Key research challenges: Irene C L Ng

The customer as endogenous in the system

From a service dominant logic perspective, service is co-creation (Vargo, Maglio & Akaka, 2008). That means the customer is part of the system and not outside the system. Current movement from Big Data to many systems methodologies do not often take the customer as endogenous in the system. There is a need to develop methodologies, that treat the customer as being an entity in the system ie as a human sensor, a human intelligence, meanings/context creator i.e. a resource integrating and contributing entity. As an analogy, there are two ways to research into at an aquarium as a system: as a viewer looking into at an aquarium, or as a fish within the aquarium. In the former, the research is for the benefit of the manager/policy maker/owner of the aquarium. In the latter, the research is for the benefit of the fish. We need to question the position, mindsets and perspective of the researcher when constructing systems methodologies and the findings from the research. This is becoming increasingly important as customer resources to co-create value is evolving into a more structured resource e.g. personal data. The customer, being a more formalised entity and increasingly empowered through technologies is a driver for future economic opportunities as both a consumer as well as a producer. The application of personal data in co-creating value with a product or service can be a massive multipler effect for the future personal data economy and national economies of the future.

The incomplete product

The boundary between a service and a material product is increasingly obscured. As material technologies evolve, a physical product can be designed to be more dynamically reconfigurable in order to fit in the diverse and dynamic interactions of actors in their contexts. Dynamic reconfigurability as a concept has been widely used in system design, which enable the system to '*have the capability to modify their functionalities, adding or removing components and modify interconnections between them'* (Rana, Santambrogio and Sciuto 2007). With the development of pervasive digital technology, dynamic reconfigurability becomes possible in future products because products could have a '*reprogrammable nature'*. This means products could have new capabilities even after a product or tool has been designed, manufactured and sold (Yoo, Boland and Lyytinen 2012, p.1399). Thus, products may not need to be 'finished' to be transferred to the customer but could be designed such that contexts of use could be incorporated into a modular product design and 'finished' through customer resources (e.g. personal data) brought into consumption through digital pervasive technologies. This 'incompleteness', resulting in open and flexible boundaries of products, allows offerings to materialise multiple affordances and dynamically alter their affordances with changing contexts. Products evolve to become platforms for service that could provide increasing returns to scale through standardisation even while they can be deeply and uniquely personalised. For example, the iPhone is fully standardised and enjoys economies of scale yet is able to be fully personalised, because of the boundary between the digital 'app' layer and the material 'phone' layer.

New Transaction Boundaries, Economic and Business Models

An economic model is the model of an ecosystem (like a market) that distributes rents (or revenues) either through the pricing mechanism or regulation, according to what the entity (such as a firm) does to stay within the ecosystem. New economic models, often arising from new business models and/or new entrants, redistributes rents within the ecosystem occasionally resulting in the exit of existing entities (disruption). With the blurring of boundaries between material and digital, firm and customer, product and service, there is a need to understand new ways to obtain revenues and the nature of transactions in the future digital service economy. Transaction is defined as '*mutually agreed-upon transfers with compensation within the task network*' and '*serves to divide one set of tasks and others*' (Baldwin, 2008, p.156). Baldwin's (2008) conceptualisation of transaction is developed from a '*systems of production*' perspective. This perspective enables us to analyse the dependencies between agents (i.e., consumers and producers). The value-creating context, as a unit of analysis for service, jointly co-created by the customer and the producer, creates an interesting challenge for modularity and product/service architecture for new innovaitons. Modularisations create new thin crossing points where transaction costs are low (p.156) and also create opportunities for new boundaries where new transactions, and new business models can be created.

The above challenges are not merely research/innovation challenges but impact on education and skills as well as since there are increasingly greater overlaps in domain knowledge, particularly between engineering and computer science and current reductionistic curriculum is not helping in developing future engineers/technologists and managers.