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# Coercing Consensus: Unintended success of the Octopus electronic payment system For PISTA 2008

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## ABSTRACT

This paper contrasts the success and failure of two electronic payment systems in Hong Kong, Octopus and Mondex, during 1996-2002. The case illustrates the new properties of electronic currencies, and provides insights for product designers and regulators. Mondex was endowed with the full legal status of money, launched by a mammoth banking group, with Mondex cards given away for free to consumers. Yet the Mondex system went into oblivion within five years. Octopus started as a modest stored value transport ticket that required a deposit. It ended up as a city-wide multipurpose payment card used by 95% of the adult population. The system has saved significant transaction costs from the handling of coins, generating heavy transactions and turnover volume.

The success of Octopus and the failure of Mondex cannot be explained by marketing strategies or technical merits alone. The two systems sought to overcome user resistance in different approaches: Mondex relied on voluntary uptake, but Octopus imposed a compulsory switch upon a large base of commuters. The case shows that in electronic currencies, large merchants and technology platforms are now in a better position to negotiate for what is valid money and what is not. Mondex, a legitimate and trustworthy source of money supply from the banking industry, failed to diffuse across the public. Meanwhile a large merchant group equipped with the point-of-sale device was able to define a new value token for the public. By controlling the material interface of electronic payment, the merchant side is playing a more active role in the loop of social consensus of money.<sup>1</sup>

**Keywords:** Octopus, Mondex, electronic payment systems, consensus, electronic currency, digital cash, smart cards.

## 1. INTRODUCTION

In the world of plastic payment, credit cards and debit cards are the two major categories that have attained mature development. Each has developed its own system of verification, settlement and security, spanning a globalized hierarchical framework of trust and settlement [19]. However, demands for an electronic payment tool suitable for small payments in the range of US\$0.5 - US\$10 remain largely unfulfilled in most parts of the world. For every day applications such as buying a coffee, a morning newspaper, paying for a bus ride, or feeding a parking meter, both merchants and consumers find it cumbersome to handle exact change in coins. Yet the transaction costs of credit cards and debit cards are formidable for these applications. It will also look outrageous if a passenger has to provide a signature, a fingerprint, or key in a chip-and-pin device in order to get onto a bus.

Mondex and Octopus were two electronic payment projects aiming at small payments. Both projects started in Hong Kong in the mid 1990s, originating from different sectors. Mondex from the banking sector ended in failure, but Octopus from the transport sector (1997) became a remarkable innovation and success, which was widely referenced in the smart card industry. Octopus was a contactless payment card based on radio frequency identification (RFID) technology. No personal identification was held in the card, and the read/write process could be finished within 0.3 seconds. (See Table 3 for more technical specifications.)

In the past decade, contactless smart card solutions emerged in many cities around the world. Examples included MetroCard in New York (1997); Chicago Card (1999); EasyRider in Nottingham (2000); EZ-Link in Singapore (2001); Calypso in Paris (2001); Andante in Porto, Portugal (2002); Nagasaki SmartCard in Japan (2002); EasyCard in Taipei (2002); OysterCard in London (2003); Beijing Municipal Administration and Communications Card in Beijing (2003); SmarTrip in Washington DC (2004); LisboaViva in Lisbon (2004); Breeze card in Atlanta (2006); CharlieCard in Boston (2006); Transcard in Shenzhen (2006); and Flexus in Oslo (2008). This list is schematic rather than exhaustive. The projects differed widely in terms of their degrees of success, showing that developers

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of smart card payment solutions had to face uncertainties and contingent local factors.

In this paper I will provide a comparative account of the dramatic history of Mondex and Octopus, two electronic payment systems in Hong Kong in 1996-2002. Then the paper will explore the success of Octopus and the failure of Mondex from five dimensions: social consensus, network effect, “killer application”, precursor products, and point-of-sales (POS) materiality.

## 2. A TALE OF TWO MONEYS

Mondex was an “electronic wallet” that stores monetary value on a microchip. It used to be a joint venture between banking conglomerate HSBC and MasterCard International. At the height of the project, Mondex cards were issued in over ten countries. Users could load monetary value from automatic teller machines to their Mondex cards, and spend money at retail merchant counters.

In Hong Kong, the project was launched in Oct 1996 by HSBC and Hang Seng Bank, both being large banks under the HSBC group. The two banks jointly occupied one-third of the city’s banking deposits. At the Mondex launching ceremony in 1996, an executive from HSBC said he wished that Mondex could replace a substantial part of their cash stock in ten years’ time. A trendy and bright image was quickly built up. With visible marketing efforts, colourful pamphlets and commercials were spread around town.

The annual charge of Mondex cards (HK\$100) was waived, such that account clients of the two banks actually got it for free. The project started out in two middle-class residential shopping malls, and was extended to three retail chains (Fortress, Watson’s and Park’n Shop), a university campus, and public sports facilities. Merchants and service providers were installed with Mondex readers at checkout counters.

Mondex was never made compulsory. It was an option additional to cash, credit cards and debit cards. In general, users and merchants did not see any obvious benefits in switching to Mondex. Eight months after the launching ceremony, I tried to use my Mondex card in a drugstore in Cityplaza, one of the pilot shopping malls. The cashier frowned, knelt on the floor to search for the card reader underneath, and spent five minutes to operate it. She apologized for being unfamiliar with this device. “No one uses it. I have never seen a Mondex card for months.” After my transaction, a dozen of irritated customers were already lining up behind me.

In fact Mondex never really took off in Hong Kong. Starting from 1999, HSBC and Hang Seng Bank adopted a more low-key position to this product, and seldom did any further marketing. Later on HSBC sold out all shares of Mondex to Mastercard International. Meanwhile, Mondex moved on to launch a new project in Taiwan [34]. In April

2002 the Mondex project was formally terminated in Hong Kong [25]. The product was totally wiped out, but Eric Tai, the former project director of Mondex, became the CEO of Octopus in 2002-06 [10].

Octopus (former company name: Creative Star) was a joint venture between five public transport companies to develop a stored value transport card. The contactless feature was state-of-the-art technology in 1997, which enabled users to swing a whole handbag near the card reader and pay the exact fare. It was extremely quick and convenient for passengers in a hurry. The card could be reloaded at transport stations, where users feed banknotes into add value machines.

The Octopus card was meant to replace the magnetic stored value ticket of the Mass Transit Railway (MTR), which was used for more than ten years. When Octopus was introduced, the MTR and the then Kowloon-Canton Railway (KCR) made all passengers replace their common stored value tickets into Octopus; otherwise their old tickets would be made obsolete in 2-3 months. The only alternative was a single journey ticket, the fare of which was higher and it had to be bought with coins and banknotes.<sup>2</sup> The public quickly switched to the new Octopus card. Within the first three months, 3 million cards were sold out [30]. While Creative Star urged card manufacturer Sony to replenish new cards, there was a temporary shortage.

There was widespread resentment of the HK\$50 deposit taken for an Octopus card, and the loss of the previous “last ride discount” available to users of the magnetic tickets. Some elderly groups and political parties from Tuen Mun, a district with a high ratio of the lower income groups, protested against the Light Rail Transit (LRT) for adding financial burden to the poor. In return, the LRT offered the elderly a discount for a short period.

User resistance only lasted for the first few months. Afterwards there was not much news from Octopus. The public got used to the new card and enjoyed the convenience it brought. Transaction volume and the number of cards issued increased steadily, and the system was extended to more than 15 transport applications. Auxiliary applications included photo booths in MTR stations and parking meters [9].

In the early stage, the community rarely perceived Octopus as a form of cash. The spotlight of local press reports was on the “war of standards” between Mondex and VisaCash, but Octopus was not seen as a direct competitor. The Economist in 1998 lamented the apathy shown towards electronic cash, without taking into account the high transaction volume of Octopus.

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<sup>2</sup> Passengers using Octopus enjoyed a 10% fare discount.

**Table 1: Background of the two electronic payment systems**

	<b>Mondex</b>	<b>Octopus</b>
Founding members	Financial sector HSBC, Hang Seng Bank, Mastercard International	Transport sector Creative Star – joint venture between five transport companies
Local market share	HSBC issues 64.4% of Hong Kong's currency (2002) [14] HSBC and Hang Seng deposit 32.5% of Hong Kong's M2 money supply (2001) <sup>3</sup>	Mass Transit Railway (MTR): 11 million passenger journeys per day (total population was 6 million)
System cost	Information unavailable	US\$53 million
Issuer	Licensed banks	Authorized deposit-taking organization (2000)

**Table 2: Outcome of user acceptance**

	<b>Mondex</b>	<b>Octopus</b>
Cards issued	Pilot phase, trial quantity (1996) 0.19 million (Nov 1998) [6]	Pilot phase, trial quantity (1997) 4.6 million (Nov 1998)
	Below 0.1 million (Feb 2002) [13]	9 million (Feb 2002) [21] 17 million (Jun 2008)
No. of merchants	8000 [6] Most are retail shops	120 (2002) [21] Most were conglomerate chains Over 2000 (Jun 2008)
Daily transactions	Not disclosed	Over 7 million (Feb 2002) [21] Over 10 million, turnover HK\$85 million (Jun 2008)
Profit	Never attained profit	HK\$18 million (2000) [20]
Outcome	User resistance Low usage HSBC sold out all shares Hong Kong project terminated (2002) [1]	City-wide acceptance High regular turnover HKMA released previous 15% restriction on non-transport purposes (2000) [21]

**Table 3: Comparison on technical and marketing merits**

	<b>Mondex</b>	<b>Octopus</b>
User cost	(+) Free (HK\$100 fee waived)	(-) HK\$50 deposit (US\$6.41)
Legal Status	(+) Full legal status of money	(-) Limited legal status / area of use
Launching time	(+) Oct 1996	(-) Sep 1997
Privacy concern	(-) Holds personal information, linked to bank account	(+) Contains no personal info (Later on optional varieties linked up with bank accounts and award programs)
Contact mode	(-) Need contact to read/write	(+) Contactless read/write
Speed	(-) Read/write time: 5 seconds Date transmission: 9.6 kbit/s	(+) Read/write time: 0.3 seconds Data transmission: 212 kbit/s
Specifications	MULTOS chip Patented issuance and update mechanism: STEP (Secure Trusted Environment Provisioning) Verification and encryption: KMA (key management authority)	Sony 13.56 MHz RFID (FeliCa radio frequency identification) chip Proprietary standard predating the ISO/IEC 14443 standard ERG (Australian) as system integrator PKI (public key infrastructure) encryption Two-way authentication

(+) Merit

(-) Disadvantage

<sup>3</sup> The total deposit of HSBC Hong Kong was HK\$722,285 million; the total deposit of Hang Seng Bank Hong Kong was HK\$414,328 million [16]. From the HKMA online resource centre, Hong Kong's M2 money supply in 2001 was HK\$3,501 billion.

“Even the people of Hong Kong and Singapore – notorious technophiles and shoppers – seem unenthusiastic... the total volume of cashless transactions in Hong Kong is still estimated at less than \$10m a year – just \$30 for each user.”

*“Keep the Change”, the Economist, 19 Nov 1998*

In fact in November 1998, Octopus had quietly reached a daily transaction volume over HK\$20 million [11], equivalent to US\$203 per Octopus user in a year.

In 2000, Octopus jumped on to non-transport purposes such as convenience stores, school tuck shops, self-serviced photocopy machines, and vending machines. Add value points extended from transport stations to hundreds of convenience stores. Octopus also cooperated with smaller banks to launch the Octopus automatic add value service, where a customer may link their Octopus to his/her credit card for automatic reloading. The application was extended to 21 banks and financial partners (including large ones) in 2008.

Response was very positive, for over 80% of the city’s population already had an Octopus card in their pockets. In transactions below HK\$10 (US\$1.28), especially in self-serviced machines where exact change was needed, people were glad to get rid of their dimes and nickels. This move towards non-transport purposes was made possible by the monetary regulators. Possibly realizing the failures of Mondex and VisaCash in Hong Kong, in 2000 the Hong Kong Monetary Authority (HKMA) issued a deposit-taking company license to Octopus, relaxing the previous 15% restriction from the percentage of turnover from non-transport purposes. After Mondex announced its withdrawal from Hong Kong in 2002, the outcome of user acceptance was clear. A summary of user response is given in Table 2, and the two systems are compared for their marketing and technical conditions in Table 3.

### 3. SOCIAL CONSENSUS

What makes a form of token valid money? For regulators and the banking sector, the answer usually includes the backing of a sound issuing bank, public trust towards state and monetary authorities, the intricate control of currency supply, and measures to prevent counterfeits. Banknotes and coins are issued from a single source of legitimacy through national mints or authorized issuing banks. Cash enters the market through authorized banks, and then circulates around a transaction network made up by banks, merchants and consumers.

The case of Mondex and Octopus in 1996-2001 was intriguing to the regulators. The Hong Kong Monetary Authority [13] found that citizens refused to use Mondex, a form of legal tender prepared by a full-status issuing bank. Instead they chose to use Octopus, a stored value card initiated from the merchant side alone. Transactions were so

successful that the Octopus company was in a good position to negotiate with the regulators, who decided to upgrade the status of Octopus from that of single-purpose stored value card to multi-purpose stored value card. The approval was granted in 2000 on the grounds of promoting innovation. However, research reports from the HKMA [13][15] raised a remaining concern: how should regulators respond to the popularity of a payment token produced by a non-bank organization? Does the case of Octopus suggest that the rise of electronic currencies may lead to “erosion of seignorage”?

From a sociological perspective, money works by social consensus [3][24] - a shared awareness that “everybody else” in the exchange community will also accept the same token at equivalent value. John and Mary recognise the value of a US\$10 banknote, because they know that others in the economy also recognise the same thing. What matters is not the material worth of the token’s constituent ink, paper, metal or plastic. What makes money work is the shared consensus that others will also accept the same token. In classical banknotes, such consensus is largely based upon the issuer’s guarantee that the token bearer will be paid in full, and the public’s trust in this guarantee. Consensus is mutually reinforced in a feedback loop [3], supported by the legitimacy and trustworthiness of the originating source of supply.

Yet in the case of Mondex and Octopus, a currency with superior legitimacy and trustworthiness (from a classical banking point of view) failed to establish this social consensus, while Octopus succeeded. Technological and sociological factors were playing an important role here.

### 4. NETWORK EFFECT

Technological products are extremely sensitive to the initial size of their user base. There are at least three reasons why a large enough user base needs to be established in an early phase: network effect [17], path-dependent lock-in [2] [18], and economy of scale. Network effect means that the value of a product or service depends on how many people are already using it. Take the telephone network as an example. A standalone phone is useless, and two phones connected by a wire is only an intercom. Yet as the number of subscribers increases, each new subscriber becomes a potential node of communication, incrementally turning the telephone system into a powerful communication network.

In the case of Mondex and Octopus, adoption of the payment tool is a two-side scenario between merchants and consumers. If a large number of consumers are already using the payment card, it becomes more attractive for a new merchant to accept payment from it; vice versa if more merchants are already accepting payment from it, the more attractive it will appear for a new consumer to put the payment card in his/her purse. Once an initial user base is captured, the system will be continually tested, improved and extended. The setup and operation cost for the payment

card, point-of-sale (POS) equipment and backend networks can also be reduced by economy of scale. A determinant factor between success and failure is whether the payment card can capture a large enough regular user base, and capture it quick enough. In the case of Octopus, the successful capture of an initial user base leads to a benign cycle of growth and development. In the case of Mondex, failure to do so leads to a vicious cycle of apathy and resistance. This may look straightforward with hindsight, but readers are reminded that product innovation is an uncertain process; it is difficult to predict the pattern of user response during planning and design stage.

## 5. KILLER APPLICATION

The two systems took very different approaches to capture their initial user base. Mondex took a “democratic” approach. It reached out to merchants by negotiated partnerships and to consumers by incentive programs. The use of Mondex was on voluntary basis, and the Mondex program seemed to underestimate the inertia of existing payment habits. Amongst 8,000 heterogeneous retail shops, the incentive program was lack of focus. It could hardly differentiate from other shopping discounts, and consumers did not see a vital need to switch to Mondex.

Octopus took a “coercive” approach. From the beginning it only focused on five merchants in public transport. Out of the five companies, a compulsory switch was imposed by the two railway systems. Regular commuters on the two metro systems found no alternatives but to switch to Octopus - single journey tickets and other public transport were far from ideal substitutes. It could be argued that the two railway companies were, to some extent, manipulating their monopolistic position in an enclosed public utility, leaving little choices for consumers but to start using Octopus. Nevertheless, such a coercive approach proved to be effective in overcoming user resistance [8], changing user habits, and bringing benefits to both the transport and consumer sectors.

Octopus managed to capture a large initial user base because of its distinctive “killer application”: as stored value ticket for passengers of the MTR and KCR. In computer science, the term “killer application” refers to remarkably successful application programs such as the spreadsheet program Visicalc on Apple II, Lotus 1-2-3 on IBM personal computers, desktop publishing software Pagemaker on Macintosh, and the game Star Raiders on the early Atari game platform [5]. The applications were so successful (or essential) that users were willing to take up a new technical platform for the sake of the application. Unfortunately for Mondex, its fate was partly sealed by the absence of such applications.

## 6. PRECURSOR PRODUCTS

For metro passengers in Hong Kong, Octopus was presented as the next-generation ticket after the magnetic

stored value ticket, which had been widely adopted for over ten years. The presence of a precursor product helped passengers to get used to a stored value cash card in their purse and to lower user resistance. Meanwhile, the decision to discontinue the magnetic cards altogether removed any competition from them.

On the contrary, Mondex was facing competition from a well-established mix of existing payment tools, namely cash, debit cards and credit cards. It was impossible for retailers to cease using them without harming business. Seemingly Mondex did not possess clear advantages to “squeeze its way through” at payment counters. It could be argued that the genuine competition faced by Mondex came from cash, debit cards and credit cards instead of Octopus.

## 7. POINT-OF-SALES MATERIALITY

In the circulation of money, it should be noted that smart card payment systems are introducing a new component, the point-of-sale (POS) interface into the money circuit. In the exchange of traditional cash, economic value is embodied by a piece of paper or metal, where receivers usually accept the token with bare hands. Standardization was controlled by the regulator and the issuing bank.

With the arrival of the POS device, large merchants are now equipped with a new filter to decide what is valid money and what is not. If the money token does not pass through the POS device, it is unusable despite whatever authority and legitimacy it carries. For large merchants in possession of a unique public utility, such as the MTR and the KCR, they can now take part in negotiating the standard of valid money by controlling access and technical compatibility.

When passengers pass through the MTR turnstiles on a daily basis, the mesmerising beep of Octopus and the smooth access to escalators, trains and stations give users a form of trust different from that of an issuing bank. The railway companies did not have the legal status of banks, but the railway infrastructure could serve as an alternative form of guarantee. From a social point of view, the card is useful and it works in the passenger’s daily life. This is especially true for a dense city heavily relying on the metro as its major form of transport. Some Hong Kong people even relate their cultural identity to Octopus, as shown in the Facebook group “‘Doot’ [beep] through life with that Octopus card” with over 11,000 members in June 2008.

## 8. CONCLUSION

The history of Octopus and Mondex is a strong case to illustrate the dual properties of electronic currencies: they are moneys as well as technological artefacts. When developing a new product, it is important that product designers, marketing personnel, and regulators take both monetary and technological aspects into considerations.

Success factors of Octopus include a densely populated city, an essential public utility, presence of a precursor product ("ticket"), social trust from daily material contact, a compulsory switch, and the absence of perfect substitutes. The payment system was adopted widely and rapidly across the population.

The case also carries implications for regulators, as materiality factor at the POS is bringing changes to the social consensus of money. Solomon [28] suggests that when money goes electronic, merchants, technology firms and telecom corporations will play a more active role in finance. The tension between banks and non-banks, regulation for non-banks, and economic stability will pose new challenges to regulators. In the case of Octopus, the HKMA had attempted to balance between financial stability and not to stifle non-bank innovations [13]. The outcome to the local economy was a healthy one. In the future, money regulators and banks can expect more partnerships, negotiations and competition to arise from non-bank organizations.

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