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Title: If we build it will they come? Or is this only if the price right? Adoption and Use of 4G versus 3G Technology. Results from a Netlogo Simulation

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If we build it will they come? Or is this only if the price right? Adoption and Use of 4G versus 3G Technology. Results from a Netlogo Simulation

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Abstract

This paper models some simple consumer behaviour of the acceptance of a new mobile phone technology (4G) versus a mode widespread existing technology (3G). It is commonly believed that the adoption and use of new mobile networks is based on price and service. New networks though may face limitations of providing access to all consumers and managers may need to carefully consider to what extent a network can be upgraded and expanded given a limited capital budget. There is however, the risk of churn, of customers leaving a network for other providers if their requirements cannot be catered for.

Results from an Agent Based Modelling Simulation using Netlogo found that consumer tolerance (or patience) the number of Four G Access points capacity of each access point and only the price of 3G seemed to influence the happiness of consumers and the mean use of technology (4G and 3G). Loss of customers is determined mainly by tolerance. The implications for managers are; that planning for capacity is important but you don't have to provide access to all consumers; the price of the old technology is more important than the price of the new technology and relationship marketing is important to increase tolerance and prevent churn.

Introduction

One of the important questions facing managers in the telecommunications industry is devilishly simple but complex to solve; how do managers of networks (cell and broadband) introduce new technology? Why it may seem that new and improved networks are always better industry practice shows that this is not necessarily the case. Motorola, for example sold its mobile phone business as the result of loss of market share brought about by slowness to introduce new technology (Crockett, 2008). The current use of 3G technology has created significant demands for capacity, such as mobile TV, and this needs to be balanced with the capital constraints of many firms (Gibbs, 2007). Facing these opportunities, are the constraints of the marketplace.

A 2008 UK government report by the Office of Communications (Jack, 2008), found that consumers spent more time using telecommunication services but paid less money for it. According to the report, mobile telephone use has doubled, and people spent seven hours and nine minutes on an average using these services every-day. There have been a number of competitive campaigns by providers focusing on free talk time (Poynter, 2006) and free text messaging (Chandiramani, 2003). Providers therefore face price pressures on margins and the need to update cell networks in the post GFC area where capital is scarce. How can this be achieved? And is there an optimal mix of price and service that can be delivered profitably to consumers?

Literature Review

Research suggests that there are three main factors which influence the use of one type of mobile phone network over another; access to new technology; price and both factors. (Iyengar, 2008) in a conjoint study found that choice probabilities and usage levels of mobile product features depended largely on price The authors then use these estimates to evaluate the expected revenues and profits of alternative plans and pricing schemes. Other studies suggest it is the experience of product quality, level of service charges, level of call charges, and level of satisfaction with the service provider that predicts network use (Goode, Davies, Moutinho, & Jamal, 2005). Research by (Deng, Lu, Wei, & Zhang, 2010) suggests that trust, perceived service quality, perceived customer value, including functional value and emotional value, contribute to generating customer satisfaction with network providers.

Other research suggests the importance of “churn” decisions of peers on contact lists has an influence on the choice of network provider (Dierkes, Bichler, & Krishnan, 2011). Other studies suggest that the degree of consumer confusion over the myriad of marketing offers leads them to rely on very simple strategies such as seeking word of mouth information or advice (Turnbull, 2000). It is clear, however, that the type of use of mobile phones drives network demand (Wagner, 2011). Ease of use and mobile phone service quality also have been shown to predict network demand (Wahab, Al-Momani, & Nor Azila, 2010). It is important to note though that there is research which shows the increased use of applications on mobile phones particularly smart applications and video is driving network demand (Constantiou, Damsgaard, & Knutsen, 2007).

Mah, (2004) in case study of the introduction of the 3G network for Hutchinson, noted that introducing a new technology (3G), had significant advantages in terms of demand, particularly if this was coupled with a low price strategy on the existing network. The challenge then for many managers and marketers is to model how these factors interact in real time so that decisions can made across a number of possible future scenarios (new technology and new price competition) as existing research methodologies rely on future forecasting using past data. These scenarios also need to be presented to a manager in useable format, with the option of providing tests of future marketing strategies.

Method

In order to evaluate the possible effect of marketing strategies on network demand and satisfaction a Netlogo model see http://ccl.northwestern.edu/netlogo/ was used to simulate the effect different market conditions. Netlogo is described by its designers as a "multi-agent programmable modelling environment", where rules of behaviour of agents (turtles), which can represent consumers in a marketplace, can be programmed using a set of rules which may be deterministic, or "learnt" over time. Actions of turtles usually can traced by their position in the "world", or a set of "patches", which can represent a geographic boundary or use of a particular product or technology.

The Netlogo model used in this study consisted of the following parameters:

Network
4G- Number of 4G cell access points (0-100)- Represented by Black Patches which had a bandwidth of 200
3G- Remaining cell access points- Represented by Green Patches with a bandwidth of 120

Capacity of each cell, number of turtles (0-100).

Price
Price of 4G (0-50)
Price 3G (0-50)

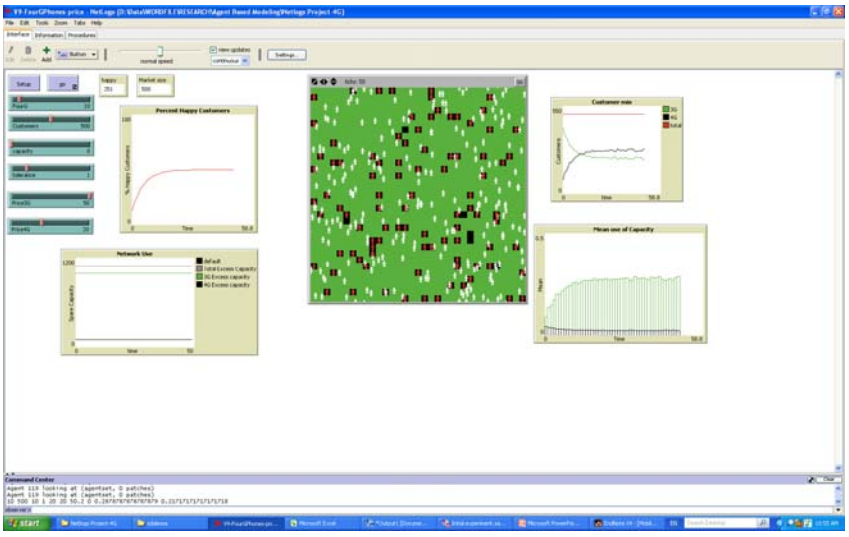
Consumers
Tolerance (of bad service) – (0-1).

The Agents or turtles, shown by the people in figure 1, start in a random position and search for a patch (Black 4G, or Green 3G) which maximises their access to bandwidth, but also minimises the price they pay. Turtles were also assigned a random distribution of bandwidth required and price they were willing to pay for that bandwidth.

Any Agent (turtle) who finds the optimal mix of bandwidth and price stops and is happy, this shown in model by the figure being red. Unhappy consumers continue to search until they find their optimal choice. Unhappy consumers are shown in the model interface as white figures. After a period of time (10 ticks) consumers who are unhappy leave the network providers, this is simulated in the model by the turtles or agents who "die" or leave the netlogo representation of the market. Turtles or agents with higher tolerance, are less likely to leave the market.

The Netlogo window as shown in figure 1, allows decision makes to manipulate a number variable and observe the outcomes in real time. The software also allows an experiment to be run on what is the effect of different combinations of these user inputted variables on the outcomes of the model.

Figure 1: The Netlogo Observer Window.



Results

Using the Behaviour Space Option on Netlogo the following conditions were tested on the model: Independent variables; ["FourG" 5 10], ["capacity" 5 10], ["Price4G" 10 20], ["Price3G" 10 20], ["tolerance" 0 1]["Customers" 500] 32 Runs. Dependent Variables; % Happy customers, Loss of customers of Mean use of 3G and Mean use of 4G

An MANOVA and ANOVA analysis was conducted the results of which are shown in table 1. For the sake of brevity, only significant ANOVA results are shown.

Table 1: ANOVA results

Source	Dependent Variable	df	F	Sig.	Partial Eta Squared
FourG	Happy	1	53.16	0.00	0.05
	Mean3G	1	188.75	0.00	0.16
	Mean4G	1	881.73	0.00	0.47
Price3G	Happy	1	66.24	0.00	0.06
	Mean3G	1	55.29	0.00	0.05
	Mean4G	1	39.68	0.00	0.04
tolerance	Happy	1	118.94	0.00	0.11
	Loss	1	69.57	0.00	0.07
	Mean3G	1	278.10	0.00	0.22
	Mean4G	1	15.46	0.00	0.02
capacity					
	Mean3G	1	494.02	0.00	0.34
	Mean4G	1	559.66	0.00	0.36
FourG * tolerance					
	Mean3G	1	49.37	0.00	0.05
FourG * capacity					
	Mean3G	1	5.00	0.03	0.01
	Mean4G	1	89.68	0.00	0.08
Price4G * Price3G					
	Mean4G	1	14.32	0.00	0.01
Price4G * capacity					
	Mean4G	1	3.83	0.05	0.00
Price3G * tolerance	Happy	1	3.97	0.05	0.00
Price3G * capacity					
	Mean3G	1	4.47	0.03	0.00
	Mean4G	1	7.97	0.00	0.01
tolerance * capacity					
	Mean3G	1	18.43	0.00	0.02
FourG * Price4G * Price3G	Mean4G	1	9.37	0.00	0.01
FourG * Price4G * tolerance	Mean4G	1	3.15	0.08	0.00

As can be seen from the results, Tolerance, Four G Access points numbers capacity and only the price of 3G seemed to influence the happiness of consumers and the mean use of technology (4G and 3G). Loss of customers is determined mainly by tolerance.
There are a number of interactions but the effect sizes are small. Implications for providers are that planning for capacity is important but you don't have to provide access to all consumers. The price of the old technology is more important than the price of the new technology. Relationship marketing is important to increase tolerance and prevent churn

Discussion

These preliminary results show that there is an important interaction between prices of different technologies, and that pricing in the use of existing technology (in this case 3G) is much more important than pricing of new, possibly more expensive technology. It is also not necessary to provide access to all consumers of new technology, only a fraction needs access for there not to be significant churn or loss of business.

Importantly, there is a need for a relationship marketing strategy, which does not have to be extensive in order to be effective in preventing churn, as this will increase in the short term the tolerance of consumers.

There are of course a number of limitations with this type of research design. We have not based the rules of the market on empirical research, though it is possible to adjust behaviours of turtles, with insights from both qualitative and quantitative research. Modelling as shown here may be useful in the formulation of hypotheses for future research and the development of potential marketing strategies in the future.

Importantly, simulations like Netloggo which are straight forward to program allow the manager and research to examine a range of scenarios (32 were studied in this paper) and to look at highly unusual events like a "market failure". This was simulated in trial where a low capacity and low price for 3G networks, lead to unhappy consumers leaving the marketplace so that only a reduced number were left served by the 4G network, a condition easily dealt with by slight increase in consumer tolerance of 1 unit. Interestingly, this type of situation may well be faced by network providers who cut costs but cannot provide sufficient capacity for the high bandwidth customers. As future research may well show, the Devil is always in the detail".

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