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Social media and Web 2.0 for knowledge sharing in product design

Abstract:

Working collaboratively with internal and external partners (suppliers, customers and internal stakeholders) has been at the epicentre of product design. Knowledge sharing has been well recognised in this context. However, there is limited research that has addressed the role of social media/Web 2.0 in facilitating knowledge sharing for sense- and decision- making within product design. To address this gap, this study draws on the resource-based view (RBV) of the firm and two vignettes that relate to 'collaborative co-design' and 'collaborative design-to-order'. We illustrate the role of social media/Web 2.0 in building knowledge sharing capabilities for sense- and decision-making for internal and external partners during product design. Limitations and further research into the use of social media/Web 2.0 are also discussed.

Keywords: Social Media/web 2.0, Product design, knowledge sharing, Resource-Based View.

1. Introduction

The development of new products is pivotal for the long-term growth and prosperity of organisations. Product design is regarded essential for product innovation and success (Moultrie et al., 2007; Jung et al., 2014). Research has focused on different factors influencing new product design, with scholars arguing that sharing knowledge between internal and external partners (suppliers, customers and cross-functional teams) may improve quality, cost, flexibility (Myers and Cheung, 2008) and may contribute to successful inter-organisational product development (Cohen and Levinthal, 1990). User-oriented designs influence new product success positively (Veryzer and de Mozota, 2005; Menguc et al., 2014). Suppliers' insights and technological skills in all stages of product development help create value, reduce design risks and achieve competitive advantage in design (Menguc et al., 2014). Their involvement may be sharing knowledge to facilitate the design of components, systems processes or general project management (Ragatz et al., 2002; McIvor and Humphreys, 2004; Irani, 2010; Menguc et al., 2014; Nemoto et al., 2015). No matter if literature has investigated knowledge sharing between internal and external partners (Ahuja, 2000; Muller and Zenker, 2001; Argote et al., 2003; Lawson et al., 2009; Nagati and Rebolledo, 2012; Soukhoroukova et al., 2012), such as suppliers and customers (Kim and Wilemon, 2002; Hong et al., 2004) during product design (including service design), there is still research to be conducted

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on how knowledge is shared; in particular, researchers have not looked into the processes of joint sense-making and decision-making during product design (Sharif et al., 2010; Revilla and Villena, 2012). They are both important, since the former term refers to interpreting and making sense of knowledge about strategic issues, whereas the latter to "inter-organisational operative routine activities" (Revilla and Villena, 2012, 855).

Literature has underlined the role of Information Technology (IT) in customised product design (Yassine et al., 2004; Nambisan, 2013), in building capabilities needed for supporting collaboration, knowledge sharing, resource allocation and planning (Kim and Wilemon, 2002; Wade and Hulland, 2004; Gordon et al., 2008). Recently, public and private sector organisations have embraced Web 2.0 technologies to create and share content in real time, allowing users to share and post content, and hence 'many-to-many' communications and knowledge sharing (Kietzmann et al. 2011; Naylor et al., 2012; Aral et al., 2013; Uthayasankar et al., 2015). Social media/Web 2.0 could enable the involvement of internal and external partners in product design through, for instance, sharing content (knowledge) about how to improve the design (Callahan and Lasry, 2004; Veryzer and de Mozota, 2005; Menguc et al., 2014).

However, literature so far has not addressed the role of social media in knowledge sharing during product design and in particular the processes of joint sense- and decision- making. The academic challenge underpinning this research is to appreciate the tacit and implicit knowledge that is synchronously co-created by the internal and external stakeholders during product design. In duly acknowledging this as a process, it is how this can be captured and represented as a collaborative process and the role that social media plays as a sharing capability is where this paper seeks to explore and make a positioning insight. Hence, our research question is as follows: How does knowledge sharing affect sense and decision making processes for product design and what is the role of social media/web 2.0? The aim of this research, is, hence, to understand the role of social media within knowledge sharing, particular in the processes of sense-and decision- making during product design. Our objectives are: (i) to review the literature on knowledge sharing for joint sense- and decision- making and the role of Social media/Web 2.0 within this process and (ii) discuss the role of social media/web 2.0 in developing particular capabilities for knowledge sharing within product design. We draw on the resource-based view (RBV) and two vignettes, related to 'collaborative co-design' and 'collaborative design-to-order'. The RBV has been fundamental in explaining the achievement of sustainable competitive advantage through the combination of valuable, rare, inimitable and non-substitutable resources (Wernerflet, 1984; Prahalad and Hamel, 1990; Barney, 1991; Teece et al., 1997). The RBV has contributed to product development and design by highlighting the role of different capabilities, created by combining

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resources (Teece et al., 1997) as they affect process efficiency and product effectiveness (Verona, 1999), as well as customer and supplier involvement in design and new product performance (Menguc et al., 2014).

In the following sections, the conceptual foundations of our study and methodology are explained. Then, the findings from the vignettes are reported. The study concludes with discussions and implications of the role of social media/Web 2.0 in sharing knowledge for joint sense- and decision-making during product design.

2. Conceptual foundations

2.1 Resource-based view of the firm and product design

The RBV proposes that firms create sustainable competitive advantage based on creating resources that are rare, valuable and non-imitable/substitutable (Wernerflet, 1984; Prahalad and Hamel, 1990; Barney, 1991). Researchers in the RBV have suggested, however, that it may not be the level of resources a firm possesses or acquires, but the deployment and combination of resources that create capabilities (Teece et al., 1997). It is capabilities, defined as the ability to combine and deploy resources in an effective way to transform inputs into desirable outputs (Newbert, 2007; Menguc et al., 2014) that explain differences in performance between firms that possess the same level of resources. Such capabilities are often defined by way of staffing skills and expertise or location, business factors that offer differentiation by way of unique positioning.

In product design, scholars have highlighted that design can be a strategic *resource* that enables firms to achieve sustainable competitive advantage (Stevens and Moultrie, 2011). Menguc et al. (2014), in their study of the RBV and customer and supplier involvement in the design process and new product performance, extend the RBV by introducing innovation *capabilities* as moderators in the resource–new product performance relationship. This paper uses the RBV as a conceptual lens to explore the influence of social media/web 2.0 in creating knowledge sharing capabilities on sense- and decision- making during product design.

2.2 Knowledge sharing for joint sense- and decision- making in product design

Product design has been emphasised as a determinant of the total cost of producing or delivering products and services (Hong and Roh, 2009) and competitive advantage (Veryzer and de Mozota, 2005; Hong et al., 2011; Marsillac and Roh, 2014; Menguc et al., 2014). Product design involves, inter alia, collaboration between suppliers, customers and the cross-functional design team for the establishment of plans on information flows and activities. Product design needs to identify market/customer requirements (formally or informally), specify products and create or

modify already existing products to meet the needs of the market. Sharing of knowledge, defined as "shared, common understanding of the design team" (Rupak et al., 2008, 724), with both customers and suppliers is critical (Lawson et al., 2009). Through knowledge sharing, transactive memory ('know- what' and 'know-how'), successful collaboration, effective and efficient collective problem solving, innovative solutions in terms of both critical strategic issues and inter-organisational operative routine activities are achieved (Rupak et al., 2008; Revilla and Villena, 2012).

Knowledge sharing of customers, suppliers, internal capabilities, and design process is of strategic and operational importance (Zailani and Rajagopal, 2005; Swink et al., 2007; Sanders, 2008). Knowledge sharing enables *joint sense-* and *decision-making* to take place (Revilla and Villena, 2012). Through *joint sense-making,* partners share their learning experience to develop a common understanding of the strategic issues of product design, and explore and interpret knowledge relevant to their relationship (Fugate et al., 2009: in Revilla and Villena, 2012). Collective design strategies are implemented, and flexibility in the design process can be achieved (Hult et al., 2004; Liker and Choi, 2004).

Through *joint decision-making* partners focus on those collaborative decisions related to the operative processes (Malhorta et al., 2005). Joint decision-making enables partners to communicate, cooperate and coordinate, and create routines to structure and solve problems, improve current processes and routines, and achieve efficient design operations (Lawson et al., 2008). Such operations may involve problem resolution and shared design plans (Malhorta et al., 2005). Consequently, shared experiences and common understanding of what needs to be done enables the achievement of operational design process flow.

2.3 Information Technology and knowledge sharing for product design

From the RBV perspective, the role of IT in facilitating knowledge sharing in organisations has been examined (Bhatt and Grover, 2005; Sambamurthy and Subramani 2005; Wasko and Faraj 2005; Taradfar and Gordon, 2007; Choi et al., 2010). In new product development and design (Bharadwaj, 2000; Nambisan, 2003; Yassine et al., 2004; Banker et al., 2006; Barczak et al., 2007; Durmuşoğlu and Barczak, 2011; Nambisan, 2013), scholars have emphasised IT as *material resources* (Boland et al., 2007; Zammuto et al., 2007; McAdam et al., 2008; Dougherty and Dunne, 2011), and *human/intangible resources* (Pavlou and El Sawy, 2006; Tarafdar and Gordon, 2007; Pavlou and El Sawy, 2010; Chen and Tsou, 2012; Mohamed *et al.,* 2013). IT resources create IT-enabled capabilities, defined as the extent to which a team is aware of what IT functionalities and tools it

has to offer, and can effectively utilise those functionalities and tools to share knowledge (Pavlou and El Sawy, 2006).

Recently, firms have been using IT in the form of social media and Web 2.0 to allow 'many-to-many' communication and knowledge sharing (Kietzmann et al. 2011; Naylor et al., 2012; Aral et al., 2013), and co-develop new products with customers (Prahalad and Ramaswamy, 2004; Hoyer et al., 2010; Sigala, 2012; Bohlman et al., 2013). The role of social media/web2.0 is discussed in the next section.

2.4 Social media/Web 2.0 and new product design

O'Reilly (2007) suggests that social media provides a platform to create communities for connecting people and sharing information. Social media builds on Web 2.0 technologies (infrastructure) that are internet-based and designed to facilitate user-generated content and information sharing through social links and interactions among individuals. Literature (Boyd and Ellison, 2007; Messinger et al., 2009; Kietzmann et al., 2011) notes that social networking in terms of Web 2.0 technologies is largely driven by user-driven/user-created content focusing on providing the portrayal of 'self' through profiles; and the sharing and accessibility to groups of individuals around loci of relationships or interests. Table 1 maps popular Web 2.0 technologies against common traits rather than an ontological positioning. It also classifies them according to the type of communication they support (one-to-one, one-to-many, one-way, two-way) and the richness of media (text vs. video) they use. The list presented in Table 1 is not exhaustive, and is limited to some notable, well-known Web 2.0 technologies. The symbol "★" indicates common features in each of the Web 2.0 technology-based online applications.

Insert Table 1 here

In exploring Web 2.0 take-up, Bughin (2008) reported the results of an empirical study that found that Web 2.0 adoption was more prevalent amongst networking tools within a business context, in areas such as Web Services (Ebrahim and Irani, 2005; Khoumbati et al., 2006; Irani et al., 2010) that support better organisational data/information integration. In exploiting further the collaborative nature of Web 2.0, the literature (Kietzmann et al. 2011; Naylor et al., 2012; Aral et al., 2013) describes Web 2.0 as a shift in technology to a system of synergistic and mutually supporting techniques and activities. This clearly supports organisations in 'linking-up' with suppliers and customers through common communication protocols and technologies. As a result, Web 2.0 has been able to penetrate far beyond Web Services at traditional data integration level, through capitalising on the widespread application of social networking Web 2.0 technologies.

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Table 2 presents a summary of Web 2.0 technologies and application areas that are being exploited by well-known, high profile brands and seeks to demonstrate their commonalities and divergences. The rationale behind the use of the table is to extrapolate the importance of the use of social media for these brands.

Insert Table 2 here

Social media/Web 2.0 allow organisations to co-operate and interact with customers, suppliers and online communities (Nambisan, 2003; Petersen et al., 2003) to generate and evaluate new ideas, and foster product innovation based on community knowledge and ideas (Sigala, 2012; Piller et al., 2012; Martini et al., 2013). It is the speed of reacting to such feedback that prompts innovation and new business opportunities (new products or services). Social media enable creativity (Leenders et al., 2003), environment scanning, idea generation, and idea evaluation and selection (Bayus, 2013), therefore establishing a shift from a manufacturing-active paradigm to a customer-active paradigm (von Hippel, 2005). In design, social media can increase the 'fit to market' of a new product, decrease the risk of product glitches and enhance the innovativeness of a new product (Culnan et al., 2011).

Sigala (2012) summarises the role of social media/Web 2.0 in that they provide: a platform for collaborating, interacting, and sharing customer and supplier knowledge to harness and evaluate new ideas; a tool enabling brainstorming during idea generation; and a tool "for gathering, categorizing, visualizing and analysing user-generated content for implementing environmental scanning and assessment" (2012, 554). In product design, literature reports mainly on social media as physical/material assets that facilitate product co-design. Kohler et al. (2009) report the use of secondlife.com for engaging customers in the design and testing of a new service, whereas Kim et al. (2008) suggest the use of 3D worlds for service design evaluation, implementation, and delivery; simulation of real-world situations to study customer reaction; and new product launch.

To contribute to the limited studies that have examined the role of social media in sharing knowledge during joint sense- and decision- making in product design, the authors present vignettes as short reflective pieces.

3. Research Approach

The methodological challenge underpinning this research is in identifying and capturing the continuous and intermittent flows of information that collectively constitutes knowledge

communicated and co-created by the multiple stakeholders involved in the product design as associated business functions. Such knowledge is not necessarily internalized as such and therefore, potentially disregarded as a given when in fact, it is integral to the co-creation process'. In exploring this phenomenon, a suitable research approach was pursued to offer a lens through which meaning and insight can be gained to allow a framing of the academic challenge.

The authors followed the interpretative paradigm which suggests that social phenomena and, in our case, knowledge sharing, cannot be explored by statistically testable hypotheses (Orlikowski and Baroudi, 1991). Within the interpretative paradigm, we used qualitative vignettes (Finch, 1987; Hughes, 1998; Taylor, 2006) to explore how social media/Web 2.0 facilitates knowledge sharing for sense- and decision- making during product design. The vignettes go beyond single 'point' examples as in the use of Web 2.0 technologies for the development of community-based acquisition standards (see Saran, 2007). They follow the noted intercompany business process linkage visualisation as highlighted in the seminal work by Lambert and Cooper (2000) and Lambert et al. (1998). They are based upon this tier-based perspective and the related managed, non-managed and monitored links for product design.

The selection of the vignettes was on the basis of their provision of appropriate illustrations of the role of social media/Web 2.0. The vignettes discuss two popular issues in product design: 'co-design', and 'design-to-order'. The organisations chosen were already using social media for knowledge sharing purposes and product design. Data were collected by non-participant observations (meetings) and supplemented by informal semi-structured interviews. During the observations, notes were kept, trying to stay as close as possible to what had been observed. At the end of each day of observation, notes were reviewed and analysed. The interviews lasted about 30 minutes on average. Interviews -12 in total, six in each vignette- were conducted with the cross-functional team, including the product design manager, three members of the design team and two of their first tier suppliers (two managers). Informants were encouraged to adopt a free format and describe their experiences with social media/Web 2.0 tools. The authors used notes to record the content of the interviews. Data were analysed following the tenets of qualitative data analysis in particular coded using the principles by Miles and Huberman (1994) and Voss et al. (2002).

4. Social media/Web 2.0 facilitating knowledge sharing during product design for sense- and decision-making

4.1 Vignette: Product co-design in Alpha Inc

Product co-design involves, in the broadest sense, a set of information request and response flows and knowledge sharing across a range of stakeholders (suppliers, customers, team) using design toolkits (Pillar et al., 2005). These toolkits enable the design team to work on a customised product or service, but also to share knowledge from previous designs or customer and market requirements. Furthermore, the toolkits foster creativity and reduce uncertainty associated with the co-design process from the perspective of supplier and customer. Therefore, the team can: i) harness the market requirements from customers and suppliers; ii) combine this knowledge with internal capabilities in product design; and iii) make decisions on both operational and strategic issues related to design, and the process followed and how it can be made more efficient. The following short vignette explores collaborative co-design through the use of social media/Web 2.0 technologies, and demonstrates their use as design toolkits for sense-making and decision-making.

4.1.1 Overview of Alpha Inc.

Alpha Inc. is a development company that is building a hotel in the Gulf region of the Middle East, where a number of regional as well as global investors are involved. The company would like to involve its customers and suppliers in all the stages of the development process, and in particular in co-designing the hotel. They believe that such an involvement will enable customer and supplier requirements and knowledge to be recorded and considered. In particular, as part of the initial scoping of requirements for the design of the building, Alpha needs to identify the requirements from across the investor community, target clientele and customers, as well as aligning the construction with local building regulations and international building standards; that is, important decisions during the design phase need to be made. However, the company operates within a global network and the complexity because of the different stakeholders involved is high. Furthermore, due to the volatile context in which it operates, there is concern that it may lose critical suppliers. These disruptions may have an undesirable operational and financial impact. Alpha Inc. intends to create a cross-functional and inter-organisational team to collaboratively co-design and co-develop the hotel with both customers and suppliers. In terms of the design of the hotel, the company has conducted an initial scoping of requirements from discussions and sharing knowledge with investors and interested parties, that is, customers and suppliers. To facilitate

knowledge sharing with customers and suppliers Alpha Inc. needed to use the 'collective intelligence' provided by social media/Web 2.0. Such technologies would also enable external partners to understand the internal process of design and development within Alpha and share knowledge regarding the design process. Furthermore, the design team would use social media/Web 2.0 to sense changes in market requirements (that is, sense-making), as well as enabling people to share knowledge they gain from dealing with everyday issues within the team. Alpha has knowledgeable IT personnel and possesses internal IT resources: i) technical, that is, hardware, software, Alpha-specific applications, and networks; ii) IT-related human resources, such as skills of their staff including technical skills, skills in IT management, communication, and understanding of the processes underlying the design; and iii) intangible resources, namely knowledge assets, customer and supplier knowledge of the process, and a flexible IT culture. Staff therefore can leverage and combine existing IT resources to develop abilities for accomplishing, inter alia, knowledge sharing that contributes to organisational learning, efficient decision-making and design, and achieving performance. Below we explore these different options when fully using social media/Web 2.0 for product design.

4.1.2 Social media/Web 2.0 tools

Beyond the initial requirements phase, identification of commercial issues and constraints is supported through collaborative working with social media/Web 2.0 tools (Google Wave, Wikis) due to their characteristics extrapolated in Table 1 (including their abilities for many-to-many and two-way communication of both text and video and their ability to facilitate information sharing between the partners). Furthermore, social media/Web 2.0 can enable online collaboration between the members of the design team (including, for example, investors, potential contractors, clientele, building regulation agencies and bodies as well as travel and leisure stakeholders). A breakout design community may emerge, which would create and share content (knowledge) and be enabled through a series of self-created collaborative websites. For example, within the design team there may be a working group / party which would look at the local and international marketing challenges of providing yet another luxury hotel in the region – but which involves stakeholders from across the globe. Important decisions would need to be taken regarding: i) customer and market requirements; ii) operational issues, such as how different knowledge and ideas from the market can be operationalised; and iii) the design process and how it can be more efficient. Such decisions can be made in a more efficient and informative way by using social

networking websites specifically built for this purpose, so that the design team members would then be able to come together and share knowledge without being influenced or constrained by the overall design process.

So far then, Alpha Inc. may have provided a number of collaborative (Google Wave, Wiki), facilitations as well as social (Facebook, LinkedIn, Exploroo) presences. Based upon online as well as offline discussions and feedback, Alpha would potentially then be able to identify pertinent commercial, engineering, marketing or financial discussions and feedback into its business initiative. Prior to this phase, Alpha may indeed have identified potential suppliers/contractors who would be involved in designing and building the new hotel. Clearly, if Alpha is an experienced property developer, it would have a range of business partners who it may have used in the past. In this instance, Alpha would have access to additional stakeholder information that it may not have been privy to, and indeed, which it might not have realised previously. Thus, Alpha could harness content across the above Web 2.0 platforms in order to target and engage in feasibility tests with suppliers or contractors, thereby decreasing risks related to loss of suppliers or contractors, which would be fatal to the project. Then, identified contractors could be invited to become members of discussion communities, or to collaborate directly with the specification of requirements with Alpha (for instance on an 'Alpha-Wiki').

The partners could use social media platforms in terms of location-based, travel and lifestyle and blogging platforms at the initial requirements stage within Alpha alone, to harness opinion and provide and capture innovative brainstorming about requirements. For example, platforms such as Google Wave and Wikis could be used to share documents regarding the requirements identification by the design team. The discussion and sense-making process of the emerging requirements could be facilitated by hosting and storing project documentation 'in the cloud' within Google Wave, while allowing for real-time updating and flexible amendments to low-level technical and business specification and operational decision-making in terms of a 'Hotel Wiki' website. Marketing and conceptual specification material could also be disseminated onto social networking sites related to travel and lifestyle or construction and business (either on Facebook; as a business group community on LinkedIn to generate interest in investing in the build; or to gain immediate feedback on the design needs and responses on sites such as Exploroo).

Moving onto the design process itself, Alpha would be in a better position following its Web 2.0 engagement to determine its requirements in a more specific manner. This would potentially take into consideration not only commercial requirements (for example, a need for the new hotel to not only have extensive health and wellbeing facilities, but also extensive transport services such as providing a helipad); but also experiential needs from potential customers (for example, all the

way through to the lighting and 'mood' of guest rooms depending on whether they are leisure or business travellers). Such requirements would need to be processed by the team, who would then have to decide which of these would be incorporated in the design. Thus, sense- and decision-making can be enhanced through social media/Web 2.0. Knowledge of customers, suppliers, and the design process could be promulgated within and across the whole range of networking, messaging and collaborative websites as identified in Table 1. In terms of the intercompany process links as part of the design process, Table 3 shows how Web 2.0 technologies could support the design process, noting the usage of the Lambert and Cooper (2000) components of monitored, managed and non-managed tiers within the supply chain.

Insert Table 3 here

As noted within Table 3, the authors suggest that there is a strong overlap between the monitoring of such Web 2.0 infrastructures and social media platforms, and the active management of specific network spaces (such as business or social networks on the one hand) and less active approaches on the other hand (such as for blogging sites and messaging). This is in order to take into consideration the fact that in each of the monitored, non-monitored, managed and non-managed cases there needs to be a balance struck between the impact of decisions taken collaboratively within a given digital community as compared to opinions and personal insights which are merely shared in a similar context. As Messinger et al. (2009, 224) warn: "assumptions that can be safely made about the physical world may not necessarily hold true in virtual worlds".

4.2 Vignette: Design-to-Order in Beta Computers

The design-to-order process involves product management and configuration to a given specification defined by the end user. This process and level of flexibility in design enables the customisation of a variety of consumer products such as computers, cars, and other mass products that may involve a plethora of configuration options (for example, size, colour and other factors). In this instance, the supply chain involves the integration, sharing, and co-ordination of knowledge emerging from interactions among and between tier and network partners, (suppliers, customers, and internal stakeholders). A vital requirement for the operation of this chain involves the orchestration of product, assembly, supply chain, and ultimately delivery and sharing of

information and knowledge. The following short vignette highlights the ways in which Web 2.0/social media can support knowledge sharing capabilities for design-to-order strategies.

4.2.1 Overview of Beta Computers

Beta Computers seeks to provide its customers with a unique customisation experience in terms of the specification of its computers (in direct competition with leading manufacturers established on the internet already). Beta provides a catalogue of products to choose from, as well as product customisation and specification. It directly and indirectly integrates all demand and fulfilment information outwards to the demand creator (the customer). Therefore, knowledge sharing in a timely matter is vital to their integration with their supplier network and their long-term survival. As in the case of Alpha Inc, Beta possesses the appropriate IT resources to develop knowledge sharing capabilities for joint sense- and decision- making.

4.2.2 Social media/Web 2.0 tools

In order to arrive at this product configuration stage, and then beyond to the sales order process, the access to and the ability of customers to interact with the organisation would be facilitated by interacting with product evangelicals ('fans') through identifying those social media platforms and in particular those network sites which: (i) espouse product reviews (for example, sites such as EnGadget, Amazon or Price Runner); (ii) where specific user communities have developed (for example, on LinkedIn); (iii) even where there are a significant number of responses to track websites (for example, del.ic.ious, Reddit).

Through the use of social media platforms Beta Computers could leverage and identify market and user sentiment and future requirements and needs based on consumer creativity. Additionally, through the use of social media/Web 2.0 for sharing and making information/knowledge visible among the supply partners, Beta Computers could not only record configuration and customisation needs, but it could: i) share its own internal knowledge with customers and suppliers; ii) co-create and make joint decisions with supply network partners and customers on current and future product design foci; and, iii) be flexible and fast enough to deal with disruptions related to the supply of specific raw materials and peripherals, or positively adapt to new circumstances such as changes in customer requirements.

Such a focus may involve technology-supported criteria related first to sense-making, for instance, of the identifying themes of the most useful or requested peripheral devices and/or packaged software and services as part of the purchase of the product. Although not a major or

significant modifier for customised product requests, geographical or market-specific requests could be further grouped and clustered for demand analysis through interrogating location-based requests. These may arise out of affiliated sales and purchasing channels (such as, for example, banner advertising on location-based Web 2.0 sites, or product placement adverts on YouTube or in virtual environments such as Second Life, in terms of viral marketing campaigns).

Second, decision-making criteria would be related to operational activities, and would include the relevant functional areas involved. For instance, once past the specification of the product, Beta would then have to move rapidly to the so-called spontaneous build phase (taking a fulfilment request and processing it as soon as possible). Clearly, fulfilment and build are related to decision-making criteria, and can only be achieved if there is sight of an available inventory and a mechanism for triggering re-supply as necessary. Additionally, as a result of a customer specifying a build-to-order computer, Beta could also have in place alert mechanisms through the use of the Web 2.0 infrastructure and social media platforms, i.e. in the form of sending out 'tweets' or syndicated news alerts to pre-defined vendors, partners and / or suppliers in the wider supply chain network. Knowledge shared through these channels would relate to decisions on the identification of materials, cost, logistics supply and payment (invoice) information – which in turn could be made and implemented through web services extensions to traditional manufacturing and production management systems such as Enterprise Resource Planning (ERP). This would be in the wider sense of strategic inventory control for forecast demand of (mass) standard and custom orders, through agile concepts such as Kanban re-supply. In this sense, location-based services (such as Foursquare, if not a derivative of it) could also be used to identify the level and location of local inventories in order to assist in the forecasting of schedule adherence. An extension to these potential uses of Web 2.0 and social media would therefore be amenable to a 'mash-up' of these functionalities via flexible and exposed web services to chain participants. This would therefore allow manufacturers, suppliers and tier partners to: i) handle search and query requests about product specifications and configurations directly from customers; ii) visualise knowledge shared within the 'design-to-order team' (internal functions, suppliers, and customers) in order to find, resolve and exploit unexpected events such as changes in customer/supplier status and requirements; iii) use knowledge from ii) during operational decision-making to mitigate risks and recover from any disruption.

Finally, given the advent of flexible and rapid manufacturing technologies and facilities, Beta Computers would have some internal capability for part in-house fabrication or sub-assembly (in order to retain a component of its own value chain). A characteristic of adaptable design-to-order organisations is that they seek to minimise any risks and delays associated with disruption related

to supplier dependency and infrequency of demand. Of course the final stage of the design-to-order process would involve the delivery of the product – in this case a customer-specified computer – and for this part which relates to forward as well as reverse third party logistics (3PL), standard messaging services could easily be used (for instance, invoices and shipping orders could be automatically generated and posted on tier network sections on collaborative environments such as Google Wave).

At each stage of Beta Computers' business processes, social media/Web 2.0 should be able to enable knowledge sharing within the design-to-order team to design and develop requests for manufactured products – covering value-adding, demand creation, and decision-making processes within the chain.

<div align="center">**Insert Table 4 here**</div>

As in Table 3, the bottom part of this representation utilises the Lambert and Cooper (2000) classification for supply chain tiers once again. In this case, there is a more stratified suggestion of how each of the social media/Web 2.0 platforms could be managed or monitored in an a priori sense. Given the lifecycle of the design-to-order process, it would be necessary to orchestrate product management components as part of the design-out of any product. Thus, business-networking platforms should come under the remit of managed supply chain services in a Web 2.0 sense. There is still, however, a very real need for a cautionary approach to the combined monitoring and non-management of the wider spectrum of Web 2.0 platforms noting the potential for customer and / or social interaction in these phases of the lifecycle where demand creators ultimately lead any conversation and engage with those fulfilling the demand.

5. Discussion: Modalities of social media/Web 2.0 for Knowledge Sharing in Product Design

In this paper we have shown that social media/Web 2.0 can facilitate the sharing of knowledge for joint sense-making and decision-making during product design. Our study complements the existing literature on IT resources, both in terms of the materials (Kankanhalli et al., 2005; Sambamurthy and Subramani 2005; Wasko and Faraj 2005; Choi et al., 2010; Jin et al., 2014) and human/intangibles (Bhatt and Grover, 2005; Pavlou and El Sawy, 2006; Tarafdar and Gordon, 2007) and their combinations in knowledge sharing capabilities: firstly, we illustrate the role of social media/Web 2.0 in facilitating knowledge sharing between customers, suppliers and internal functions during product design; secondly, we discuss the role of social media/Web 2.0 in terms of resources, both material (infrastructure, that is), and human/intangible resources (skills,

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expertise) in building knowledge sharing capabilities for sense- and decision- making. Therefore, we address the gap in the literature (McAdam et al., 2008; Durmuşoǧlu and Barczak, 2011) regarding the role of social media/Web 2.0 in knowledge sharing and in particular the processes of sense-making and operational decision-making (Revilla and Villena, 2012) during product design. Our results reinforce the view that social media/Web 2.0 enables knowledge sharing and co-design of products with suppliers and customers, reflecting their knowledge into product/service (von Hippel, 1998; Piller et al., 2005; Wadhwa and Saxena, 2007; Nemoto et al., 2015). Finally we add to the debate of the RBV (Durmuşoǧlu and Barczak, 2011; Jin et al., 2014; Menguc et al., 2014) by positing knowledge sharing *capabilities*, enabled by combining and deploying IT resources with the form of social media/Web 2.0, influence sense- and decision- making during product design.

From a practitioner's perspective, social media/Web 2.0 enable diffusion of ideas, collaboration, crowdsourcing and collective intelligence. In particular, the new landscape of social media/Web 2.0 not only increases the dispersal of ideas and concepts relating to product design, but also significantly increases and allows for the inclusion as well as natural selection of ideas through near-evolutionary means. Hence, not only will business and operations-centric processes be increasingly driven by ever leaner and more flexible approaches to engaging with 'connected' suppliers and customers but the core mechanisms that govern how an enterprise designs products will be subject to a tailorable and rapidly configurable dynamic, and be able to act if it becomes vulnerable (the so-called semantic web concept, as shown by the success of the online encyclopaedia, Wikipedia – see Lih, 2009) (Gunasekaran and Ngai, 2004; Prajogo and Olhanger, 2012).

Apart from enabling diffusion and enabling collaboration, social media/Web 2.0 facilitate the visibility and transparency of sense-making and decision-making processes. The integration of customers and suppliers into product design allows visualisation and transparency of shared knowledge (customers, suppliers, internal functions/capabilities, and the design process). The design team can therefore explore and exploit ideas, understand changes in customer and market requirements, learn from previous experiences, improve the design process, and increase efficiency in the sense-making and decision-making processes. Furthermore, it is important to increase the transparency of shared knowledge between the design team in order to view tacit and explicit relational links within and across the team as identified by Lambert et al. (1998) and Lambert and Cooper (2000).

5.1 Critical Challenges to the Use of Web 2.0/Social media

Noting the points in the preceding sections, there are also particular challenges that relate to the effective usage of Web 2.0/social media for knowledge sharing during product design. In particular, effective use of social media/Web 2.0 requires that any organisation will have to have *experienced or sophisticated knowledge management/sharing strategies* to deal with the vast range of information posted and knowledge shared across a range of Web 2.0 platforms. Gathering and integrating discussions, threads, ideas and collaborative actions from sites as varied as location-based networking (e.g. Foursquare) through to messaging services (e.g. Skype, Twitter) is and will be a major undertaking in order to make sense of the content that will be located there. Thus having a combined knowledge and content management strategy is therefore key, as a combination of text, audio and video content define the fluid and dynamic nature of the Web 2.0 sphere. While individual outlets and platforms may provide data readily, sophisticated mash-ups would be needed in order to bring together a holistic view of the inter-organisational and cross-functional design team, re-orienting top-down flow of information and knowledge to one that is bottom-up from 'grassroots' stakeholders instead. Furthermore, organizations would need to be *proactive* in selecting appropriate technologies for *sense- and decision-making*. While we have explored the role of social media/Web 2.0 for sense-making and decision-making, not all such technologies are appropriate to facilitate it. Sense-making and decision-making are reliant upon knowledge sharing, as well as notions of an ecology of user-created content and its impact upon the economics of Web 2.0 technologies and the co-existence of this platform with other structures (Shim and Lee, 2009).

A consistent concern and argument against having an internet-based design team relates to *issues of security, privacy and authorisation concerns*. Shared as well as independent verification and security within and across a design team would have to be mandated and agreed to as part of either separate business processes, or subsumed within the contractual obligations of how design partners would interact and engage in the product design. Furthermore, to avoid the risk of social media/Web 2.0 being another ICT 'fad' and 'fashion', *integration and interoperability* needs to be considered, namely connecting and making the best use of such technologies out towards other internet and IS platforms would be an essential requirement. Noting the challenges to knowledge sharing highlighted above, an additional requirement would be to ensure that such content is usable as a fundamental organisational asset in itself. Integrating and aligning social media/Web 2.0 with Management Information Systems (MIS) such as Customer Relationship Management (CRM), and production planning and logistics systems would therefore be key. We support and confirm the

notion of Web 2.0 being part of the ecology of information systems and not a replacement for any single part of it.

We have highlighted the role of IT resources (including skills) and their combinations into knowledge capabilities for sense- and decision- making. The ability to identify and quite literally surf the 'waves' of knowledge, and share and integrate this knowledge might be overwhelming. Therefore, identifying *knowledge management/sharing skills* and in particular resources and individuals who are able to not only identify trends and themes within large and diverse social forums, but also use tools and techniques to visualise these will become increasingly important and vital.

*O*rganisations do need to balance the suggested benefits with the management *of social networking risks* from de-regulating and de-constructing traditional and non-web-based management and design team structures. For example, cartels and cliques could still be formed in an accelerated sense where a multitude of suppliers, customers, and internal stakeholders could be brought together in a design team to form a 'rapid response' to a new opportunity (market or business issue) – but without appropriate governance structures. In this sense, these disintermediated networks would be able to hold and share knowledge and social capital outside the team, could potentially spread and leverage asymmetric information or share knowledge for their own benefit, and be reluctant to share knowledge for the needs or values of product design.

Finally the use of social media/Web 2.0 technologies for product design ultimately requires not only the management of related strategic and operational processes (sense- and decision-making), but also *design team leadership and IT management*. However, a more fundamental aspect of the potential success of this approach will be in clear and effective leadership within and across the design team and focal firm to ensure that any such initiative is a success (Sharif and Irani, 2012).

Insert Table 5 here

6. Summary

This paper followed the RBV perspective and illustrated the role of social media/Web 2.0 in knowledge sharing for sense-making and decision-making during product design. This role was further discussed using two short vignettes on 'collaborative co-design' and 'design-to-order'. Challenges for the use of social media/Web 2.0 for product design were also illustrated. This paper has highlighted social media as a facilitator to product design through its underlying network of communication and knowledge sharing.   The paper highlighted the role of material and human/intangible resources in building knowledge sharing capabilities through social media/Web

2.0 and facilitate knowledge sharing between customers, suppliers and internal functions during sense-making and operational decision-making in product design.

Future research could include comparative case studies to investigate, for instance, the role of different social media/Web 2.0 in building knowledge sharing capabilities during product design with a focus on sense-making and decision-making. Surveys could also be conducted to look into how managers use social media/Web 2.0 for knowledge sharing during product design in technology-intensive versus non-technology-intensive firms.

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Table 1. Web 2.0 Technologies Mapped against Features

Web 2.0 Technologies	Common Features								Type of communication					Media Richness	
	Location Based Mobile Social Network / Technical	Social Media Service / Music / Video Sharing	Social Networking	Business Networking	Travel and Lifestyle	Blogging	Data or text / Messaging Services	Business Process Drive Application	One to one	One to many	Many-to-many	One-way	Two-way	Text	Video
YouTube is a video sharing website on which users can upload, share, and view videos.		★									★		★		★
Web Services are the ability to support computer-to-computer interoperability at a data integration level.				★			★				★		★		
A **blog** (a contraction of the term "Web log") is a type of website, usually maintained by an individual with regular entries of commentary, descriptions of events, or other material such as graphics or video.		★	★			★				★			★	★	★
Foursquare is a location-based social networking website, software for mobile devices, and also a game. Users "check-in" at venues using text messaging or a device specific application	★		★				★				★		★	★	★
Twitter is a social networking and micro-blogging service that enables its users to send and read messages known as *tweets*.			★			★	★				★		★	★	★
Facebook is a social networking website that allows Users can add friends and send them messages, and update their personal profiles to notify friends about themselves.			★				★				★		★	★	★
iMeem was a social media service where users interacted with each other by streaming, uploading and sharing music and music videos.		★	★			★					★		★		★
Bebo, an acronym for "Blog early, blog often", is similar to other social networking websites. Each profile must include two specific modules, a comment section where other users can leave a message, and a list of the user's friends. Users can select from many more modules to add.			★				★			★			★	★	★
ShareTheMusic was an Internet platform for legal and free music sharing. The idea of the service was to make it possible for all the Internet users, disregarding their geographical location, to listen to the music without any fees and in conformity with the copyright.		★	★								★		★		★

	1	2	3	4	5	6	7	8	9	10	11	12	13
Wikis – on the most famous wikis is "Wikipedia", a massive online encyclopaedia. A wiki is a collection of articles that multiple users can add to and edit freely online.									★		★	★	
In web development, a **Mashup** is a web page or application that uses or combines data or functionality from two or many more external sources to create a new service. It implies easy, fast integration, frequently using open APIs and data sources to produce enriching results that were not necessarily the original reason for producing the raw source data.						★	★		★		★	★	
Ning is an online platform for people to create their own social networks. The unique feature of Ning is that anyone can create their own social network for a particular topic or need, catering to specific membership bases.			★						★		★	★	★
Skype (including MSN), is a an online messaging service that allows chatting and sending instant messages to others.		★	★			★			★		★	★	★
Yahoo messenger (now moved into Yahoo mail) is an all-in-one communication tool, and anyone, anywhere in the world, with a computer and Internet connection can use it.		★	★						★		★	★	★

Table 1 (contd). Web 2.0 Technologies Mapped against Features

Web 2.0 Technologies	Common Features								Type of communication					Media Richness	
	Location Based Mobile Social Network / Technical	Social Media Service / Music / Video Sharing	Social Networking	Business Networking	Travel and Lifestyle	Blogging	Data or text / Messaging Services	Business Process Drive Application	One to one	One to many	Many-to-many	One-way	Two-way	Text	Video
Google Wave was an online software application product from Google, described as a "personal communication and collaboration tool". It was a web-based service, computing platform, and communications protocol designed to merge e-mail, instant messaging, wikis, and social networking.	★	★	★				★				★		★	★	★
FixMyStreet.com is a website to help people report, view or discuss local problems they've found to their local council by simply locating them on a map.	★							★		★			★	★	
An **e-petition** is a form of petition posted on a website. Individuals or groups can create a petition on the site and visitors can add their details to the petition to "sign" it. The format makes it easy to collect signatures, and it also makes it easier for us to respond directly using email.			★	★			★	★			★		★	★	
LinkedIn is a business-oriented social networking site. The purpose of the site is to allow registered users to maintain a list of contact details of people they know and trust in business.			★	★						★			★	★	★
MySpace is a social networking website that offers customization of your profile and image on the web.			★							★			★	★	★
BigTent is a web-based organisation and communication portal for groups. Groups can plan events, manage memberships, host discussion forums, collect payments, and organize subgroups. Examples of groups using Big Tent are parenting groups, neighbourhood groups, school groups, alumni and professional groups, and hobby groups.			★				★				★		★	★	★

Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Friendster is a leading global social network emphasizing genuine friendships and the discovery of new people through friends		★				★			★			★	★	★
Nexopia.com is a popular Canadian social networking website based in downtown Edmonton. Users are able to create and design their own profiles, friends list, blogs, galleries, articles, and forums. Interaction is accomplished through an internal personal messaging system, and public user comments on profiles, blogs or through threads and posts on the forums.		★			★				★			★	★	★
Hi5 is a social networking website. In Hi5, users create an online profile in order to show information such as interests, age and hometown and upload user pictures where users can post comments. Hi5 also allows the user to create personal photo albums, play online games, and set up a music player in the profile.	★	★							★			★	★	★
Hyves is a free Dutch social networking site which enables keeping in touch with existing friends and making new friends. Users can create personalized pages of themselves with rich media content, such as photos, videos, flash content and custom layouts.	★	★							★			★	★	★
StudiVZ is a social networking platform for students (in particular for college and university students in Europe), based in Berlin, Germany. Students are able to keep and maintain a personal page containing information about their name, age, study subjects, interests, courses and group memberships within StudiVZ. StudiVZ also provides a private messaging service for its members, including a birthday reminder for people on their friends list.		★				★			★			★	★	★

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IWiW (abbreviation for *International Who is Who*) is a Hungarian social networking web service. Users can provide personal information such as the place they live in, date of birth, schools and universities they attended, workplaces, interests and pets.			★								★		★	★	
Decayenne was an invitation-only on-line social network service. Its member pool aimed at exclusivity and was composed of mostly Europeans and Americans. Although primarily a website, the Decayenne community met off-line in both official and unofficial events.			★								★		★	★	
Tagged.com is a social networking site. Tagged members can play games, meet new people based on suggestions, and share tags and virtual gifts. Tagged was the subject of numerous customer complaints for sending deceptive bulk mail.			★				★				★		★	★	★
XING is a social software platform for enabling a small-world network for professionals. The platform offers personal profiles, groups, discussion forums, event coordination, and other common social community features. But many core functions, like searching for people with specific qualifications or messaging people to whom one is not already connected, can only be accessed by the premium members.			★	★			★				★		★	★	★
Badoo is a multi-lingual social networking website. Badoo is "like a chat room, dating site and picture rating site disguised as a social network."	★	★									★		★	★	
Skyrock.com is a social networking site offering its members a free web space where they can create a blog, add a profile, and exchange messages with other registered members. The site also offers a specific space for members who create blogs showcasing their original musical compositions.			★			★	★				★		★	★	

Orkut is a social networking website that is owned and operated by Google Inc. The service is designed to help users meet new friends and maintain existing relationships.		★						★		★	★	
Mixi, Inc. is one of several social networking websites in Japan. The focus of Mixi is "community entertainment", that is, meeting new people by way of common interests. As is typical of social networking sites, users can send and receive messages, write in a diary, read and comment on others' diaries, organize and join communities and invite their friends.		★				★		★		★	★	★
Multiply is a social networking service with an emphasis on allowing users to share media - such as photos, videos and blog entries - with their "real-world" network. Multiply tries to be the one-stop shop for a user's Web 2.0 experience.	★	★			★			★		★	★	★
The **Renren** Network, formerly known as Xiaonei Network is a Chinese social networking site with an interface similar to that of Facebook. It is popular among college students in China.		★				★		★		★	★	★
Cyworld was a South Korean social network service. Members cultivated relationships by forming "friendships" with each other through their mini-homepage, which encompassed a photo gallery, video, message board, guestbook, friend list, and personal bulletin board.	★	★				★		★		★	★	★

Table 1 (contd). Web 2.0 Technologies Mapped against Features

Web 2.0 Technologies	Common Features								Type of communication					Media Richness	
	Location Based Mobile Social Network / Technical	Social Media Service / Music / Video Sharing	Social Networking	Business Networking	Travel and Lifestyle	Blogging	Data or text / Messaging Services	Business Process Drive Application	One to one	One to many	Many-to-many	One-way	Two-way	Text	Video
The Whole Earth 'Lectronic Link, normally shortened to **The WELL**, is one of the oldest virtual communities in continuous operation. It is best known for its Internet forums, but also provides email, shell accounts, and web pages. The discussion and topics on the WELL range from the deeply serious to the generally silly, depending on the nature and interests of the participants.			★				★				★		★	★	
Ryze.com is a free social networking website designed to link business professionals, particularly new entrepreneurs.			★	★							★		★	★	
Talkbiznow is a comprehensive interactive business networking site for business professionals. By displaying how each member is connected to any other member, it visualises the small-world phenomenon.				★							★		★	★	
WAYN (*Where Are You Now?*) is a social networking website with a goal to unite travellers from around the world.			★								★		★	★	★
Vox is an Internet blogging service that is more focused on social networking features than other blogging platforms. Such features include the ability to set permissions on who is able to view each post and a friends list on the sidebar. While other social networking sites offer blog functionality as an additional feature, blogging is the main focus of Vox.			★			★					★		★	★	
Qapacity is a business-oriented social networking site and a business directory. Users are given a set of tools to promote their business online, to keep their clients and business partners up-to-date with their work and to reach new clients.				★				★			★		★	★	
PartnerUp is an online networking community that entrepreneurs and small business owners use to find the expertise and resources they need to start and grow a business. Members can connect with potential partners, advisers, and business resources.				★				★			★		★	★	

Description														
My Opera was the support community for the Opera web browser. My Opera was a social networking site, featured with blogs, photo albums etc.	*	*			*					*		*	*	*
MeettheBoss is a *business networking tool* for business executives around the world, across all vertical industries. MeettheBoss facilitates secure video conferencing, IM, email and SMS between members.	*		*			*	*			*		*	*	*
Flickr is an approach to public or private *tagging* that form the basis of connections or links to desperate content for sharing.			*			*	*			*		*	*	
Exploroo is a free-access social network website that is operated and privately owned by Exploroo Pty Ltd. It is an information loaded one-stop website for everything travel related. People can add friends and send them messages, and can also add travel stories or videos and review photos and articles which are all related to travel around the Globe.	*			*		*				*		*	*	*
RSS is an abbreviation for Really Simple Synchronisation and offers an opportunity to subscribe to a feed that relates to content, such as a blog. These are filtered to interest and offer the opportunity to personalise to ones' interest this push approach to Web 2.0.			*	*	*	*	*		*			*	*	

Table 2. Business Applications of Web 2.0 Technologies

Organisation	Web 2.0 Technology	Application Area	Reference
Coca-Cola	Blogs Second-Life Facebook Virtual Worlds	• Target Marketing • Brand Management	Skiba, 2007
Procter and Gamble	Facebook Myspace	• Target Marketing • Brand Management • Promotions	Lee et al., 2006
General Motors	MySpace Facebook YouTube Bebo Blogs	• Risk Management • Impact Management • Corporate Communication • Promotions • Web Services	Saran, 2007 Lee et al., 2006 Hagel and Brown, 2001
DELL	Blog Facebook RSS Taggin Second Life	• Customer Service • Product Development • Corporate Communication • Web Services	Cooke and Buckley, 2008 Lee et al., 2006 Hagel and Brown, 2001
North-western Mutual Life Insurance Company	Blogs RSS	• Corporate Communication • Team Productivity	Young, 2007

Table 3.   Application of Web 2.0 technologies to the Tendering and Procurement Process

Tier	Location-based Network	Social Media	Social Networking	Business Networking	Travel and Lifestyle	Blogging	Messaging
Focal company	Y	Y	Y	Y		Y	Y
Managed Tier Suppliers	Y		Y	Y		Y	Y
Managed Tier Customers	Y	Y	Y		Y	Y	
Monitored Tier Suppliers	Y		Y	Y		Y	
Monitored Tier Customers		Y	Y		Y	Y	
Non-managed Tier / Customers / participants			Y		Y		
Non-member Tier / Customers / participants		Y	Y		Y		
Core Business Process	-	Product development	Product design and innovation	Inventory Management, Supply Chain Orchestration	-	Customer care and relationship management	Reverse and third-party logistics
Example Web 2.0 platform	Foursquare	YouTube	Facebook	Google Wave, LinkedIn	Exploroo	Misc.	MSN
Intercompany Process Linkage		Monitored				Monitored	
		Managed				Non-Managed	
Supply Chain Integration	Medium	Medium-High			Medium	Low	
Demand Chain Integration	High	High			Medium	Low	

Table 4.   Application of Web 2.0 technologies to the Design-to-Order Process

Tier	Location-based Network	Social Media	Social Networking	Business Networking	Travel and Lifestyle	Blogging	Messaging
Focal company	Y	Y	Y	Y		Y	Y
Managed Tier Suppliers	Y		Y	Y		Y	Y
Managed Tier Customers		Y	Y			Y	Y
Monitored Tier Suppliers	Y		Y	Y		Y	
Monitored Tier Customers		Y	Y			Y	
Non-managed Tier / Customers / participants	Y		Y			Y	
Non-member Tier / Customers / participants		Y	Y			Y	
Core Business Process	Inventory and Warehouse Management	Product development	Product design and innovation	Inventory Management, Supply Chain Orchestration	-	Customer care and relationship management	Reverse and third-party logistics
Example Web 2.0 platform	Foursquare, Mash-Ups	YouTube, Second Life	Facebook	Twitter, Web service extensions to ERP/MRP	-	Misc.	Twitter, MSN, Skype, Google Wave
Supply Chain Imperative		Monitored		Managed		Monitored	Managed
	Non-Managed					Non-Managed	
Supply Chain Integration		High		High		Medium-High	High
Demand Chain Integration	Low-Medium					Low	

Table 5: opportunities and challenges on the use of Social media/Web2.0 for knowledge sharing during sense- and decision- making

Social Media/Web 2.0 for knowledge sharing during sense- and decision- making	
Opportunities	Challenges
Diffusion of ideas, collaboration, crowdsourcing and collective intelligence: increase sharing of ideas and concepts, engage with 'connected' suppliers and customers, design of products is subject to a tailorable and rapidly configurable dynamic.	*Knowledge management/sharing strategy:* organisations need a sophisticated knowledge management/sharing strategies to deal with the vast range of information posted and knowledge shared across a range of Web 2.0 platforms.
Visibility and transparency of sense-making and decision-making processes: integration of customers and suppliers into product design triggers transparency of shared knowledge in terms of exploring and exploiting hew ideas, improvement of the design process and increase of transparency in the sense-making and decision-making processes.	*Proactive sense-making and decision-making:* organisations need to find appropriate technologies to facilitate the role of social media/Web 2.0 for sense-making and decision-making.
	Security and authorisation: Shared as well as independent verification and security needs to be mandated and agreed between design partners for interaction and engagement in the product design.
	Integration and interoperability: such technologies need to be integrated with other systems within the organization to allow seamless flow of knowledge sharing content that is an organizational asset.
	Knowledge management/sharing skills: organizations need to identify the appropriate resources and capabilities, tools and techniques to facilitate knowledge sharing and visualise, and make use of it.
	Social Networking Risk Management: organisations do need to balance the suggested benefits with the management of risks from de-regulating and de-constructing traditional and non-web-based management and design team structures.
	Design team leadership: Clear and effective leadership including IT management is required within and across the design team and focal firm to ensure that product design using social media/Web2.0 is successful.