OCTOPUS

Making Everyday Life Easier

Presented By

Michelle Li
October 27, 2008

Introduction

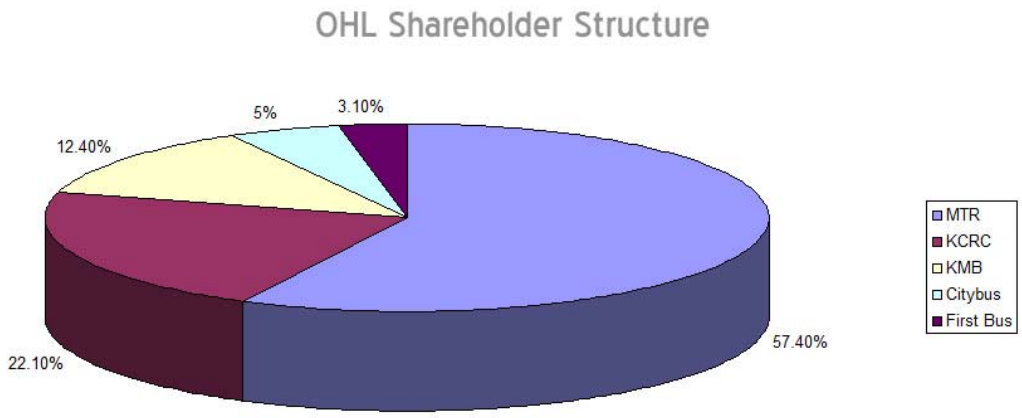
Hong Kong's Octopus Card is a contactless smart card originally developed as an electronic payment device for the city's various public transport systems. Since its launch in 1997, the Octopus Card has become an integrated part of the lives of Hong Kong residents, 95% of whom use it on a daily basis. Through innovative technical and business development by engineers and co-operating transportation operators, it is now the world's leading and most extensive smart card system in the world (Octopus Cards Limited, 2005). Octopus has evolved into a process enabling easier monetary transactions that extended into retail shops and services, self-service facilities like vending machines, and for access control systems in schools and residential blocks. Octopus has established itself to be a truly useable and ubiquitous system in Hong Kong by "making everyday life easier," as the company's motto affirms.

This paper explores how the design of Octopus – as a product, system, and process – creates value to both consumers and businesses alike through increasing speed and throughput on public transport, offering convenience and efficiency for purchase transactions, and providing overall ease and versatility of one card applied in multiple applications. This paper discusses the origins of the Octopus card, the Octopus system, and the resulting business value. Thereafter, the user value of the Octopus will be reviewed.

The Origins of the Octopus Card

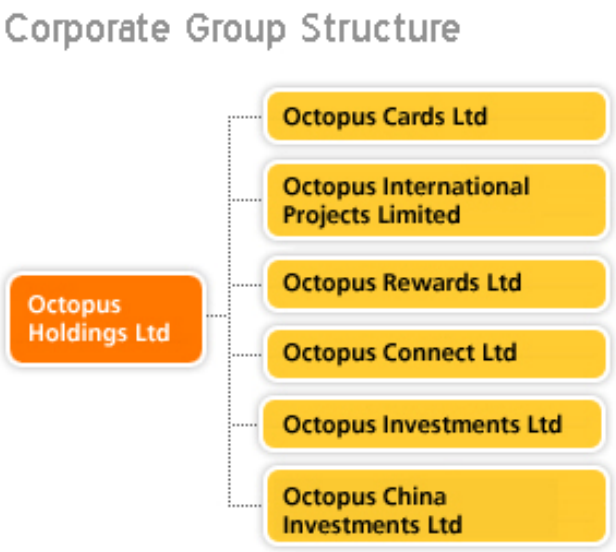
In 1992, The Mass Transit Railway Corporation Limited (MTRC) led the review of its fully automated fare technology and determined that a contactless smartcard technology would be the best platform for future developments (Octopus Holdings Limited, 2006c). In 1994 MTRC, along with four other major transport operators, Kowloon-Canton Railway Corporation (KCR), Kowloon Motor Bus Company (KMB), Citybus, and New World First Bus (NWFB), co-operated in establishing a non-profit making venture,

Creative Star Limited (renamed Octopus Cards Limited in 2002) to develop and implement a universal automatic fare collection system to improve operational efficiency.



Data source: Octopus Holdings Limited. (2006b)

Upon the launch of the Octopus in 1997, three million cards were sold in the first three months; passengers now had ability to travel across six transport systems on one cashless card system (Octopus Holdings Limited, 2006a). Octopus later applied for a special purpose deposit-taking company authorization from the Hong Kong Monetary Authority in 2000 in order to take advantage of commercial opportunities outside the transportation industry and since 2001, the company officially became a profit making company. A company restructuring in October 2005 resulted in the OCL incorporating Octopus Holdings Limited (OHL). OHL, in turn, became the holding company of OCL along with other subsidiaries responsible for the non-payment business of the Octopus, including Octopus Rewards Limited, a brand loyalty program and Octopus International Projects Limited, an international automatic fare collection consultancy (Octopus Holdings Limited, 2006b; Wong, 2007). The figure below illustrates the Octopus group corporate structure:

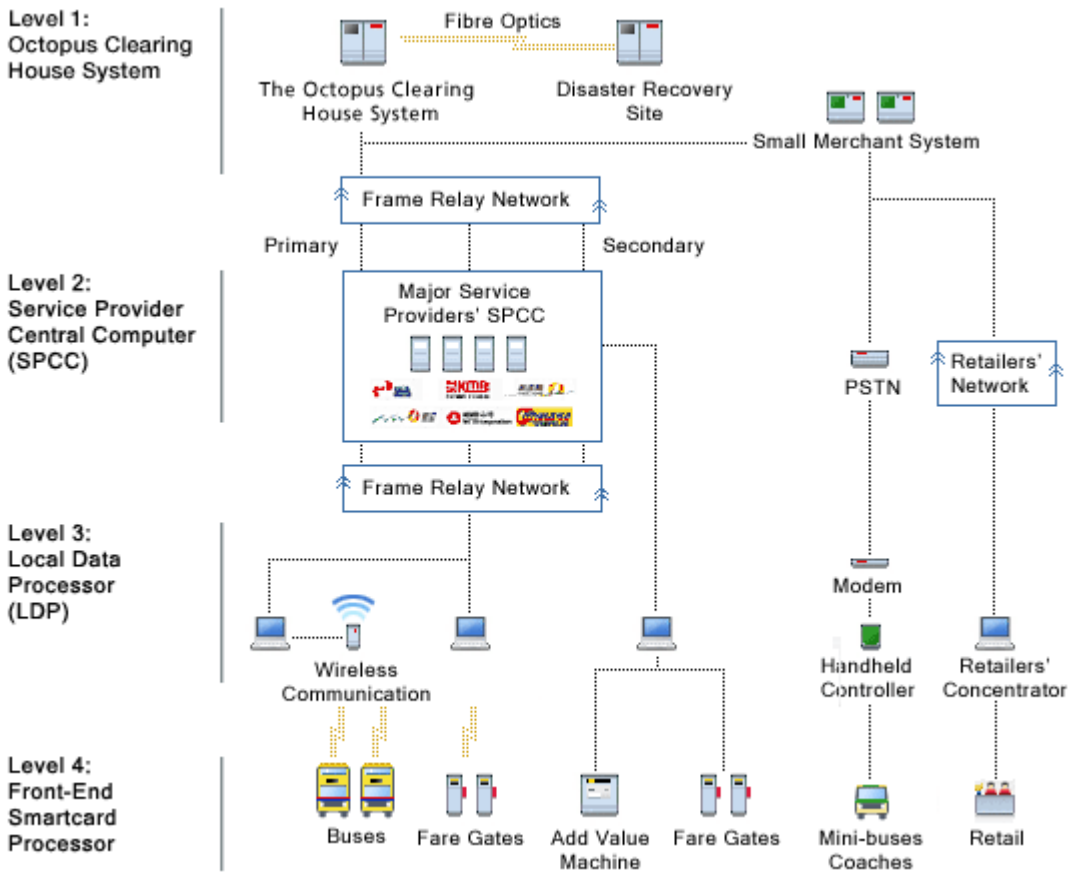


The Octopus Group is lead by CEO Prudence Chan, who is in charge of the following key executives: Head of Corporate Development, International Business Director, Sales and Marketing Director, Head of Operations, Head of Human Resources and Administration, Technical Director, Finance Director, and Head of Risk Management (Octopus Holdings Limited, 2006b).

The Octopus System

Each Octopus card contains a microchip that keeps track of payment information and monetary value stored in the card. The card is swiped in proximity to an Octopus processor, which deducts the transaction cost from the stored-value of the card. Whether taking public transportation or making retail purchases, the interaction mode is consistent in all transactions.

The figure below illustrates the system architecture, in which Octopus Clearing House (OCH) is the core component that is responsible for transaction validations, revenue apportionment, and fund transfer (Octopus Cards Limited, 2005d; Chau and Poon, 2003). The front-end smartcard processors are the reader machines with which the users interact. Processors can communicate with the central computer or database in real-time but with certain readers, the transaction data may be stored offline and sent later on through the network (Wikipedia, 2008).



Source: Octopus Cards Limited (2005d)

The Context of Design and Value

This paper discusses the notions of design and value and in order to understand the concept of creating value through design we must briefly examine these terms, which may have different meanings to different people from both a user and business perspective.

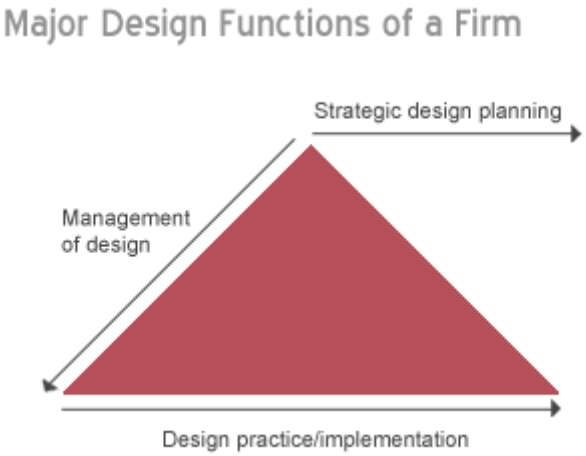
Design, according to Herbert Simon (as cited in Heskett, 2008), is the competence to change existing situations in preferred ones. Design then, is the human capacity to serve the needs of people and give meaning to life through objects, communications, environments and systems (Heskett, 2008).

Value is typically viewed as the monetary worth of something exchanged (Merriam-Webster Online, 2008), however, Carl Menger (as cited in Heskett, 2004, p. 23) states that value is not inherent in goods themselves, but is the worth or importance an individual places on the goods to fulfill one's human needs. A new concept of value proposed by Shillito and Marle (1994, p. 1) terms value as a behavioural force motivating human action. When a motivating force is applied to the collective society, individual values conform to social values, which in turn determine the goods and services of the market (Shillito & Marle, 1994, p. 4). This paper will be more of an exploration of all of the above definitions of value by Menger, Shillito, and Marle.

While satisfying a customer's needs, a firm can employ design as a business strategy to create economic growth in the market, characterized by an increase in profitability and marketability, while satisfying the needs of its customers. New Growth Theory explains how this can be achieved: one of its key contributors, Joseph Schumpeter (as cited in Heskett, 2004, p. 42), introduced the idea of "creative destruction," whereby technological innovations continually destroy existing markets to create new ones in their place. Thus, technological development and innovation combined with competition and changes in society produce economic growth and wealth. It is design that is the driving force of this technological development and innovation.

Role of Design in the Octopus

System design differs from traditional forms of design simply because systems depend on technology and technical expertise. The upper-level management tier are the decision-makers that steer projects in the right direction while the system engineers are the executors in making it happen, along with the support of other important teams such as business, sales, and operations teams. Within this development process there is not only a top-down style of organizational function but also lateral development in strategic planning and implentation that involves multi-disciplinary collaboration between various teams within the company.

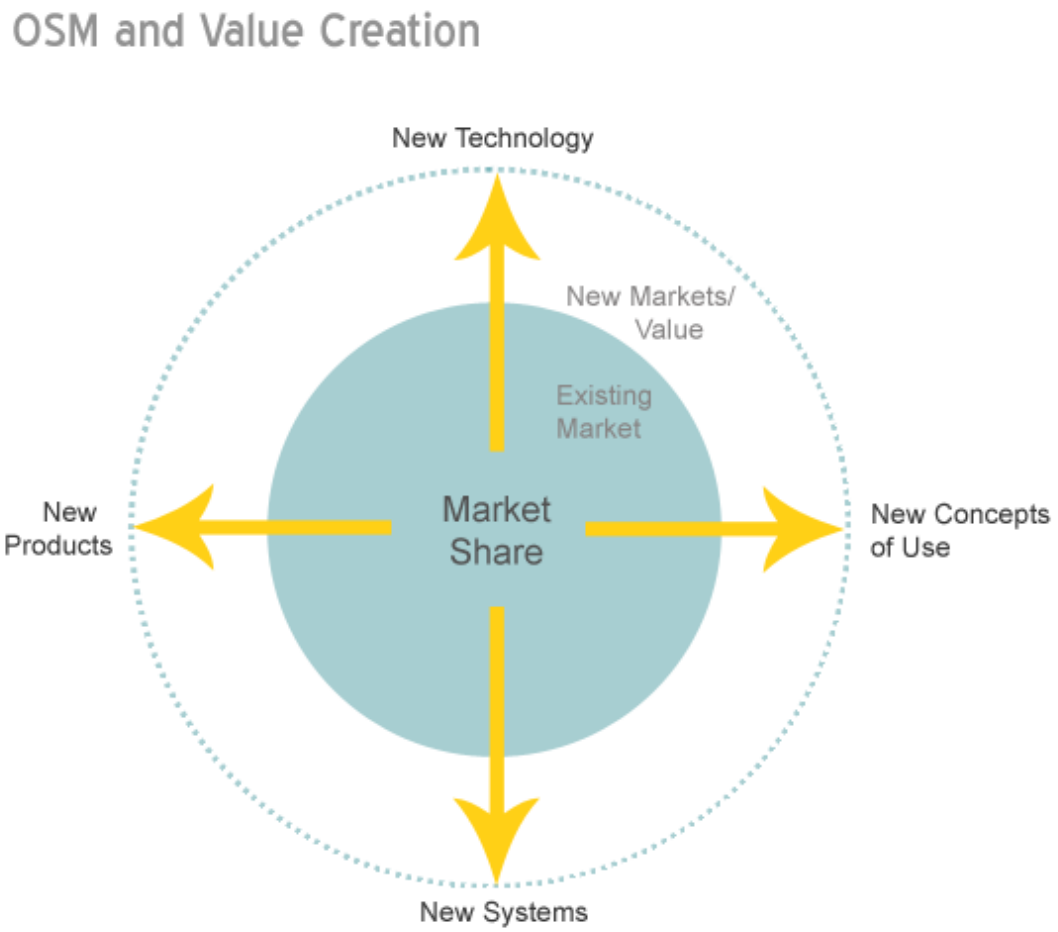


Source: Heskett, 2007

In the development of the Octopus system, it appears that it was engineers who were engaged in the design process rather than professional designers. Although the design of the Octopus was driven from a user-oriented perspective, it was the business needs of transportation companies that stimulated the entire design process in the first place (Gaffney, 2006). In 1994, ERG Limited, a company that designs and implements integrated automated fare collection systems, was contracted to develop the Octopus system (ERG Limited, 2008). The deal involved joining the various transport operators together in co-operation with ERG to execute the plan (The Age Company Limited, 2006). Thus, the design team seemed to have been comprised of engineers and key members of the transport operators to strategize, plan, design and implement the Octopus system. Design as a discipline in business, therefore is a social process that involves those that make design decisions who are not necessarily identified as designers in the formal sense (Buchanan, 1995, p. 49).

The main outcome of this design process was the success in applying an innovative technology to a creative idea in order to create economic value. Not only did Octopus create a new product/system, but it opened up a new market of using contactless smartcards for purchase transactions and access control, thus transforming into an Original Strategy Management (OSM) business. The following model clearly demonstrates this process of market and value creation as executed by Octopus, which

has extended itself through all four factors of introducing new products, technology, concepts of use and systems to the existing market.



Source: Heskett, 2007

This result follows from the company's mission: "continuously innovate, seeking better ways to conduct business and creating new opportunities [while striving] to delight customers whenever they encounter Octopus" (Octopus Holdings Limited, 2006d). By employing innovative design strategies a business such as Octopus effectively factors in the context of use by the consumer such that the product or service is not only desirable, useful and meaningful to the user, but it also fits into the cultural and behavioural patterns of society (Heskett, 2004, p. 76).

The Octopus Design and Business Value Creation

With the adoption of the innovative smartcard technology, the Octopus system effectively eliminated the magnetic ticket system and increased passenger throughput at boarding gates and on buses due to the reduction of cash handling (Chau and Poon, 2003). Previously, 60 tonnes of coins were collected on a daily basis, which cost as much as 0.8% of revenue to collect and count (ERG Limited, 2008). The user-friendliness of Octopus increased usage and revenue over time and decreased maintenance costs.

Given the Octopus' wide acceptance and popularity, the service has eventually evolved into a process of enabling quicker payment transactions not only for transportation, but for goods and services as well (Skytta, H. et al., n.d.). Its application was able to expand to a large number of services outside the transportation market and currently over 2000 services now accept Octopus (Octopus Cards Limited, 2005f). Retailers are able to implement the system easily and inexpensively by economies of scale through a shared system infrastructure (Octopus Cards Limited, 2005b).

Although each Octopus transaction costs the business a 1% fee going to Octopus Holdings Ltd., the overall benefits for them outweigh the cost. In addition to increased revenue and efficient operation, businesses can implement their own or joint loyalty programs and collect customer data on their behaviour to further understand the market and improve services.

According to Octopus Cards Limited (Octopus Cards Limited, 2005a), the Octopus system is "the world's leading and most extensive contactless smartcard system, with the highest penetration, the highest transaction volume and the widest scope of applications." With over 10 million transactions per day valued at HK $85 million (Octopus Cards Limited, 2005f), Octopus has become a global leader in the smartcard market as well as a role model to other societies; it is currently implementing an automatic fare collection system in the Netherlands on a national scale (Hong Kong Trade Development Council, 2006).

The Octopus and User Value Creation

Value can be added to a product using a set of seven opportunities, called Value Opportunities (Cagan and Vogel, 2002, p. 62): emotion, ergonomics, aesthetics, identity, core technology, quality and impact. Because these opportunity classes are defined for product design, I will re-categorize them in a way that makes sense in a service context to examine how the design of the Octopus creates value for its users.

Emotion and Ergonomics

The incredible success of the Octopus is due to its simple and elegant user-friendly design in which the underlying system's computer processing is distributed throughout the environment. Embedding powerful informatics in everyday objects or spaces makes the computer invisible, increases accessibility and creates a more natural, humanistic and spontaneous user experience. This interaction paradigm can be referred to as ubiquitous, pervasive, physical or tangible — in short, such information technology can be referred to as "everyware" (Greenfield, 2006, p. 1).

Source: The Smart Card Revolution

The Octopus card is so easy to carry and use that a cardholder is not aware of the underlying computing system they are using; the system *just works* with a "touch and go" action of swiping the card to complete an instantaneous transaction in a mere 0.3 seconds. Radio frequency identification (RFID) technology enables a contactless system so the card does not require physical contact with the radar, allowing the user to simply swipe his/her wallet or bag. Hong Kong's transport network comprises of complex fare

and zone structures, but the system complexities are completely hidden from the user (Gaffney, 2006). Fixed fares for buses and ferries are deducted upon embarkment, and disembarkment in the case of trams. Variable fares are also a hassle-free for users: the card is swiped upon entry of the Mass Transit Railway (MTR), then swiped again on exit and the proper fare is deducted.

Not only applicable on mass transit systems, the card can be carried as a form of electronic cash and used to shop at various retailers like supermarkets, convenience stores and fast-food chains, to pay for parking meters, or even to gain access to their apartment buildings. This flexibility increases the use value of the Octopus.

Source: Flickr, 2006

Certain system features are designed to establish user satisfaction and manage emotions, permitting everyone to be able to use the Octopus with virtually no risk of error. Good feedback is one such feature; upon a successful transaction, a user is informed by a "doot" sound from the card reader, and on transportation systems, a visual display shows the transaction cost and the balance remaining on the card. When a transaction cost exceeds the stored value on the card, the system will debit the negative amount the next time the card is topped up. This user-centered feature favours the customer and increases usability. Octopus also provides an Automatic Add Value Service (AAVS), which allows the customer to link his or her Octopus card to a credit card account so that the card will be automatically reloaded when the remaining balance dips below zero (Octopus Cards Limited, 2005e). This valuable service provides a hassle-free method to top up the Octopus and also eliminates any embarrassment that one may experience when trying to pay for something with no value left on one's card. Should a card reader be inoperative, bus companies promise customers a free ride (Paynter and Law, nd). Finally, the non-personalized

Octopus cards are anonymous so no personal user information is stored in the card, making it safe and secure to use.

Special products embedded with Octopus transponders have emerged to match certain lifestyles and to add mobility and convenience for its users. These collectible items and souvenirs have personalities that appeal to different demographics and come in various forms: key chains (some even featuring cute Japanese characters), phone straps, Nokia mobile faceplates, wristwatches, jewelled ornaments, and children's wristbands.

Source: Octopus Holdings Limited, 2008a

Source: Octopus Holdings Limited, 2008b

Identity

The Octopus brand name connects suitably with the philosophy behind the product. Selected by the MTR Corporation, the parent company of Octopus Cards Limited, through an open naming competition held 1996, the Cantonese name *baat daaht tùng* (八達通) literally translates to "eight-arrived pass." It relates to a popular expression *sei tùng baat daaht* (四通八達), meaning "reachable in all directions" (Wikipedia, 2008). The number eight in Chinese is often used to convey the idea of "many," thus relating to the English name – an octopus has eight tentacles and can grab many things at a time, which can refer to a user's ability to use the Octopus card for many different types of transactions.

Source: Lew, 2007

The Octopus logo is a Möbius strip twisted to resemble the number 8. Orienting it horizontally, it resembles the mathematical symbol for infinity ∞ to convey the card's "infinite" possibilities (*Octopus card, 2008).* Octopus has thus developed a very fitting identity to express the card's multiple uses as well as the company's continual strive for developing new application opportunities. The logo is featured on all of its card reader/writers throughout they city making it known that Octopus is an accepted form of payment at a particular location while increasing brand recognition.

Core Technology and Quality

The Octopus is developed using Sony's FeliCa ("felicity card"), a contactless integrated card (IC) technology that employs an RFID chip in the smartcard. This technology facilitates contactless communication between a reader/writer and card via electromagnetic waves emitted from the reader/writer and reflected by a microchip within the card (Sony Global, 2008).

All Octopus reader/writer devices consist of a pad on which to swipe the Octopus card. The design of the various devices is modified depending on its context of use: retail devices are smaller and portable to fit in the cashier environment, wet market processors are small with a waterproof pad, self service devices used for photocopiers have a card capture mechanism to physically lock the Octopus card in place throughout the entire transaction.


Source: Flickr, 2005

A study conducted by Paynter and Law (n.d.) evaluated the reliability of the Octopus system. They concluded it to be very reliable with a considerably low: 28% of users experienced a failure within the past year, 60% of whom experienced a failure only once. They explained that the major reason was that the users did not take proper care of their card, causing damage that hindered accurate readings from the electronic readers.

Employing optimum hardware and software architecture and design, security algorithms, and an efficient mutual authentication method, Felica ensures a high level of security, reliability, and performance, allowing a high speed of data transfer (Sony Global, 2008). The Octopus system has stood the test of time and has never been successfully hacked since its introduction in 1997 (Winer, 2003). In contrast, London's Oyster smartcard employs the Mifare technology, which has been proven to have serious security flaws allowing them to be cloned (Mostrous, 2008).

Impact

Octopus has created enormous socio-economical impact on Hong Kong and is now slowly extending its use in Shenzen, China. The key factor in creating such a successful system that resulted in quick and widespread adoption was the agreement between all the Hong Kong public transportation companies to co-operate in establishing a single shared system. This made it effortless for users to transition and adapt to the new system and technology. By offering convenient, easy, and fast solutions to make quick cashless payment transactions for mass transit, retail stores, bakery shops, wet markets, supermarkets and fast food restaurants, parking meters, vending machines, and even for time on a skating rink, the Octopus is not only useful and purposeful in its goals but it has become a ubiquitous system ingrained in the daily lives of people in Hong Kong. Its impact on society is noted by the Wall Street Journal Online (Octopus Cards Limited, 2005c):

> "Hong Kong isn't known for being the center of technological innovation but it could very well become the first cashless society in the world, thanks to a little plastic card known as the Octopus."

Source: Cafe de Coral, 2008

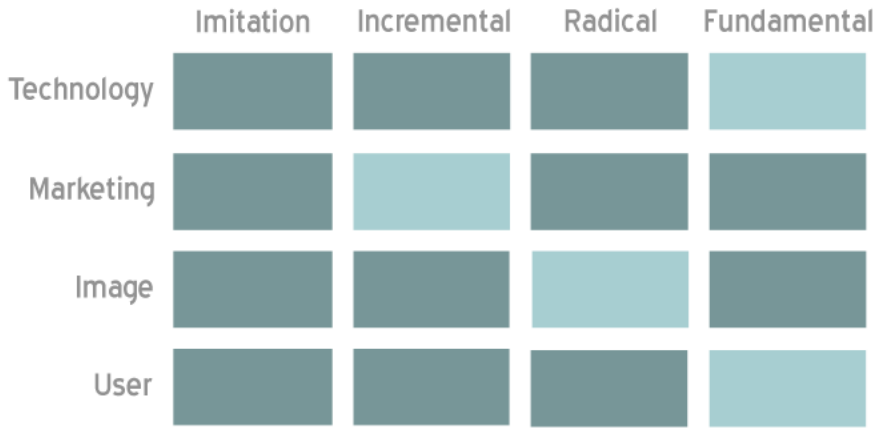
As the company continued to envision creative new ideas and possibilities for the Octopus, more interesting applications of the system emerged, such as the SchoolPlus Scheme. In addition to using the Octopus to buy lunch in the cafeteria, the scheme uses personalized card for electronic attendance taking and library book loans, thus increasing administrative efficiency (Money Magazine, 2004).

In addition to having tremendous social impact, the Octopus has positive environmental effects as well. The concept of having one rechargeable card for multiple uses implies re-usability and in its application on mass transit, it has eliminated paper and one-time use tickets. The cards were originally manufactured using polyethylene terephthalate (PET) plastic, which is the least environmentally harmful, but Sony later developed the cards to use vegetable-based plastic, the first of its kind to take such environmental consideration (Sony, 2004).

Aesthetics

Aesthetics of products is inherently distinct from the aesthetics of services, simply due to the nature of their forms. Cagan and Vogel (2002, p. 64), focus solely on the sensory perception of physical objects; however, in interaction and service design, aesthetics refers to the perception, appreciation and enjoyment of an experience (Dewey, 1980, p. 47). Considering the previous value-adding aspects of design, they all work in harmony to create an experience that is both emotional and satisfying, and hence, aesthetic.

Reviewing the analysis of the seven value opportunities, we can derive a design/innovation matrix as follows:



Source: Heskett, 2004

The development of the Octopus involved a fundamental change in the way technology was employed to create a new contactless smartcard payment system allowing users to travel on mass transit, pay for goods and services, and access building facilities like never before. By extending itself into different industries beyond transportation, the Octopus brand became such a ubiquitous symbol throughout the city that it is has become the most favourable Hong Kong brand (Octopus Holdings Limited, 2006e).

Conclusion

In analyzing the Octopus design process, the question emerges as to who takes on the role of designer. It appears that in this case of system design, the designer is not a professional designer in the traditional sense, but is actually ERG Limited, who was contracted to design and implement the automated system. Engineers then take over the design function of creating systems to support human activity.

As a whole, the design of the Octopus has proven to be successful in terms of market penetration, widespread adoption, social impact, and profitability. The most striking result is how it changed the way people go about their daily lives. It is immersed in our every day activities from commuting to work, to buying our groceries, and to paying for a movie admission. Creative thinking combined with innovative technology and user-centered design resulted in a usable and valuable service and product to create tremendous social impact.

References

The Age Company Limited. (2006). *ERG fails to disarm Octopus* [Web page]. Retrieved October 24, 2008 from http://www.theage.com.au/news/business/erg-fails-to-disarm-octopus/2006/07/11/1152383740971.html

Buchanan, R. (1995). *Discovering Design*. Chicago: The University of Chicago Press

Cagan, J. & Vogel, C. (2002). *Creating Breakthrough Products: Innovation from Product Planning to Program Approval*. USA: Prentice Hall PTR

Chau, P. Y. & Poon, S. (2003). *Octopus: an e-cash payment system success story* [PDF]. New York: ACM. Retrieved October 24, 2008 from http://doi.acm.org/10.1145/903893.903927

Dewey, J. (1980). *Art as Experience*. New York: Perigee Books

ERG Limited. (2008). *Case Studies – Hong Kong* [Web page]. Retrieved October 25, 2008 from http://www.erggroup.com/worldwide/details.asp?pid=39&r=1

Gaffney, G. (Presenter) (2006, October 23). *Hong Kong's Octopus Card – A Highly Usable Product* [Podcast]. UXpod – User Experience Podcast Retrieved September 21, 2008 from http://www.uxpod.com/index.php?post_id=143982

Greenfield, A. (2006). *Everyware: The dawning age of ubiquitous computing*. USA: New Riders Publishing

Heskett, J. (2004). *Design and the Creation of Value*. Hong Kong: The Hong Kong Polytechnic University.

Heskett, J. (2007). *Creating Value By Design: How Design Creates Value* [Presentation].

Heskett, J. (2008). *Creating Value By Design: Introduction* [Presentation].

Hong Kong Trade Development Council. (2006). *Octopus Cards Limited: Smart Cards that Go Beyond Transportation* [Web page] Retrieved September 21 2008 from http://design.hktdc.com/suc-e518.htm

Merriam-Webster Incorporated (2008). *Value* [Web page]. Retrieved October 9, 2008 from http://www.merriam-webster.com/dictionary/value

Money Magazine: Rising of interest rates; Future applications of Octopus (2004, August 17). [Television broadcast]. Hong Kong: Production of Television Broadcasts Ltd. (TVB)

Mostrous, Alexi (2008, June 21). *Alert over security as researchers show Oyster card can be cracked with laptop* [Web page]. Retrieved October 22, 2008 from http://technology.timesonline.co.uk/tol/news/tech_and_web/article4184481.ece

Octopus Cards Limited. (2005a). *About Us* [Web page]. Retrieved September 21, 2008 from http://www.octopuscards.com/corporate/aboutus/en/index.jsp

Octopus Cards Limited. (2005b). *Benefits* [Web page]. Retrieved September 21, 2008 from http://www.octopuscards.com/corporate/why/benefits/en/index.jsp

Octopus Cards Limited. (2005c). *Media Quotes* [Web page]. Retrieved October 21, 2008 from http://www.octopuscards.com/corporate/why/media/archives/en/index.jsp

Octopus Cards Limited (2005d). *OCH Architecture* [Web page]. Retrieved October 24, 2008 from http://www.octopuscards.com/corporate/technology/architecture/en/index.jsp

Octopus Cards Limited. (2005e). *Reload Your Octopus* [Web page]. Retrieved September 21, 2008 from http://www.octopuscards.com/consumer/payment/reload/en/aavs.jsp

Octopus Cards Limited. (2005f). *Statistics* [Web page]. Retrieved September 15, 2008 from http://www.octopuscards.com/corporate/why/statistics/en/index.jsp

Octopus Holdings Limited. (2006a). *Milestones* [Web page]. Retrieved October 12, 2008 from http://www.octopus.com.hk/milestones/en/index.jsp

Octopus Holdings Limited. (2006b). *Our Company* [Web page]. Retrieved October 12, 2008 from http://www.octopus.com.hk/company/en/index.jsp

Octopus Holdings Limited (2006c). *Our History* [Web page]. Retrieved October 12, 2008 from http://www.octopus.com.hk/history/en/index.jsp

Octopus Holdings Limited (2006d). *Our Mission* [Web page].
Retrieved October 12, 2008 from
http://www.octopus.com.hk/mission/en/index.jsp

Octopus Holdings Limited (2006e). *Awards* [Web page].
Retrieved October 25, 2008 from
http://www.octopus.com.hk/awards/en/index.jsp

Paynter, J., & Law, P. (n.d.). *An Arm's Length Evaluation of Octopus* [PDF].
Retrieved October 16, 2008 from
http://www.code.auckland.ac.nz/follow/e-comWorkshop/work\An arms length evaluation of Octopus.pdf

Shillito, M., & De Marle, D. (1992). *Value: Its Measurement, Design & Management*.
New York: John Wiley & Sons, Inc.

Skytta, H., Harrison, N., Liew, J., Ung, M., Moore, S., Yueng, G. (n.d.) *Are There Different Paths for Disruptive Technologies? Alternative Trajectories to Optimisation of DT*.
Retrieved October 17, 2008 from
http://userwww.sfsu.edu/~ibec/papers/24.pdf

Sony Global. (2008). *FeliCa* [Web page].
Retrieved October 17, 2008 from
http://www.sony.net/Products/felica/index.html

Sony Global. (2004, September 1). *Sony Develops Non-Contact IC Card Made from Vegetable-Based Plastic* [Web page].
Retrieved October 17, 2008 from
http://www.sony.net/SonyInfo/Environment/news/2004/04.html

Wikipedia. (2008). *Octopus card* [Web page].
Retrieved September 21, 2008 from
http://en.wikipedia.org/wiki/Octopus_Card

Winer, P. (2003, May 13). *Security and Authentication Technologies* [PDF].
Retrieved October 22, 2008 from
http://www.bigchief.com/whitepapers/rfid-world-2003-05-13.pdf

Wong, T. (2007). *Information Note: Operation of the Octopus Card in Hong Kong* [PDF].
Retrieved October 24, 2008 from
http://www.legco.gov.hk/yr06-07/english/sec/library/0607in08-e.pdf

Image Sources

Café de Coral. (2008). *Using Octopus in Shenzen is fast, convenient and reliable* [Image]. Retrieved October 26, 2008 from http://www.cafedecoral.com/web/show/show.jsp?pid=3&type1=1&cnid1=4007&rhtID1=3&gf1=1

Flickr. (2005). *Octopussy* [Image] Retrieved November 2, 2008 from http://flickr.com/photos/stu_plaw/46053081/

Flickr. (2006). *Value Remaining: $41.7* [Image] Retrieved November 2, 2008 from http://flickr.com/photos/littlepillow/172569269/

Lew, A. (2007). *You Can't Live in Hong Kong Without an Octopus* [Image]. Retrieved October 18, 2008 from http://blog.wired.com/cars/2007/10/you-cant-live-i.html

Octopus Holdings Limited. (2008a). *My Melody and Minna No Tabo Mini Octopus Make Their Debuts Tomorrow* [Image]. Retrieved October 26, 2008 from http://www.octopus.com.hk/release/detail/en/20080728.jsp

Octopus Holdings Limited. (2008b). *First Hello Kitty Mini Octopus to Launch Tomorrow* [Image]. Retrieved October 26, 2008 from http://www.octopus.com.hk/release/detail/en/20080121.jsp

The Smart Card Revolution [Image]. (2007). Retrieved November 2, 2008 from http://www.urbanphoto.net/blog/2007/03/03/the-smart-card-revolution/