Information Science-Knowledge Management-HCI-Project Management-CRM Models-Software Processes:

Implications To E-Commerce Open Design And Co-Design

Chien-Sing Lee(✉), Lee-Yin Yew, Pai-Lek Chew, Yew-Keong Chee, Yit-Thang Hiew, and Jing-Pynn Wong

Department of Computing and Information Systems, Sunway University, Subang Jaya, Malaysia
chiensingl@sunway.edu.my, yewleeyin93@gmail.com, {14012264,13079959,13084058, 14031405}@imail.sunway.edu.my

Abstract. Information Science and Human-Computer Interaction (HCI) have often formed the fundamentals of Information Systems Analysis and Design (ISAD) aimed at creating better user experiences and addressing information overload. Data compression and information compression have thus become symbiotic disciplines. This paper investigates the efficacy of including Project Management (PM)-computational thinking as design considerations to Information Science-HCI and in the process, to investigate which of the customer relationship management models and software engineering processes are more suitable for open co-design. Three examples and user testing findings are presented as to how these three disciplines influence the design of navigational structures and creativity. The identified model for open co-design in our context is surprisingly, reflective of design thinking and agile methodology principles and values, and more specifically, Gartner's and the IDIC CRM models.

Keywords: Information Science · Knowledge management · Software engineering · Project management · Human-computer interaction · CRM models · Open co-design

1 Introduction

As competition increases in business-to-consumer e-commerce, customer loyalty and sustainability are challenging. Some have increased new customer support features such as assistive intelligent recommendations and chatbots. Correspondingly, the trends in project management [1] highlight the need for entrepreneurial project managers who think and decide not only quickly but also analytically and judiciously, by utilizing and managing frameworks and diverse decision support tools. This leads to application of agile project management as well as hybridization of project

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management methodologies from different industries to promote different ways to build things and enhance processes and outcomes [1, 2].

Another two trends which are increasingly gaining attention are open design collaboration and gamification. Europe's Open Innovation movement in 2016 sets off much interest. In parallel, Ikeda and Bernstein [3] suggest that open co-design and rewards would be a viable option especially when the economy is bad. Hence, if designed well, these can sustain motivation in e-commerce, supply chain and momentum in growth. Hence, there is a need to model and to use computational thinking to differentiate and generalize.

1.1 Objective

Information Science and Human-Computer Interaction (HCI) are key drivers underlying modern Information Systems Analysis and Design (ISAD). Both aim at addressing information overload and creating better user experiences. As such, data compression and information compression have become symbiotic. This paper contextualizes systemic modelling within an entrepreneurial framework. We investigate the efficacy of including Project Management (PM)-computational thinking as design considerations to Information Science-HCI in terms of the design of navigational structures and creativity. In the process, we investigate which of the customer relationship models and software engineering processes are more suitable for open co-design. User testing findings are positive and promising.

In the following section, we present sustainability-related work on user satisfaction and behaviors, Information Science, increasing choice through upsell and cross-sell, social media, gamification and the supply chain. Subsequently, three examples related to customer relationship management systems are presented and conclusions derived.

2 Related Work on Sustainable Systems

2.1 User Satisfaction and Behaviors

E-commerce enables sellers to access market segments of different demographics and buyers to access a wider variety of sellers [4]. In view of sustainability, understanding and predicting, online consumer behavior is key. Among the various factors influencing consumer behavior, user satisfaction is increasingly, the most important evaluation metric. [5] propose that e-satisfaction can be measured not only in terms of convenience, product offerings, and product information but also *site design*, and financial security.

[6] utilize [7]'s Technology Acceptance Model (TAM) and [8]'s TAM 2, TAM 3 models to understand customers' behavior. Though TAM models and [9]'s Theory of Reasoned Action (TRA) are influenced by social norms and perceived utility among diverse options, they differ in terms of foci. TAM models focus more on technological factors such as perceived usefulness and perceived ease of use as key contributors to

behavioral intention. TRA believes that intention towards a behavior will lead to actual behavior. Hence, motivation for an action is an aspect which proponents would analyze. This requires more in-depth knowledge and application of psychology, which we as information systems analysts, are not capable of, especially during adverse economic conditions.

In view of studies such as [5]'s, [6] suggest additional four predictors to the original TAM: expectations, process satisfaction, access average time and access total time, leading to satisfaction and eventually, traffic and return on investments. This increases the breadth and specificity in assessment compared to the original TAM. Interestingly, access average time and access total time, directly correlate with Search Engine Optimization (SEO) and user experience/user satisfaction.

2.2 Motivation: Increasing Choice Through Cross-Sell and Up-Sell

Customers expect new products. Choosing which products and related products to offer to which customers to increase sales is a challenge in e-commerce. Conventionally, past historical records are used to predict future purchases. According to [10], segmentation analysis, purchase acquisition trees and survival analyses are effective and can be applied in many contexts. Since it is possible to launch multiple campaigns through several distribution channels at different times such as through Salesforce, complexity in possible alternatives-actions can be transformed to positive opportunities.

2.3 Motivation: Increasing Choice Through Supply Chain

[11] highlights the critical role of third-party supply chain management systems to business to consumer (B2C) and business to business (B2B) companies. In B2B, each partner in the supply chain is variable and the choice of supplier at each stage in the chain depends on various factors, aimed at optimizing value creation. Besides choice of partner, modern logistics includes improving the efficiency of material flow, and reducing distribution costs. Consequently, the supply chain has transformed into an agile value chain with diverse partners and/or agents. Logistics acquisition, management and continuous re-evaluation of partnerships in the supply chain have become a necessity and a strength, to ensure sustainability. [12] echoes [11]'s proposition. He opines that not only will it lead to more environmentally friendly and sustainable transportation, but also create jobs.

2.4 Motivation: Social Media

Another means to promote sustainability and increasing *choice, cross-sell and up-sell* is by using social media as we can attract new customers, find out what customers think about the business, and build stronger relationships with existing customers. Influencers are also increasingly gaining leverage. For example, if a celebrity with many followers retweets a post, his/her post is more likely to be retweeted multiple times.

2.5 Motivation: Gamification

Gamification has transformed business models. Gamification, integrates game mechanics into non-game environments to motivate participation, engagement, and loyalty [13, 14]. It works because like social media, it recognizes that all of us are motivated by community, feedback, achievement and reward.

2.6 Some Recent Optimization Studies

The above contribute in part and in whole to Customer Relationship Management Systems [2]. Popular Customer Relationship Management Models are [15]'s strategic, operational, analytical and collaborative CRM, [16]'s competency model and [17]'s CRM value chain model. Each has a different focus and hence can be applied to different contexts based on needs.

Another important factor is optimization, for example, using association rules for online business process analytics based on confidence, support and lift in [18]'s study. [19]'s fast prediction of web user browsing behavior based on the most interesting browsing patterns using association rules reduces search time by more than 10. Association rules' confidence and support are utilized as part of interestingness measures along with lift, and average as well as conviction.

[20] address discovery of users' interests based on a three-layer model (TLM). This involves keyword extraction, analysis of semantic structures and ranking of interest words. The inclusion of semantic-structural analyses reflects how the underlying ontological associations and users' goals enables more efficient search compared to the existing hit rate methods.

Our approach is based on prior work [21, 22], which regard design as pre-processor to deeper analytics and that social factors such as in [8]'s TAMs are important besides technological factors. For this paper, we have extended to open co-design due to inspiration from [3].

3 Methodology

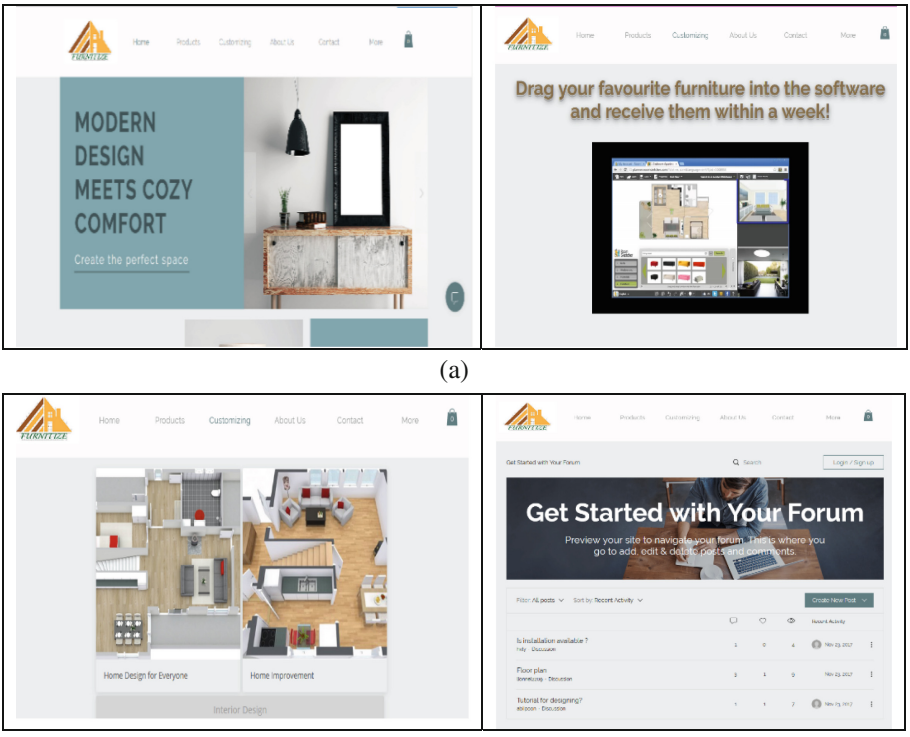
This research is influenced by Information theory and the first study in the series by [23]. In [23], self-organizing map (SOM)-principal component analysis (PCA) is simulated for adaptive e-learning in Matlab. SOM is used to identify significant clusters (k) and PCA to further confirm based on eigenvector/eigenvalues. For actual e-commerce, PCA-SOM concepts are applied, i.e., we need to first identify the gap in terms of market analyses through Project Management considerations and design/computational thinking aspects, e.g. patterns, with decomposition, abstraction and algorithmic thinking. Then, human-computer interaction [24] and information systems analysis, design and development principles are applied.

Incremental design prototyping is used for both systems but the second and third systems lean more heavily towards agile methodology's principles and values, as it involves more dynamic factors arising from high and direct degree of exposure to changes in market demands and trends. The user testing questionnaire is designed based on human-computer interaction (HCI) design principles [24].

4 Case Studies

4.1 Case Study 1: *Furnitize's* Systems Design and Development

The first Project Management consideration is *Project Integration Management* and the outcome is illustrated in Fig. 1a [25].



(a)

(b)

Fig. 1. a. *Furnitize* https://pailekchew963.wixsite.com/mysite, **b.** *Furnitize's* Customization System, Forum

Company Services

- Delivery system (Supply Chain Delivery System)
- Installation and renovation services
- Agent, to save cost and time

Company strategies

- Live chat, forum, instant reply to increase customers satisfaction and loyalty
- Joint venture with other companies to increase the variety of products
- Customize: to allow customers to have their own experiments with concepts and to increase customers' confidence in our company

Knowledge areas contributing to the above formulation are:

a. Project Scope Management (Marketing, Customers self-design, Customers transaction – PayPal payment gateway, Customer delivery system)
b. Project Time management, Project Cost Management
c. Project Quality Management

The outcome from this second round of considerations is illustrated in the choice of floor plans, and customization of interior design and furniture selection. Examples shown (Fig. 1b) are screenshots, using the open source *RoomSketcher* software.

To confirm implementation feasibility, a third round of considerations are:

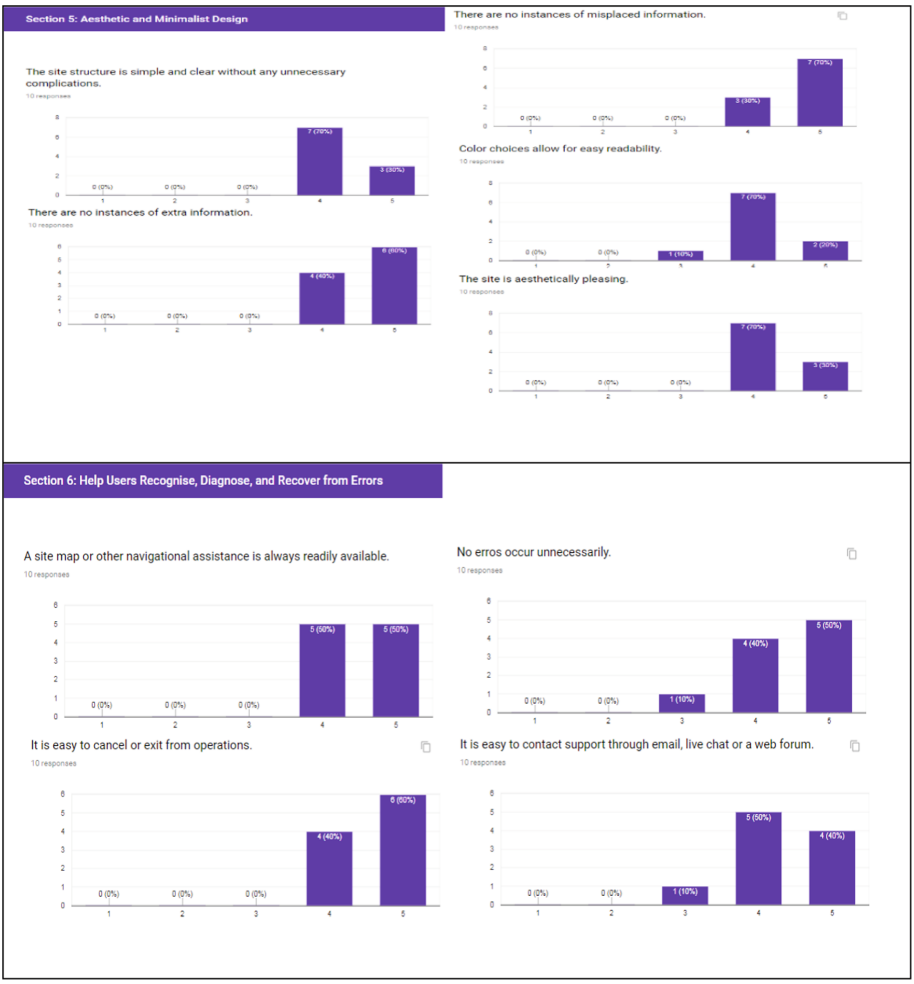
a. Project Human Resource Management (customer feedback, customer forum, live chat support, Team development)
b. Project Communication Management
c. Project Risk Management (Financial risk-cashflow management, Operational risk-supply chain distribution, transport risk, Customer satisfaction risk and risk control and monitoring)
d. Project Procurement Management (Source selection (quality), contract administration, Stakeholder Management: CEO, CTO, COO, CFO)

4.2 *Furnitize's* Evaluation (User Perception)

There are 7 sections in the survey: visibility of system status, user control and freedom, consistency and standards, recognition rather than recall, aesthetic and minimalist design, users recognition/recall, diagnosis, and recovery from errors, and language [24]. Ten different university students did the user testing. Findings are presented in Table 1 below.

Table 1. *Furnitize's* user testing findings





4.3 Case Study 2: *The Enchantress'* Systems Design-Development

The Enchantress [26], is a crowdsourcing platform which encourages the community to recycle and to imagine what these items can become, i.e., the user as designer with the challenge of enchanting buyers (Fig. 2).

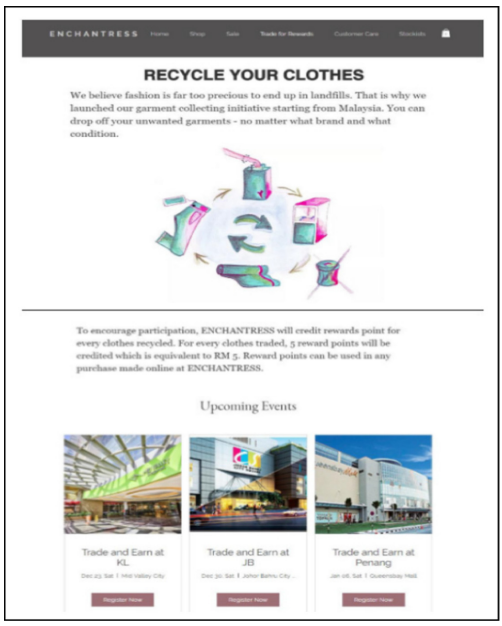
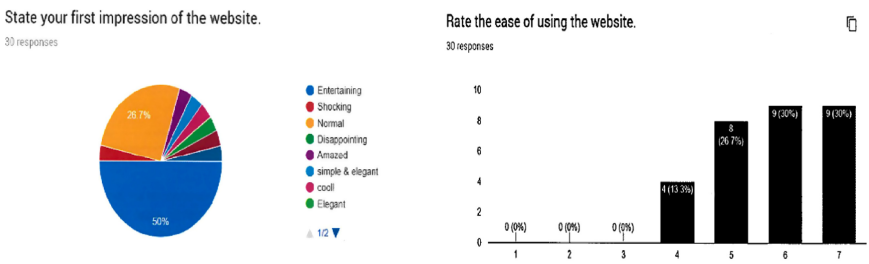


Fig. 2. *The Enchantress*

4.4 *The Enchantress'* User Evaluation

Technology acceptance by users has also been positive. Figures 3a, b present some of the findings on 30 respondents.



(a) (b)

Fig. 3. **a**, **b.** *The Enchantress'* user testing findings

4.5 Case Study 3: *HerAll*

The *Enchantress* exemplifies business process reengineering, with gamification as the motivator. Yew and Lee [27] have further investigated the efficacy of three Knowledge Management approaches on a crowdsourced platform *HerAll* based on Shapira, Youtie, Yogeesvaran, and Jaafar's [28] propositions. Three hypotheses in the study (Fig. 4) are:

a) A resource-based view approach (RBV) knowledge management approach will result in higher quality participatory design and have a positive and medium effect on customer satisfaction and in B2C e-commerce.
b) A knowledge-based view approach (KBV) knowledge management approach will result in higher quality in participatory design and have a positive and low effect on customer satisfaction and in B2C e-commerce.
c) A mixed (MBV) view knowledge management approach will result in higher quality in participatory design and have a positive and best effect on customer satisfaction and in B2C e-commerce.

The sample group are young Malaysian customers who are potential designers. The leader's design and leadership skills are instrumental to the number and quality of comments and likes, but the most important motivators are recognition and rewards. Some sample screenshots are presented in Figs. 5a, b, c.

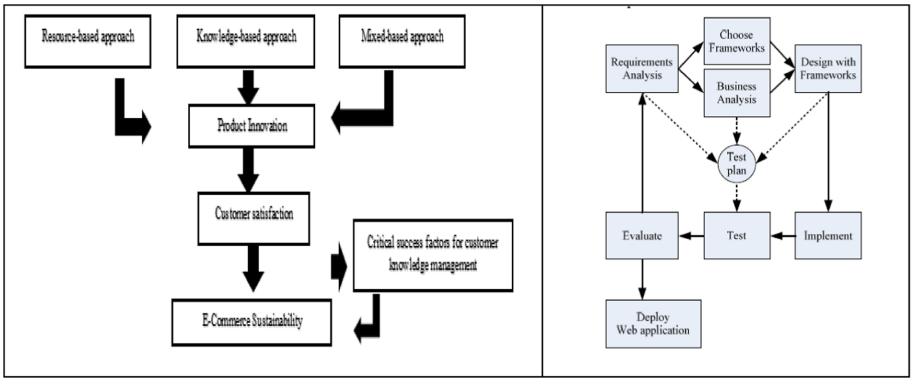


Fig. 4. [27]'s research model on Knowledge Management approaches in relation to product innovation, customer knowledge management and e-commerce sustainability (left) and the development methodology based on the SDLC (right)

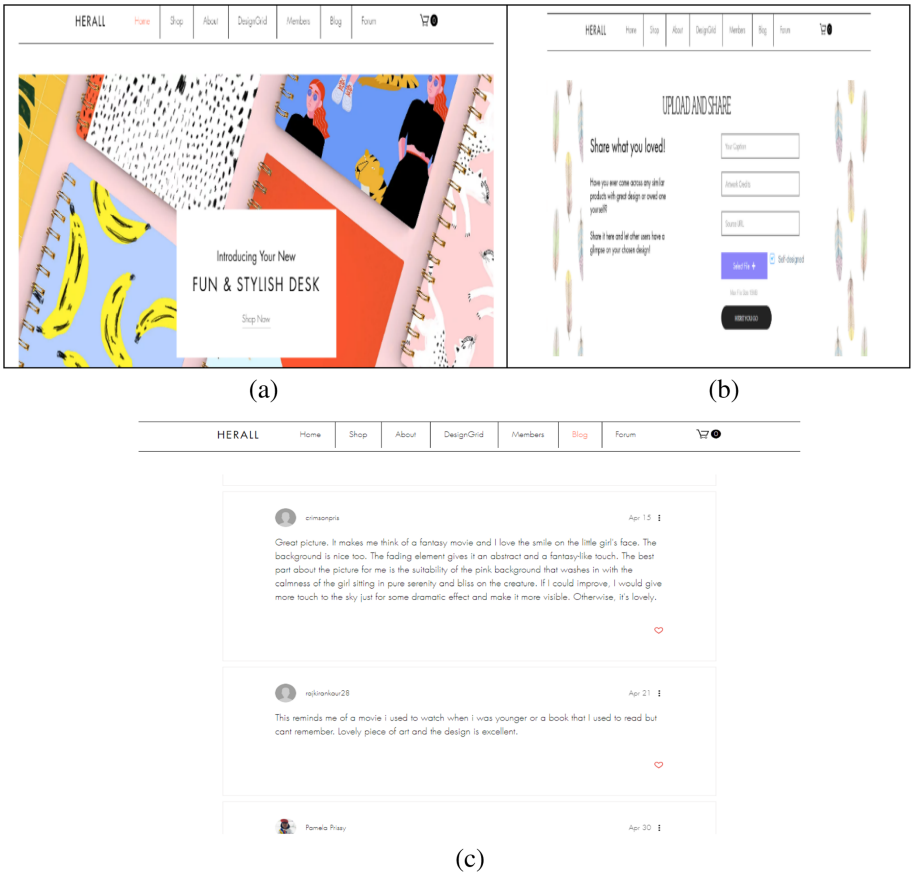


Fig. 5. **a.** Top part of *HerAll's* [27] homepage, **b.** Upload and share at the Design Grid, **c.** Sample blog posts

In addition, among the three approaches, the Mixed Knowledge-Resource-based approach is the most successful approach compared to Knowledge-based and Resource-based approaches in developing more effective learning and higher customer satisfaction. The average customer satisfaction percentages based on the CSAT instrument for each approach are resource-based approach: 75.85%, knowledge-based approach: 71.40% and mixed approach: 81.35%. Some designers also improved over time (Fig. 6a). Blog posts also indicate increased interests and likes (Fig. 6b).

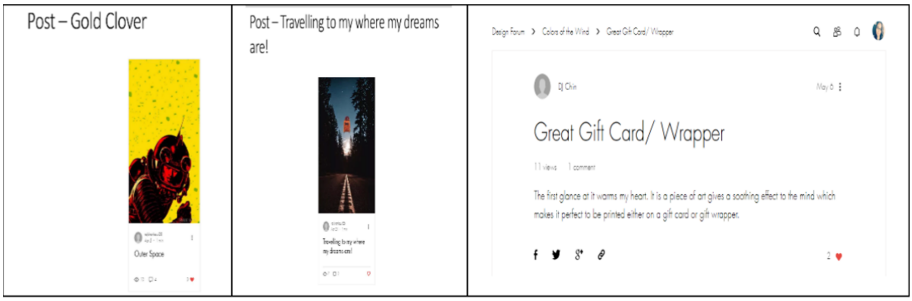


Fig. 6. **a.** A participant's card designs: Apr 5 (left), Apr 21 (centre), **b.** Sample blog posts on how to productize the designs

5 Discussion

Furnitize's design is more stable as the market and product items are predefined, though customization is allowed. *The Enchantress* and *HerAll's* degree of exposure to market demands and trends are higher, and designs are totally open. *HerAll* is especially sensitive as it caters to a niche market. Hence, we agree with CRMs with object-oriented architecture and agile-SCRUM/KANBAN design-work processes, integration and dashboards such as Salesforce's. Such model-driven architecture and work processes would enable more efficient and effective customization, monitoring and assessments. In addition, throwaway prototyping arising from the sharing of designs and comments greatly complements incremental rapid prototyping for all three systems.

These findings indicate the suitability of [16]'s yin-yang CRM model and [29]'s Identify, Differentiate, Interact, Customize (IDIC) model (Fig. 7) for open co-design. Both models emphasize tradeoffs/balancing and more importantly, design thinking's empathy at every stage. For instance, *identifying* customers as individuals and

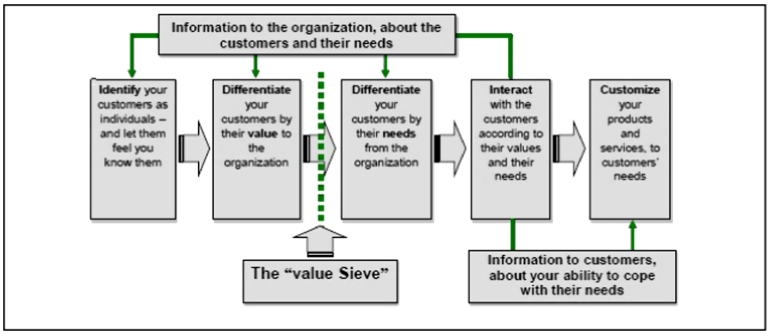


Fig. 7. IDIC CRM model: The identified model for agile open-co-design based on findings above Source: Medium (2020) [31]

subsequently, creating user experience and feelings of personalization at stage 1, *differentiating* based on customer's value to the organization (stage 2) and their needs from the organization (stage 3), *interacting* with customers based on their values and needs (stage 4) and finally, *customizing* to these needs (stage 5).

Findings also highlight the importance of social/humanistic factors such as in [8]'s TAM models and also [30]'s findings on design thinking-computational thinking and dispositions in the creative industries, transferred slightly, from computing.

The importance of the product innovation-supply chain is also supported by [32]'s product innovation-sustainable supply chain model. It extends the supply chain to environmental, operational, social and economic considerations in order to be sustainable. Moreover, since product innovation significantly influences sustainable supply chains upstream and downstream, strategic balancing between higher product margins arising from customization and total long-term supply chain costs, is critical. Due to varying different dimensions in dynamic market demands, agile supply chains take precedence. They also confirm the viability of socially responsible innovations towards social standing/reputation as well as green supply chains. Further investigation, however, are beyond our capacity and scope. Business process studies such as [33]'s series of studies, may play a bigger role in the future.

6 Conclusions

We have posited that ISAD-HCI and Project Management (PM) enable and enhance the product innovation model as well as the sustainable supply chain model concurrently. For instance, Information Systems Analysis and Design (ISAD) emphasize decomposition, loosely and tightly coupled relationships and methodologies. While human-computer-interaction has often been able to create more positive user experience, wider considerations influenced by the Technology Acceptance Model (TAM), highlights the importance of ease of use and usefulness and their influence towards intention and behavior. The integration would help modeling and simulation of what-if scenarios and in scoping user requirements, design and development in software engineering.

The three systems discussed in this paper started out as Information Systems Analysis and Design (ISAD)-Knowledge Management (KM)-Project Management (PM) projects. Hence, for all systems presented, informatics includes not only computational but also cognitive and social aspects. This integration has enabled us to better appreciate all Customer Relationship Management (CRM) models as the common thread across ISAD-KM-PM are retrieval, management, sustainability. Each captures the multifactorial facets influencing the possible degree of sustainability in open co-design. Furthermore, among these, information design, user experience, customer satisfaction metrics, diversity, and environmental support are the most important.

The design in our study is preliminary and involves a very small sample size. Findings confirm that sustainability should be multi-factorial even from the start and that Project Management-computational thinking as design considerations to Information Science-HCI and open co-design can be added strategic advantage to both product innovation and sustainable supply chains.

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