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Quality and Customer Satisfaction Spillovers in the Mobile Phone Industry

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This study investigates the possible spillover effects of customer satisfaction from product manufacturer to service provider, and vice versa. The survey results provide empirical evidence for the presence of spillover effects of quality and customer satisfactions in the mobile phone industry. This finding suggests that research on the ways in which quality affects customer satisfaction and loyalty should consider the influence of partnering firms and suppliers, rather than only examine the relationship within the same organization. This is particularly relevant in settings where the simultaneous presence of physical product and the service are needed. In the mobile phone industry, handset manufacturers and network operators need to consider whom they partner, depending whether they are the likely receiving or giving party of the spillover effects. Moreover, these effects are moderated by product image gap between the handset and network operator.

Key words: spillover effects; product quality; service quality; customer satisfaction; customer loyalty

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1. Introduction

Increasingly, companies are focusing on creating a holistic and delightful experience to win and retain customers in an ever competitive market (Pine and Gilmore 1998). For the effective use of products, users rely on the service as much as on the product itself. For instance, when customers buy a mobile phone, they do not simply wish to purchase a communication device. They seek to obtain a means to communicate over a distance at any given place and time. This objective can only be achieved by the simultaneous presence of high quality products (provided by the handset manufacturer) and high quality service (provided by the network operator). A low quality handset not only affects the customer satisfaction with the handset manufacturer, it may also lead to dissatisfaction with the network operator. While studies on the way in which quality affects customer satisfaction have been going for more than two decades, most of the research on how quality affect satisfaction and loyalty in the past has focused largely in pure product (e.g. Garvin 1988, Grönroos 1983, Steenkamp 1990) or pure service settings (e.g. Brady and Cronin 2001, Oliver 1997, Parasuraman *et al.* 1985). Surprisingly, little work has been done to examine the spillover effect of customer satisfaction on the products toward service provider, or vice versa. As early as 1988, Gummesson writes that a management philosophy is required, which 'manages both product and service quality and the synergy effects between them' (Gummesson 1988, p. 14). This subject is of great importance to managers today as more and more products and services are bundled together where there is a pressing need to understand how other's product/service quality may affect customer satisfaction with one's own product/service, i.e. the possible spillover effect of customer (dis)satisfaction on product manufacturer towards service provider, and vice versa. To our best knowledge, there is no study done on the interrelationship between quality, customer satisfaction, and customer loyalty in settings where the simultaneous presence of product and service are needed in order for the consumers to use the product properly.

Thus far, the few studies which examine the spillover effect of product and service quality on customer satisfaction have been on car owners. Using the critical incident technique, Archer and Wesolowsky (1996) look at how satisfaction with product and service quality simultaneously affects the intention of owners in automobile industry. Taking this step further, Mittal, Kumar and Tsiros (1999) studied the dynamic nature of how product

satisfaction and service satisfaction affect intention towards manufacturers and service providers. They found that the relationship between satisfaction and behavioral intentions changes over time. While these two studies have provided some new insight, more research is needed to understand how the relationships between quality, customer satisfaction, and loyalty affect each other for companies with strong interdependency.

The proliferation of mobile phones in our daily lives during the past few years provides an interesting setting for continuing research in this direction. More specifically, we choose mobile phone as the research context because of two reasons. Firstly, there is a high degree of interdependency between handset manufacturers and service providers where products and services from handset manufacturer (i.e. mobile phone and related services) and the telecom company (i.e. mobile network and related services) are highly intertwined. The simultaneous presence of product and service is needed when a consumer uses the mobile phone, providing an ideal context to see how product and service elements “jointly affect satisfaction, how they interact, and how their relative influences changes” (Rust and Oliver 1994, p. 15). Secondly, this is a growing industry of great economic and social importance. According to the recent report by Gartner (2007), more than 1.15 billion mobile phones were sold to end users in 2007, and continuous growth is expected. The handset manufacturer Nokia alone employs 49,560 employees worldwide and has a market capitalization of 101,995 million Euros by 2007 (Nokia 2007). In addition, the increasing use of mobile phones for internet access is creating a whole new industry around mobile internet, leading to greater growth in this industry.

The research objective of our study is to investigate the interrelationship between quality, customer satisfaction and loyalty of interdependent companies in the mobile phone industry. For the purpose of this study, for handset manufacturers, the product refers to the handset while service refers to both pre-sales (e.g. information about product) and after-sales services (e.g. technical support, replacement, warranty) which the customer obtains through such channels as retail outlet, website, customer service hotline. For network operators, product refers to talk plan and transmission network while service includes pre-sales (e.g. information about the subscription contract) and after-sales services (e.g. monthly payment, report of loss) which customers gained through channels such as retail outlet, website or customer hotline.

The rest of the paper is organized in the following manner. The next section presents a summary of the exploratory interviews and the hypotheses. After that we describe the research approach adopted. The results of a large scale telephone survey are reported in the subsequent section. In the final section, we summarize the contributions of this work as well as limitations and areas for future research.

2. Hypotheses Development

The links between quality, customer satisfaction and loyalty are one of the most popular research topics among service researchers (Pilkington and Chai 2008). In a setting where companies do not depend on others to serve customers, the customer is aware to whom his/her perception is dedicated, and the direct link between perceived quality, customer satisfaction and loyalty is naturally expected. This has been proven by many researchers in both pure product (e.g. Brady and Cronin 2001, Cronin *et al.* 2000, Zeithaml 1988) and pure service settings (e.g. Cronin and Taylor 1992, Parasuraman *et al.* 2005, Patterson and Spreng 1997, Wofinbarger and Gilly 2003). A recent study on the halo effect in satisfaction by van Doorn (2008) provides a good review on this topic. However, these studies were largely conducted in a single-firm setting. In the case of mobile phone, the relationships between quality, customer satisfaction and customer loyalty may not be that straightforward because of the high interdependency among the companies (specifically handset manufacturers and network operators) involved.

2.1. Exploratory Interviews with Practitioners

Because of the lack of previous studies in this topic, a series of exploratory interviews were conducted with practitioners in the telecom industries. According to Tiwana and Bush (2004), such an approach allows for a richer and more grounded understanding of the research phenomenon. The primary purpose of the interviews is to investigate and understand any possible interrelationships between quality, customer satisfaction and loyalty among the interdependent companies in the mobile phone industry. In addition, we also hope to identify the attributes of the product and service qualities for handset and telecommunication network. In total, we conducted 16 in-depth interviews with practitioners who work for handset manufacturers, handset retail shops as well as network operators in Singapore and China through telephone as well as face-to-face meeting. We also interviewed 12 mobile phone users in China.

Overall, our interviews reveal several interesting observations. In regard to the attributes of handset quality, the interviews reveal that appearance, battery stand-by time, reliability and durability, ability to send and receive

signals, memory capacity and user-friendliness are seen as important attributes. Interestingly a practitioner commented that the durability of the handset is increasingly less important as the product lifecycle becomes shorter and shorter. In contrast, design and user-friendliness will become more and more important. In terms of network quality attributes, signal coverage, reliability (e.g. call drop rate, put through rate), voice quality (e.g. clarity, no distortion) are regarded as important. The interviews also reveal that customers not only derived satisfaction from functional performance such as good product quality, they also derived satisfaction from emotional fulfillment. For example, a user commented that he is 'not satisfied with current handset due to having used it for a long time and being sick of it'. This suggests customer satisfaction comprises cognitive satisfaction as well as emotional satisfaction. It is also evident from the interviews that the performance of a handset manufacturer might affect customer satisfaction with the network operator, and vice versa because of the technical and business interdependences between the handset manufacturer and the network operator. Technical interdependence refers to the fact that the proper functioning of a mobile phone depends on the simultaneous presence of good quality from handset as well as communication network. A practitioner pointed out that problem such as the speed of picture transmission maybe due to network transmission speed as well as handset memory and processor, and internet access ability (using a handset) problem may be related to both the handset as well as the SIM card configuration. According to a handset manufacturer manager, before deciding whether to include a particular handset onto their subsidized program¹, network operators generally test the handsets for their ability to receive and send calls with reasonable clarity with their existing transmission network. Otherwise the incompatibility between the handset and transmission network may lead to customer dissatisfaction with the network operator, even though the problem may not lie with the operator.

Business interdependence, the interdependence between handset manufacturer and network operator in areas of bundled sale, and after-sale support by network operator to certain type of handsets, is another possible source for the spillover effects. For example, because of the greater number of network operator outlets and higher publicity in many markets, consumers have a tendency to contact network operators when they face a problem whenever the source of the problem is unclear. Examples of such problems include the inability to send SMS or text messages to particular numbers, trying to activate advanced features (e.g. Internet search or video) which are not supported by local operator.

Contextual factors such as the perceived superiority of foreign products may also affect Chinese customers' perceptions about the source of the problems. A practitioner commented that when encountering the same problem, customers with local brand handset would often assume the problem is due to the handset rather than because of the network operator, while customers with foreign brand handset would attribute the problem to the network operator, rather than the manufacturer. This suggests that the product image might be a moderating factor in affecting how product quality with handsets affects the satisfaction with the network operator.

These interviews provide firsthand information on how practitioners and users perceive the interrelationship between handset manufacturers and network operators. It forms the basis for the hypotheses developed in the next section.

2.2. The Spillover Effects of Product Quality on Partners

From the exploratory interviews with the practitioners and mobile phone users, it is very clear that the simultaneous presence of good quality handsets as well as transmission networks is needed in order for the users to enjoy a good mobile communication. For instance, the performance of handsets depends as much as on the product quality (e.g. quality of the speaker) provided by the handset manufacturer as well as the network quality (e.g. signal strength) by the network operator. Given that many customers today acquire their mobile phone through bundle sale offered by network operators, where they sign a long term contract in return for obtaining a free handset (or with reduced cost), when a user experiences bad sound quality as a result of bad handset, they might put the blame partly on the network operator for bundling the talk plan with a low quality handset. Therefore we propose that:

H1a: Handset product quality positively affects customer satisfaction with the network operator.

It is also possible that a network operator affects customer satisfaction with the handset manufacturer. This can be illustrated by an incident revealed by an engineer of a leading European handset manufacturer during an exploratory interview with the researchers. To meet the long battery expectation of its European customers, the manufacturer has successfully designed a handset where the battery power can last for two weeks when it is in a

¹ Many network operators choose selected handsets and offer these to their subscribers at prices lower (some time as much as 50%) than the retail price in order to attract customers into signing long term subscription contract.

standby mode. However, when the product was launched, the manufacturer received many complaints that the handset did not last as long as had been advertised. Puzzled by this, the manufacturer conducted a thorough investigation. They found the problem was because the base stations of a particular network operator were constantly sending out signals which prevented the handset from going into the standby mode. As a result, the handset was not able to enter the energy saving mode which leads to a much shorter standby time. This example illustrates the case where a problem caused by the network operator has led to customer dissatisfaction with the handset manufacturer because the customers were not able to distinguish the role of product manufacturer and service provider. Therefore, we propose that:

H1b: Network operator product quality positively affects customer satisfaction with the handset manufacturer.

2.3. The Spillover Effects of Service Quality on Partners

The close dependence between the companies' operations (e.g. sales, maintenance service) may lead to confusion among customers on which party shall be responsible when they run into a problem. Consequently, an experience of poor service from a company maybe wrongly blamed on the partner company as the customer is not able to differentiate the scope of responsibilities of the companies involved. Take the example given by a practitioner during an exploratory interview where a customer sent his/her handset to network operator for service related to the handset². When the customer experienced a good after-sales service provided by the handset manufacturer, this positive service quality may partly contribute to his/her satisfaction with the telecom company to which they sent the handset. In contrast, when a customer approaches the network operator store because of a handset problem, the poor service experienced by the customer (e.g. the delay in processing customer's request) may lead to customer dissatisfaction with the handset manufacturer. We therefore hypothesize that:

H2a: Network operator service quality positively affects customer satisfaction with the handset manufacturer.

Similarly, a poor service quality by handset manufacturer, e.g. delay in service due to lack of spare parts or long service queue at service center, might lead the customers to blaming the network operator of partnering with an incompetent handset manufacturer. Therefore,

H2b: Handset manufacturer service quality positively affects customer satisfaction with the network operator.

2.4. The Spillover Effects of Satisfaction to Partners

Customer loyalty, whose importance has been well recognized by both practitioners and academics, has been discussed extensively in literature. Among other factors, customer satisfaction (e.g. Anderson and Sullivan 1993, Dube and Menon 2000, Oliver 1980, Yu and Dean 2001) is one of the most widely accepted antecedents to customer loyalty. The blurred distinction between the contribution of network operators and handsets towards good performance may cause the spillover effect from satisfaction to loyalty. For example, when a user is satisfied with the web surfing function on a mobile phone acquired for a reasonable cost, he is likely to be loyal to the network operator as he also attributes the good performance of web-surfing on the handset due to the combined quality of handset and the network operator. Similarly, if customers are satisfied with the high speed download of images or videos on his mobile phone, not only will they be loyal to this network operator, they will also be loyal to the handset because of the performance might be seen as a result of good combination between the network and handset. Therefore, we propose:

H3a: Customer satisfaction with the handset manufacturer positively affects customer loyalty with the network operator.

H3b: Customer satisfaction with the network operator positively affects customer loyalty with the handset manufacturer.

2.5. The Moderating Effects of Product and User Image Gap

In our exploratory interviews in China a practitioner highlighted that Chinese mobile phone customers using foreign brand handsets have the tendency to blame an unknown problem on the network operator because of the perceived high quality of foreign products. This suggests the presence of a halo effect (Nisbett and Wilson 1977, Wirtz 2000)

² In countries such as China, network operators provide after-sales service for a number of handset brands.

where the product or brand image perceived by the users influences whom they might attribute their satisfaction to. According to Herzog (1963), brand image is 'the sum of the total impressions'. Gordon (1991) posited that brand image is an umbrella term, encompassing different image dimensions, and designed five-part model of brand analysis. Among them, two types of images are deemed to moderate the spillover effects: product and user image. In a single product setting, product image refers to consumers' belief about the physical or functional characteristics of a product. It is a subjective and perception-based judgment which may or may not reflect the real performance of product attributes. User image refers to the target group believed by consumers to be the most likely buyers/users of the brand (Gordon 1991). That is, consumers tend to ask the question, consciously or unconsciously, "who is the most likely to buy X", or "do I fit into the group of customers who use X". A user image might be described in terms of consumer characteristics, such as the age of consumers (e.g., some handset brands are more popular among younger consumers), social status (e.g., middle class, working class) and life styles. Therefore, brand image is inclusive of, rather than equal to, product image or user image. Conversely, product image and user image are two distinct constructs that cover different aspects of brand image.

In products like mobile phones, a gap may exist between the consumer's image of the handset and the image of the network. The larger the perceived product image gap between the two parties, the more easily customers tend to attribute the poor product performance (e.g. poor voice quality) to the one with lower product image, resulting in a decrease of satisfaction with it, and superior product performance (e.g. good signal reception) to the one with higher product image, resulting in an increase of satisfaction with it. Conversely for two parties with similar level of product image, the chance is that customers would attribute their positive and negative perceptions to different parties with equal probability. In other words, customers have a tendency to perceive quality of the product with poorer/higher image as inferior/superior, and thus decrease the possibility for spillover effect. While in the case where two parties with similar level of product image, customers themselves are not able to clearly put the blame on one single party, this, therefore, leads to a stronger spillover effect. Therefore, we propose that:

The larger the perceived product image gap between the handset manufacturer and the network operator,

H4a: the weaker the relationship between the handset product quality and the customer satisfaction with network operator

H4b: the weaker the relationship between the handset manufacturer service quality and customer satisfaction with the network operator

H4c: the weaker the relationship between network operator product quality and customer satisfaction with handset manufacturer

H4d: the weaker the relationship between the network operator service quality and customer satisfaction with the handset manufacturer

It is not hard to imagine that if a customer identifies the user image as 'people like me', he/she would have a higher tendency to repurchase the products/services of this brand as the congruity between customer's self-concept and product/service concept would increase both his/her satisfaction with the brand. As the functionality of mobile phone depends on both the manufacturer and the network operator, sometimes it might be hard to identify whether this congruity comes from. Therefore, it is logical to assume that the larger the user image gap between the two parties, the less likely it is for the spillover effect to occur as it appears apparent to the consumers which party they feel congruent with. In contrast, when the gap is smaller, the possibility for a spillover effect to happen is higher as consumers are unsure to which party they should dedicate the congruity. Therefore, we propose that:

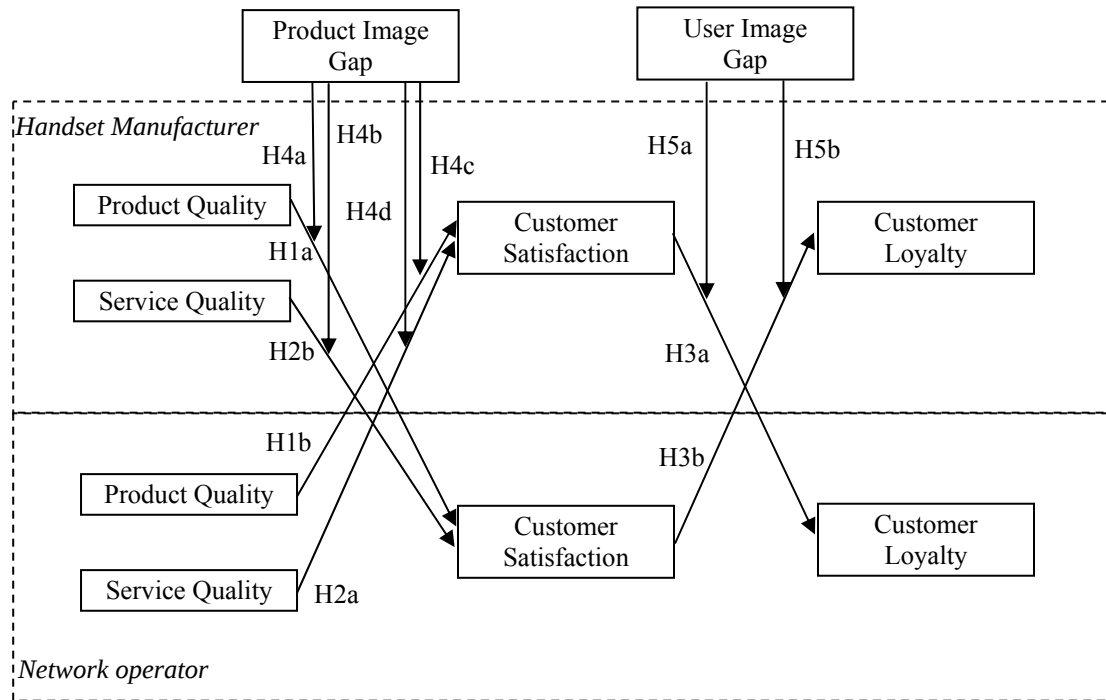
The larger the perceived user image gap of handset manufacturer and network operator,

H5a: the weaker the relationship between customer satisfaction with handset manufacturer and customer loyalty with the network operator

H5b: the weaker the relationship between customer satisfaction with network operator and customer loyalty with the handset manufacturer

Figure 1 shows our research framework and the hypotheses.

Figure 1 Research Framework



3. Research Method

We conducted a survey in China to test our hypotheses. The questionnaire, largely developed using existing measures found in literature (see Appendix I for details), was first prepared in English and then translated into Chinese. It was checked for accuracy following the conventional back-translation process, and tested with 23 consumers of different backgrounds to ensure the face validity and appropriate wording.

The survey was conducted with the help of an established local market survey company with proven track records in conducting market surveys for local and foreign handset manufacturers and network operators. Instead of a mail survey, we adopted the telephone survey with random digit dialing because it offers a better coverage of the targeted population and a higher response rate based on the experience of the market survey company. Respondents were approached on residential telephone lines instead of mobile phone as early trial shows a low response rate when contacted through mobile phone. This may be because when calling on a mobile phone is more likely to interrupt the receiver's activities in contrast to when call on a residential line. In the latter the receiver is more likely to be resting or engaging in non-work related activities.

In total, 15134 numbers were dialed and 256 completed questionnaires were received with 2999 refusals. The non-respondents are due to factors such as busy phone line (2345), not meeting the survey requirement (2481), no answer (3505), invalid number (2502) etc. Hence, the effective response rate is 7.86% following the cooperate rate rule (Groves *et al.* 1988). As the response rate is rather low, non response bias test was implemented. Demographic characteristics are appropriate for the test to conduct upon (Kwaku and Li 2002) and Kruskal-Wallis test result was obtained between respondents and refusals for gender ($\chi^2 = 18.562$) since gender is the only information known for the refusals. The significant result shows the bias exists. However, since the statistics showed insignificant correlations between gender and survey variables of interest, following Colombo (2000), no adjustment for the bias such as reweight the estimates is necessary.

Among the 256 respondents, 159 are males and 97 are females while the numbers of male and female approached are roughly the same. As there are no theoretical reasons which indicate the influence of gender on the hypotheses, the survey results can be extended safely to both male and females. A variety of handsets, ranging from foreign brands such as Motorola and Nokia to local brands such as TCL and Bird, were used by the respondents. 76.4% of them subscribed to services offered by China Mobile, the leading network operator in China and the

remaining 23.6% subscribed to China Unicom. 91% of the respondents have used more than one handset, whereas only 46.1% have experienced more than one network operator. They all have considerably extended experience of using the current handset and telecom network, where 79.1% of them have used the current handset and 91.8% of them have used the current network for more than 6 months or above. Hence, one can safely assume that the respondents know their handset and telecom network well and the answers truly reflect their perception with the products and services. 35.5% of the respondents had never contacted their network operator before. Unfortunately as 75.4% respondents did not use any after-sale services offered via toll-free hotlines or physical outlets provided by the handset manufacturers, hypotheses H2b and H4b which involve handset manufacturer service quality had to be dropped from the analysis due to insufficient sample size. Similarly, only 144 respondents had experienced services (via toll-free hotlines, internet, SMS, or physical outlets) provided by network operator. The low sample size means Hypotheses H2a and H4d which involve network operator service quality could not be tested. In order to prove the relevance of spillover effect in this context, respondents were asked who did/would they approach when encountering unknown problems during the use of the mobile phone. The survey shows 53.5% of them indicate handset manufacturer and 46.3% notes network operator. This balanced distribution shows the suitability of the study context.

4. Results and Discussion

The survey results were analyzed using the Partial Least Square (PLS) approach. The software used for the analysis is SmartPLS, version 2.0 (Ringle *et al.* 2005). Compared with covariance-based structural equation modeling, such as LISREL, PLS is a component-based approach which can be used for theory confirmation as well as prediction (Chin *et al.* 2003). Our choice of PLS can be justified from two aspects. The first aspect is that PLS can accommodate both reflective and formative scales (Fornell and Bookstein 1982), which is absent in covariance structure analysis (e.g., LISREL, EQS, etc.) (Falk and Miller 1992). This is also the major factor stimulating renewed interest in PLS in recent years (e.g., Esposito Vinzi *et al.* 2008). The second aspect is that PLS does not require any a priori distributional assumptions and relatively small sample size is acceptable (Chin *et al.* 2003).

Both handset and network product quality, which are evaluated by an aggregation of multiple dimensions, should be treated as formative constructs (Rossiter 2002). Other constructs, product image, user image, satisfaction, and loyalty, are all reflective in the light of their original sources (Appendix I) and the decision rules established by Jarvis *et al.* (2003). Loyalty is a second-order construct with four first-order reflective constructs, cognitive loyalty, affective loyalty, conative loyalty and action loyalty, as its reflective indicators. For those reflective constructs, reliability was tested by Cronbach alpha which should be over 0.7 as suggested by Nunnally (1978). To assess the construct validity, both convergent and discriminant validity are examined. Convergent validity is measured by two parameters: composite reliability and average variance extracted (AVE) (Hair *et al.* 1998). Typically, composite reliability should be greater than 0.7 and AVE should be greater than 0.5. To achieve discriminant validity, the root squares of AVE should be greater than the correlation coefficients with other latent variables (Fornell and Larcker 1981). As shown in Table 1, the validation and reliability results of all reflective constructs are well above the cut-off values. Overall, good reliability and validity are achieved. For formative constructs, none of these criteria are applicable; however, there are two other specific issues, content validity and indicator multicollinearity (Rossiter 2002, Bagozzi 1994). Content validity really matters since the domain of the formative construct is completely delineated by the indicators (Jarvis 2003). To achieve this, we invited both practitioners and consumers to discuss the possible attributes of product quality in an open question format, following Karnes *et al.* (1995). The interview results revealed that the commonly noted product quality attributes all fall into the dimensions of Gavin's (1988) model.

Besides, any formative indicator multicollinearity should be checked before testing the structure model because it causes unstable indicator coefficients as well as confounds the distinct impact of individual indicators (Diamantopoulos *et al.* 2008). One common approach to detect multicollinearity is based on the variance inflation factors (VIF). A VIF value greater than 10 is always considered as a signal for multicollinearity (Chatterjee and Hadi 2006). Table 2 and 3 reports VIF and correlation coefficients for both handset and network product quality indicators. All VIF values range from 1.33 to 1.88, which is far below the generally accepted cut-off value. In addition, correlation coefficients are all relatively low in terms of rule of thumb suggested by Schmidt and Muller (1978) that intercorrelation among independent variables above 0.80 indicates possible collinearity. In sum, no multicollinearity was found in this study.

Table 1 Correlation Matrix and Descriptive Statistics of Latent Variables

Latent Variables	AVE	Composite Reliability	Cronbach Alpha	1	2	3	4	5	6
1. HP Loyalty	.64	.97	.96	(.80)					
2. HP Satisfaction	.65	.92	.89	.72***	(.81)				
3. NP Loyalty	.71	.97	.97	.77***	.58***	(.84)			
4. NP Satisfaction	.75	.95	.93	.53***	.64***	.63***	(.86)		
5. Prod Image Gap	.65	.85	.73	-.26***	-.20***	-.27***	-.35***	(.81)	
6. User Image Gap	.64	.84	.73	-.25***	-.18**	-.17**	-.21***	.37***	(.80)

Numbers in brackets are square roots of AVE.

p < .01 (one-tailed). *p < .001 (one-tailed).

Table 2 Correlation of Handset Product Quality Formative Indicators

Indicators	Mean	SD	VIF	1	2	3	4	5	6	7	8
1. Battery	4.73	1.58	1.33	1							
2. Signal	5.61	1.38	1.40	.39***	1						
3. Memory	5.14	1.60	1.54	.23***	.27***	1					
4. Interface	5.45	1.35	1.54	.33***	.30***	.45***	1				
5. Feature	4.93	1.74	1.56	.26***	.30***	.49***	.43***	1			
6. Reliability	5.45	1.65	1.80	.30***	.40***	.18**	.31***	.31***	1		
7. Durability	5.46	1.65	1.88	.39***	.40***	.21***	.34***	.29***	.64***	1	
8. Aesthetics	5.55	1.25	1.37	.19***	.23***	.42***	.40***	.42***	.14***	.21**	1

p < .01 (one-tailed). *p < .001 (one-tailed).

Table 3 Correlation of Network Product Quality Formative Indicators

Indicators	Mean	SD	VIF	1	2	3	4	5	6
1. Signal	5.37	1.34	1.53	1					
2. Transmission	5.41	1.41	1.83	.53***	1				
3. CallDrop	5.87	1.37	1.61	.42***	.52***	1			
4. PutThrough	5.93	1.13	1.71	.46***	.55***	.54***	1		
5. Plan	4.81	1.68	1.47	.24***	.30***	.21***	.23***	1	
6. AddFeature	4.39	1.75	1.41	.08	.20***	.23***	.20***	.51***	1

***p < .001 (one-tailed).

During hypotheses testing, the estimation of second-order factors are implemented by the approach of repeated indicators, which best fits our model since each first-order construct has equal numbers of indicators (Chin *et al.* 2003). To examine moderating effects of product image gap with formative constructs (i.e. product quality) as predictors, we follow a two-step score construction procedure proposed by Chin *et al.* (2003). That is, the interaction term was created by the production of predictor and moderator scores first obtained from the model excluding moderators.

Before analyzing the results for the proposed hypotheses of spillover effects, we first need to establish the classical relationships between quality, customer satisfaction and loyalty within the boundary of the respective operation. In other words, we examine if the quality of the handset affects customer satisfaction with the handset manufacturer, and if customer satisfaction with the handset affects customer loyalty towards the handset manufacturer. The results, shown in the Table 4a, are consistent with the findings from previous studies, showing a clear relationship between handset product quality, customer satisfaction and customer loyalty with handset manufacturer. Similarly, the network operator's product quality is found to be positively affecting network operator's customer satisfaction, in turn which positively affect loyalty with the network operator.

Table 4a Direct Effects

Path	Path Coefficient	SE	T Statistics
HP Prod Quality → HP Satisfaction	.43	.080	5.46***
HP Satisfaction → HP Loyalty	.63	.054	11.77***
NP Prod Quality → NP Satisfaction	.45	.068	6.65***
NP Satisfaction → NP Loyalty	.38	.093	4.11***

Table 4b Hypotheses Testing Results: Spillover Effects

Path	Path Coefficient	SE	T Statistics
H1a. HP Prod Quality → NP Satisfaction	.15	.065	2.32**
H1b. NP Prod Quality → HP Satisfaction	.26	.084	3.11***
H3a. HP Satisfaction → NP Loyalty	.32	.094	3.41***
H3b. NP Satisfaction → HP Loyalty	.10	.062	1.58 [†]

Table 4c Comparison Between Direct and Spillover Effects

No.	Direct Effect vs. Spillover Effect	Path Coefficient	SE	T Statistics
1	HP Prod Quality → HP Satisfaction	.43	.080	2.72**
	HP Prod Quality → NP Satisfaction	.15	.065	
2	HP Satisfaction → HP Loyalty	.63	.054	2.86**
	HP Satisfaction → NP Loyalty	.32	.094	
3	NP Prod Quality → NP Satisfaction	.45	.068	1.76*
	NP Prod Quality → HP Satisfaction	.26	.084	
4	NP Satisfaction → NP Loyalty	.38	.093	2.51**
	NP Satisfaction → HP Loyalty	.10	.062	

Table 4d Asymmetric Characteristics of Spillover Effects

No.	Direct Effects	Path Coefficient	SE	T statistics
1	NP Prod Quality → HP Satisfaction	.26	.084	1.04
	HP Prod Quality → NP Satisfaction	.15	.065	
2	HP Satisfaction → NP Loyalty	.32	.094	1.96*
	NP Satisfaction → HP Loyalty	.10	.062	

Table 4e Hypotheses Testing Results: Moderating Effects

Moderator	Predictor	Dependent Variable	Moderating Coefficient	SE	T statistics
Product Image Gap	H4a. HP Prod Quality	NP Satisfaction	-.09	.065	1.45 [¶]
	H4c. NP Prod Quality	HP Satisfaction	-.09	.066	1.32 [¶]
User Image Gap	H5a. HP Satisfaction	NP Loyalty	-.14	.143	.96
	H5c. NP Satisfaction	HP Loyalty	.02	.087	.27

[¶] p < .1 (one-tailed). *p < .05 (one-tailed). **p < .01 (one-tailed). ***p < .001 (one-tailed).

T statistics are calculated by bootstrapping method with 256 cases and 500 samples.

Overall, these positive results demonstrate the validity of the previous studies and provide us with the basis to test the spillover effects. Table 4b shows the results of the spillover effects hypotheses. Except for H2b and H2a which could not be tested due to insufficient sample size, all the hypotheses on the spillover effects were supported. Comparing Table 4a and Table 4b, one can see that the path coefficients of the direct effects (i.e. within the same company) are much higher than the path coefficients of spillover effects. T-test confirms that all the differences are significant at least at 0.05 level (Table 4c). This is intuitively correct and consistent with previous studies which found strong quality-satisfaction-loyalty relationships in the single-firm setting. More interesting, however, is the comparison between the spillover effects. T-test shows that while there is no significant difference (Table 4d) between the spillover effects from handset quality to network satisfaction and from network quality to handset satisfaction, the spillover from handset satisfaction to network loyalty is significantly higher (Table 4d) than the spillover from network quality to handset loyalty. This suggests that network operator will enjoy greater spillover benefits compare to handset manufacturer in customer loyalty. This resembles the findings of Crosby and Stephens (1987) who found that satisfaction with the core product drives satisfaction with the peripheral services. Although it is debatable whether the handset is the core product and network is the peripheral service in today's 3G era, the sophistication and increasing number of advanced features on a handset may create a perception to the end users that the handset is the core product. The tangibility of the handset and of features like photo taking and music may further enhance this impression.

In contrast, the results of the moderating effects presented in Table 4e are less positive. Although we found partial support for H4a and H4c, we did not find significant support for H5a and H5c. The results means that indeed product image gap moderates the relationships between product quality of the handset and customer satisfaction with network operator, and between product quality of network operator and customer satisfaction with the handset manufacturer. However, user image gap does not moderate the spillover effect from customer satisfaction to customer loyalty (H5a and H5b). One possible reason for this could be due to the measurement items adopted. In this study we adopted the user image gap measurement from Gordon (1991), which is primarily a cognitive perception of the mobile phone users. A recent study by Ross and Friman (2008) shows that customer satisfactions of mobile phone users may comprise a large portion of emotional component. Therefore, this inconsistency between high emotional component of customer satisfaction among mobile phone users and cognitive perception of user image may have contributed to the non-existing moderating effects.

5. Conclusions and Implications

In this study, we hypothesized on and found empirical support to quality and satisfaction spillover effects between handset manufacturers and network operators. This extends the well established quality-satisfaction-loyalty relationships into a multi-firms setting and suggests the presence of halo effects among companies which work closely together in delivering solutions to customers. Therefore, it is necessary for firms who rely heavily on their partners to consider the influence of their partner's quality and customer satisfaction in order to predict customer satisfaction and loyalty with their own company more accurately.

Our study also shows that the spillover effect from product quality to customer satisfaction is moderated by product image gap. That is, the spillover effect is weaker when the product image gap between the two firms is large, and conversely the spillover effect is stronger when the product image gap is small. This is an important finding as it suggests that managers may control or influence the spillover effects, depending whether their firm is stronger or weaker compared to their partner firms.

Our findings have two important implications. First, firms may benefit from the spillover effects, either as the receiving or the giving party. In the former case, a firm with lower product quality may benefit from partnering with a firm with stronger quality because of the spillover effects. However, this benefit can only be realized when the product image gap between the two firms is not large. In other words, managers can choose to invest in improving the product image in order to compensate for the inferior product quality. Firms in a position that causes the spillover effects may demand returns from their weaker partner firms in exchange of the positive spillover effect received.

Second, given that network operator will enjoy greater spillover effects from the handset manufacturer in terms of customer loyalty, they need to pay more consideration to the quality and customer satisfaction with the handset. At the moment, the primary consideration for network operator when choosing which handset to include appears to be financial, as suggested in the case of Apple iPhone (USA Today 2007).

Our findings should be interpreted with several limitations in mind. Firstly, this study takes a cross-sectional perspective rather than a longitudinal perspective. It is believed that by considering the dynamics of the relationships through a longitudinal study (e.g. Mittal *et al.* 1999), more accurate and interesting results would be uncovered. Therefore, it may be useful to conduct surveys at different times of the ownership. However, this can be quite challenging given that many users do not keep the same mobile phone for a long period of time. Such studies can be conducted for other more durable products, such as cars. Product quality, customer satisfaction and loyalty can be measured at different stages, for example, at the beginning of the purchase, and half a year after purchase. This would help to understand the evolving pattern of spillover effects.

Secondly, the survey which provided empirical data to the hypotheses was conducted in Beijing, China. Given that the mobile phone market in China might be different from other countries, particularly countries with more technologically advanced services such as 3G, the findings may not be easily generalizable. More empirical research examining the existence of satisfaction spillovers in mobile industry outside China is required. In addition to the moderating effects observed in our study, other factors such as consumer knowledge (Alba, Hutchinson 1987), which reflects customers' understanding of the product and service, can also affect the satisfaction spillovers. Given that firms are increasingly relying on each other in delivering products and services, there is an urgent need to understand more thoroughly the spillover effects observed in this exploratory study.

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Appendix I. Measurement Items

Product Quality (Source: Garvin 1988.)

Scaling from “strongly disagree (1)” to “strongly agree (7)” on a 7-point scale.

Handset Manufacturer	Network operator
The battery can last for a long time.	It provides wide signal coverage.
It has strong power to send and receive signal.	It has good transmission quality.
It has a large phone memory capacity.	The call drop rate is low.
Its functionality is user friendly (e.g. dialing or SMS).	The put through rate is high.
I like its additional features (e.g. camera, mp3, games, etc).	The talk plan (e.g. free calls/sms, charge per minute, etc.) feeds my needs.
It is seldom broken down.	I like the additional features of talk plan (e.g. loyalty price schemes, etc.)
It can last for a long time.	
I like its design/appearance.	

Customer Satisfaction (Source: Wirtz and Lee 2003.)

Scaling from 1 to 7.

The product / service:

- displeased me ~ pleased me
- contended with ~ disgusted with
- very dissatisfied with ~ very satisfied with
- did a poor job for me - did a good job for me
- poor choice to have..... ~ wise choice to have
- Unhappy with ~ happy with

Customer Loyalty (Source: Harris and Goode 2004.)

Scaling from “strongly disagree (1)” to “strongly agree (7)” on a 7-point scale.

Cognitive Loyalty

- I believe that using the brand is preferable to other brands.
- I believe the brand has the best offer at the moment.
- I believe the products of the brand are well suited to what I like.
- I prefer the service of the brand to the service of competitors.

Affective Loyalty

- I have a positive attitude to the brand.
- I like the brand offering.
- I like the products of the brand.
- I like the services of the brand.

Conative Loyalty

- I have repeatedly found the brand is better than others.
- I nearly always find the offer of the brand superior.
- I have repeated found the products of the brand superior.
- Repeatedly, the services of the brand are superior to that of competitor firms.

Action Loyalty

- I would always continue to choose the brand before others.
- I would always continue to choose the products and services of the brand before others.
- I would always continue to favor offerings of the brand than others.
- I will always choose to use the brand in preference to competitor firms.

Product Image (Source: Gordon 1991.)

Scaling from “strongly disagree (1)” to “strongly agree (7)” on a 7-point scale.

- I believe this brand represents good product and service quality.
- The product and service provided under this brand are highly reputed.
- The quality of the product and service provided under this brand is trustworthy.

User Image (Source: Gordon 1991.)

Scaling from “strongly disagree (1)” to “strongly agree (7)” on a 7-point scale.

- I believe I belong to the type of consumers who would be the most likely buyers/users of this brand.
- I believe the buyers/users of this brand are people like me.
- I believe I fit in the group of consumers who would buy/use this brand.