

RFID – Some Challenges Ahead

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Good Morning, I'm an

**Economist
not
Engineer!**



Challenges to Adoption and Diffusion

- Adoption and diffusion of RFID is no different in principle from the adoption and diffusion of any other technology – the starting conditions have to be right
- This presentation will examine the challenges under the headings
 1. Innovation
 2. Adoption
 3. Standards
 4. Drivers
 5. Diffusion

Remember!

- **Inventions** often take years or decades before they become **'innovations'** through widespread adoption – for example, cellular telephones, robots, computers, **RFID**, etc., all inventions first used by the military in the 1940s

1a. Sources of Innovation

- Traditionally, industrial innovations have been driven by problem solving, such as overcoming bottlenecks in production, distribution or exchange - *it is economically beneficial to do so (cut costs, improve quality, health and safety, new materials, new products, etc.)*
 - These benefits must outweigh alternatives, such as shifting manufacturing to low-cost areas
 - RFID reduces labour costs, data errors, track and trace costs, etc. ... but who pays? Who benefits? What are the incentives?

1b. Sources of Innovation

- 'Customer-driven innovation' – customers and the users of goods and services are now recognized as a vital source of innovation (ref. von Hippel at MIT)
 - For example, SMS was never designed for use by cellphone customers, it was designed as a carrier signal for internal use by operators, but subscribers found their own uses for it!
- RFID may well be driven in its later stages by customer expectations and demands for information
 - but at this stage it is being 'pushed' by large corporations to save money and by State security concerns.

1c. Sources of Innovation

- Is there a case for Government to promote RFID? - Are there wider economic and social benefits (“externalities”) – for example, in Hong Kong the government is promoting the DTTN (Digital Trade & Transportation Network)
- Hong Kong Government is supporting use of RFID in a new project

1d. Sources of Innovation

Hong Kong is Pioneering RFID

- Hong Kong Government’s Innovation and Technology Commission has funded HK\$14 million (US\$1.8 million) for a project across the Pearl River Delta that uses the EPCglobal Network to provide end-to-end supply chain management – see <http://www.rfidjournal.com/>
- The funds will help develop and use IS including RFID to ‘track and trace’ ships, truck and cargoes across the borders at ports and vehicle stations
- Hong Kong companies have 70,000 manufacturing plants and employ 10 million workers in Southern China and approximately 80% of the goods of the region are exported through Hong Kong
- Products made in China will be fitted with EPC tags and the serial numbers will be registered with the Object Number Service that points computers worldwide to the EPC information database.

2a. Adoption

- RFID is **already widely used worldwide** in ports and airports, in road toll booths, the Octopus travel card in Hong Kong, etc.
- These are all examples of **homogeneous and standardized** product and service markets – e.g, ships, roads, buses, etc
 - For example, each car pays the same road toll, each ship pays the same harbour fee, each passenger pays the same bus fare, etc
- These are also examples where the adoption of RFID is **market neutral**, it does not distort or skew the competitive advantage of any of the adopters
 - For example, Octopus card in Hong Kong is a convenient method of payment, but allows buses, ferries, the metro, etc., to charge different prices

2b. Adoption

Examples of Homogeneous Markets?

- **Transportation** services - (ships, airfreight carriers, motor vehicles) and **warehousing** (crates, containers, packages, etc.)
- **Trade documentation** requirements by governments – everyone needs the same sets of documents for the same categories of shipments
- **Within a single company** - IT systems can be integrated and procedures standardized
- Between companies with **long term contracts** – long term contracts between buyers and sellers justify investment in integrated IT systems and standardized procedures

2c. Adoption

- The big challenge is the adoption of RFID in **heterogeneous and non standard** goods and services markets
- Heterogeneous and non standard goods and services may be made using different methods, with different materials, with different properties, different prices, different sell by dates, etc.
 - For example, sofas made of inflammatory or non-inflammatory materials, fresh food genetically modified or organic, furniture hand-made or machine-made, etc.

2d. Adoption

Examples of Heterogeneous markets?

- Markets dominated by **SMEs** making and selling many varieties, shapes and sizes of products and **not engaged in long-term buyer contracts**
- **Products markets with many variations**, such as fresh food requiring different storage conditions, ballpoint pens each type with its different refill shape and size, etc.
- **Batch production** (vs mass production) = frequent changes
- Larger companies who use ‘track and trace’ and ‘just-in-time’ based upon IS systems such as RFID to **differentiate** themselves

2e. Adoption

Transaction Theory

- Information-rich transactions are likely to be within (internal to) companies because of the complexity of knowledge and skills required
 - RFID can be adopted internally because the company can control and integrate its own information systems
- Information-simple transactions (e.g., supply of single products) are likely to be between (external to) companies
 - RFID can be easily adopted between companies where information systems are simple and do not require much control

2f. Adoption

Transaction Theory

- Heterogeneity within companies is therefore a manageable problem- ROI of trials of **RFID** can be forecast
- Heterogeneity between companies is difficult to manage – so it requires long term contracts so the supplier can invest with confidence of a ROI in information systems and the adoption of **RFID** required by the buyer

3a. Standards

- Acceptance of standards is absolutely a key issue to gain economies of scale and lower cost of chips
- Technology standards – two countervailing forces
 - national industrial policies
 - IPRs and licence fees
- Is there a solution? Is inter-operability a Second Best solution? Is the First Best solution possible?
 - complex because this involves not just countries but also private companies within countries (IPRs)
 - Ideally the ISO is the forum, but are China, Korea and Japan fully represented? See <http://www.trp.hku.hk/tif/papers/2004/oct/0410>

3b. Standards

- Trade is global, the economy is global, standards should be global – users, consumers worldwide are frustrated that they are not.
 - But the IT world is full of examples of non-standard inventions becoming worldwide innovations, e.g. the Internet Protocol!
- Radio frequencies are non-standard – ePC Global (Electronic Product Code), ISO, ANSI (American National Standards Institute) and AIAG (Auto Industry Action Group) have all proposed different frequency bands
 - Most common today = 125kHz in LF waveband, 13.56MHz in the HF waveband, and 866-869MHz (Europe – clashes with CDMA); 902-928Mhz (USA clashes with GSM) and 950-956MHz (Japan clashes with GSM)
 - Hong Kong to use 865-868MHz and 920MHz range

3c. Standards

- ID codes, product descriptions, content descriptions – how are these to be standardized?
 - The range of new goods and services being marketed each year multipliers by tens of thousands –
 - Are we speaking the same 'language' – xml ?
 - Does each country compile its own database? If so, what are the product definitions and categories to be used? Are they harmonized? are databases comparable across countries?
- Databases of code references – buyers, users, customs officials, drug administrators, etc., will need to look up the codes on a database
 - Are databases comparable across countries and available globally?
 - Are they searchable by common Web search engines, eg Google?

4a. Drivers

- Global trading is not new, what is new is the degree of foreign direct investment (FDI) globally
 - For example, Hutchison Whampao of Hong Kong has just agreed to sell 20 per cent of HK International Terminals to a Singapore state-owned ports group, PSA – regional rivals compete and cooperate
 - For example, > 50 per cent of China's exports to the USA come from US-owned or invested companies in China, which means...
 - cutting imports from China will not help the US economy
 - RFID on these exports has to conform to the requirements of US companies (eg. Wal-Mart) and US Customs

4b. Drivers

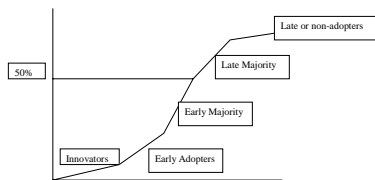
- Supply Chains – Wal-Mart is the classic example of a driver, requiring all suppliers to adopt RFID on pallets and containers from January 2005
- Security – RFID tags seem to promise greater cross-border security, but do they? Who puts them on? Who authenticates them?
 - US Customs and Border Protection requires under the Automated Manifest System (AMS) ship manifests 24 hours before sailing - is RFID 'evidence' sufficient?
- Cost efficiency – 25% - 40% of product cost can be in logistics, but the issue is not cost savings but who gets them? Who pays and who benefits? Do SMEs need to be dragged into RFID? **What are the incentives/penalties?**

5a. Diffusion

- Innovators – vendors? They have something to sell!
- Early adopters – Wal-Mart, Gillette, etc., who see logistical cost savings, eg. procurement/wholesale focus
- Early Majority adopters- who see standards and business opportunities, eg. wholesale/retail focus
- Late Majority adopters – who see loss of business!
- Late or non-adopters – who are little or not at all affected

5b. Diffusion

Typical diffusion or “S” curve



5c. Diffusion

- If the key driver is cost-savings, the key to diffusion is either
 - (a) supply-chain buyer (Early Adopter), or
 - (b) cost advantage of competitors (Early Majority Adopters)
- Service advantages – RFID offers product information to the customer (**if standards and harmonization are established**) ⇒ greater sales and customer 'trust' in brand ⇒ customer loyalty
 - For example, RFID tags can give information about content of drugs, or food cooking instructions, etc.

5d. Diffusion

- Who pays for the RFID tags and who benefits is the key market question – do SMEs have an incentive to adopt?
- RFID tags remain expensive – for example, EPGlobal's Gen 2 'passive' tags are widely approved by industry but are more expensive - \$5 needs to become 5 cents.
- Stages of diffusion
 - Supply chain management ('compliance') over next 4-5 years?
 - Innovations and applications into the retail over next 5-8 years? (But how long to tag every individual item?)
 - Mass market, tags reduced to US\$1-5 over next 8 -15 years? Or 20 years?
- General level of public acceptance will be crucial to later diffusion – RFID in retail involves privacy issues.

6. Trust

- RFID involves trust at many levels
- Security – who does the tagging? Who monitors the tagging?
- Credibility – is the information accurate? Are these drugs safe? Are these contents genuine?
- Confidence – is this commercial information secure? Can it be read by competitors?
- Machine-to-machine (homogeneous) is easily implemented (but hacking?) while machine-to-person (heterogeneous) is always problematic in terms of accuracy
- Personal data – tagging personal items, data mining and providing tracking information to marketing agencies?

7a. Conclusion

- RFID is a technology that is full of engineering issues that need to be solved and production costs that need to come down.
- RFID is a major business application to be exploited
- RFID is a standards issue, which can become very political – but a common standard is essential to global compatibility, a 'harmonization of standards' is a Second Best solution
- RFID poses the challenge of who bears the costs and who enjoys the benefits? Large buyers can impose their standards, but will this drive diffusion beyond the Early Adopters?
- RFID offers enormous benefits to retailers and customers, but trust and public confidence are as important as technical solutions and standards

7b. Conclusion

- The Telecom InfoTechnology Forum (TIF) seminar on RFID in October 2004 –
 - see <http://www.trp.hku.hk/tif/papers.html>
- 4 recommendations from Jonson Yue, Senior Marketing Manager for Hewlett Packard were as follows:
 1. Before adopting RFID, make a detailed analysis of your own production process
 2. RFID generates lots of information, but ask what type of information is useful?
 3. There is always a degree of error that needs to be managed
 4. Training of the workforce is essential

Thank You

The End