factor. The majority of these enterprises strive to subjugate expenditures on software management. Owing to the complexity and simultaneous benefits of these systems, small firms must adopt long-term visions in terms of return-on-investment and abandon their short-term, cost-cutting measures in these critical areas where it has been demonstrated that the investment would be fruitful.

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