Environment Versus Partnering Experience: an Exploration of Chinese Healthcare IT Manager Attitudes toward Innovation of Services

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Abstract

This study defines and explores work experience-based constructs influencing IT manager support of remote service innovation. Data from surveys of 808 IT managers in China support the hypothesized model and demonstrate that partnering experience factors impact support attitudes, particularly with regard to the more emergent technology: mobile. Insight from this study can help form better policies and understandings to enable healthcare innovation. Our central question regarding the role of the IT manager as an innovation partner demands greater attention in the IS literature. We believe it will help solve large persistent problems such as how to innovate healthcare service delivery using emerging technologies.

1. Introduction

With the development of mobile technology and broadband internet access, remote healthcare services delivery has been growing quickly worldwide [1]. Remote care can produce comparable results to in-person services, even in services such as recovery after surgery [2]. Remote healthcare can save time, travel expense and reach out to more patients, particularly rural patients of lower means, but only if designed and implemented well [3], [4].

Even in the most socio-economically advantaged countries, such as the US, usage of technology to innovate healthcare runs into many impediments even though billions of dollars have been invested in such systems [5]. One of the key problems faced in implementing healthcare technologies is getting the members of an organization to understand, accept, and value the usage of a new system [6], [7], [8]. Old ways of delivering care persist even in the face of evidence demanding they change, in part due to the difficulty of motivating and enabling changes [9].

The Chinese context offers a very interesting natural laboratory for examining innovation of healthcare through applied technology innovation. A recent op-ed blog article is perhaps the best entry into understanding how healthcare reform in China is going. Leana Wen, a Chinese-born, American-trained MD practicing at leading hospitals in the US spent two months visiting 9 provinces in 2012 exploring the state of the Chinese healthcare reforms. She found a system is in a terrible state of disrepair and lack of care for the poor and even middle class. There was little evidence that privatization had led to innovation and better care [10].

The healthcare system in China has undergone somewhat radical privatization over the past decade, leading to a system in which individual hospitals have more control over their business models and decision rights [11]. Ironically, in the US context, people talk of the importance of privatization in driving innovation, but the balance between government and private roles in care delivery is uncertain and in need of study [12]. Additionally, the application of new technologies in both places is considered a key opportunity for addressing the critical need (lower costs and greater access) for community level health [13].

One chronically neglected role in this puzzle is that of the middle manager [14], particularly the IT manager in healthcare organizations [15], [16]. They are in a key position to oversee and enable successful design and implementation of innovation within their organizations. IS organizational adoption research neglects these participants, instead focusing on top managers/champions and end-users. We propose that IT manager innovation support varies and matters, and researchers and practitioners cannot assume IT managers will automatically be motivated and willing to adopt IT systems to support remote services simply due to mandates. What factors does influence healthcare IT managers to innovate services?

Theories in the field of information systems research suggest key drivers for successful innovation using technologies. Many of these predict individual-level acceptance of technology and have recently been unified [17], yet they explain why an individual will personally use technology, not why they would be willing to implement it for others to use (the general case for IT managers). Other theories focus on

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organizational acceptance of technologies [18] and how they diffuse through whole industries [19]. We believe healthcare technology innovations operate at both of these levels. Individual doctors, patients, and nurses have to be willing and able to use systems. At the same time, there can be huge national programs in place supporting and driving certain types of innovations regardless of whether individuals are willing and able, particularly in the privatized organizations.

These two forces may align or conflict. So far few studies have directly explored the role of IT managers on hospital systems-related innovation, especially with regard to remote services. Our study explores this gap in current literature and theory with an eye to developing better insight into how to influence and enable IT managers in healthcare organizations to be innovation partners in China as well as the US and other contexts.

Using archival data from a representative nationwide survey conducted in China in 2010 of 808 healthcare organizational IT managers, our study examines factors that impact healthcare IT manager attitudes toward successful healthcare technology innovation, with a particular eye to the pressing, current issues of using mobile and Internet technologies.

2. Work context influencing IT managers

Researchers have known for decades that managers need to drive innovation and take on an innovation mindset in order to enable their organizations to survive and thrive [20]. In the design and implementation of innovative technologies, prior research has shown that the role of the IT managers and their support is a critical enabler [21]. While immutable individual characteristics of managers do relate to innovation capability [22], our goal here was to identify formative influences in the work context that would systemically shape IT manager innovation support.

We presumed these factors would be especially useful for policy-makers and top managers targeting increasing innovation support. We find two insights in research that can help explain this kind of variance in healthcare IT manager support for innovating. One focuses on environmental pressures and how they exert themselves. The other focuses on managerial beliefs drawn from personal experience working with innovation partners (vendors).

2.1. Environment

Institutional theory explains that normative, coercive and mimetic pressures are the mechanisms that drive innovation [23]. Implicitly, institutional theory suggests that IT managers will feel these environmental pressures expressed through governmental policies or other specific contextual cues and be motivated to affect change. And, in the area of healthcare, some evidence exists to support the notion that environmental mechanisms from institutional theory are indeed driving technological innovation [24], yet how healthcare IT manager motivations are formed by environmental cues and which types of context most impact remote services innovation intent among these IT managers remains unexamined. For example, why would one healthcare IT manager experience the institutional theory cues substantively differently than another? Certainly, the pressures exerted at the national level should be the same for all IT managers.

Privatization is a key buzzword in discussions of healthcare innovation, even in China [11]. The core idea is that a profit motive would impel organizations to innovate. Based on this theory, IT managers in private hospitals should experience higher environmental pressure to innovate and express it in their support of mobile and Internet service innovation. We believe there would be less normative pressure to innovate in the public hospitals, based on existing economic literature observing privatization in China as a driver of innovation [25].

H1: IT managers in private hospitals will have higher support for mobile and Internet innovation of services.

A second source of environmental pressure on IT managers comes from the institutional value possible from the application of the technology. Mobile-enabled services offer at least two values. They can reach the masses (help with scaling to deal with larger patient populations, especially those who cannot afford a premium for individualized, personal care) and they can reach the far-flung (provide connection to those for whom travel or Internet access is prohibitive). IT managers could potentially support remote service innovation for only one or both of these reasons. In the Chinese context, the ratio of hospitals and doctors to patients is very low [26]. Thus, the institutional pressure to innovate remote services will more likely be due to serving the masses than reaching the far-flung.

H2: Chinese hospital IT managers will support remote service innovation more for reaching the masses than for reaching the far-flung.

The value achieved from remote service innovation will be limited by the ability of patients to access the platforms (mobile or Internet) and understand the basic

concepts of using them. IT managers should take these issues into consideration in deciding on innovations. Some types of healthcare institutions are likely to be more engaged with providing services to patients in larger geographic areas. For example, healthcare systems in the US often include community health centers, local specialty clinics, local hospitals, regional hospitals, and major teaching hospitals that draw from multi-state regions (ie. a tiered hospital network) [27]. While each type of organization may benefit from enabling remote care, the broader the geographic reach of patients being served by an organization, the more we expect that remote healthcare provision would be desirable to the patients (ie. save travel time, be able to have the best care and follow-up without the cost and difficulty of traveling).

In China, we see that mobile technologies have a very distinct adoption patterns in rural (western) versus urban (eastern) provinces. Urban areas have 50-60% Internet penetration and mobile penetration as high as 80%. In the western, more-rural provinces have mobile penetration around 60% versus low Internet technologies penetration where fewer than 6% had personal computers (means for Internet access) in 2010 [28]. This distinct difference should exert a normative pressure on IT managers such that the more rural ones (ie. western China) should feel more favorable toward mobile rather than Internet-based innovation.

H3: IT managers in rural China will support mobile innovation rather than Internet-based remote service innovation.

Researchers have identified that differences between mobile and Internet technology pricing and access can impact relative advantage from services [29]. And, in the case of healthcare, technology affordability may be greater with mobile technology than Internet technology (ie. mobile devices and their service plans tend to be lower than computers and broadband) [30]. Thus, the lower the socio-economic environment surrounding a hospital is, the more value there will be from implementing mobile-based remote healthcare services.

H4: The lower the socio-economic environment surrounding a healthcare organization is, the higher will be the healthcare IT manager's relative support of implementing remote services, especially mobile.

In the combination of environmental pressures facing IT managers, the relative penetration of a given technology should impact his or her decision to use it for innovating. Prior studies in the US healthcare context have shown that normative pressures related to penetration or technologies with network effects like electronic medical records have a threshold effect [31]. A remote services technology relying on an underlying network platform would also display the same characteristics regarding adoption. It would not seem viable or useful at all at very low adoption rates. There would be a middle level of adoption rates at which a threshold judgment concerning adequacy of the network would be important, and finally, adoption would be so high that penetration would no longer be a concern. Since Internet penetration in Chinese urban areas is fairly high (around 50% as of 2010 versus 6% in rural areas [28]) and mobile penetration in rural areas is rising quickly, we expect IT managers to display this u-distribution of concern differentially in rural and urban areas regarding the penetration of mobile and Internet technologies as they consider using them for innovation of remote services.

H5: IT managers will be more concerned with tradeoffs due to technology penetration issues when technology penetration is moderate.

A final environmental pressure is normative and relates to the relative importance of security and privacy of data. Prior research shows that security of data in healthcare settings can be a very high priority. It is not clear that the public can differentiate security and privacy. Security here defines the degree to which data held by a healthcare institution is protected from theft and misuse. Privacy defines the degree to which data are openly available for others to observe and learn.

In some settings, when the public can see a clear public health value to forego privacy and share data, individuals are more willing to share data. We suspect the value on privacy of healthcare data will be culturally dependent, as some cultures, such as China's, are more collective and therefore perhaps more open to sharing information [32]. These effects would impact all healthcare institutions within a general culture, but in China the private hospitals serve a more elite patient pool in general, due to their market position as high-end service providers [33]. Thus, we would expect IT managers in private hospitals to show a higher concern for privacy when innovating remote services.

In China, anecdotal evidence suggests that data security is not a big issue at present [34]. So there may not be any concern among IT managers regarding patient data security unless it related to mobile services. Since 2008, mobile banking is rapidly expanding in China [35] and with that expansion have come rampant payment scams reported among mobile services users in China [36].

H6: Healthcare IT managers in private organizations will have a higher concern for privacy when innovating remote services.

H7: All healthcare IT managers will show a heightened concern for security with regard to innovating mobile services.

2.2. Partnering experience

Managerial beliefs about technologies and their implementation have been shown to influence innovation outcomes [37]. Yet, studies of managerial belief regarding IT innovation seem rare and focused on product rather than IT managers and how they perceive personally using technology [38] or how IT managers need to enable others to transition their beliefs [39] rather than focusing on IT manager attitudes about innovating with an emerging technology. Can we really assume that IT managers uniformly believe in innovating using new technologies? We believe this is a substantial missing discussion in the IS literature concerning organizational innovation.

Literature examining IT manager turnover implies that the attitudes of IT managers and staff impact the capacity of an organization to use technology and innovate [40], [41]. As our interest is in the variance in work experience *as IT managers*, we focus on what sort of experiences they may have had analyzing and implementing remote services in their organizations.

The theory of diffusion of innovations offers way to understand how the environment surrounding a technology differs as healthcare IT managers would experience it. This theory holds that innovations that are perceived as less complex but have higher trialability, relative advantage, observability, and compatibility will be adopted more rapidly than other innovations [42]. Which of these factors would be important and show variance among the experiences of healthcare IT managers considering implementing remote healthcare services using mobile and Internet technologies?

Our fundamental assumption is that IT manager experiences with remote services vendors will help form how they understand the innovation characteristics of remote services. They will not be able to implement mobile and Internet technologies without some sort of vendor assistance. As a result, variance in the characteristics of the vendor experiences they have had will influence their attitudes toward innovating.

Provision of remote healthcare services potentially increases direct patient connections. To the degree this is true about Internet and mobile innovation, observability will be uniformly high (observability refers to the degree that results of the innovation will be obvious to others), because external stakeholders (ie. doctors, nurses, patients) will directly experience the changes. We expect no variance in support attitude due to observability.

Trialability refers to the degree that one can experiment with an innovation. This concept may show some variability based on IT manager experiences with vendors. If the cooperating vendor has greater experience developing and implementing mobile or Internet technologies we can expect the IT manager would receive cues from the vendor (perhaps stories, use-cases, shared ideas of various options) that demonstrate greater trialability. This concept may also be conflated with complexity in that the same cues would likely reduce the IT manager's perceptions of complexity too.

H8a: IT managers working with vendors with higher demonstrated experience implementing mobile technology will have more favorable attitudes toward innovating services using mobile technology.

H8b: IT managers working with vendors with higher demonstrated experience implementing Internet technology will have more favorable attitudes toward innovating services using Internet technology.

The market for technologies enabling remote healthcare provision remains fragmented [3]. Thus, any effort to achieve remote care services will likely require the integration of technologies from multiple vendors. IT managers hopefully realize that the capability to integrate knowledge in improvement projects is a critical enabler of project success [43]. The degree that healthcare IT managers facing the implementation of remote services using Internet and mobile technologies have experiences with multiple vendors in their jobs could indicate experience integrating multiple vendor technologies into their organization's services. We presume such experiences lead to learning how to do such integration, thereby reducing their perception of the complexity of the mobile and Internet technology innovations. They would feel more confident attempting another integration project given more experience and therefore more positive toward innovating, as innovating would likely require more integration of vendor technologies.

H9a: **The more prior experience IT managers have working with multiple technology vendors the more they will positively support using mobile technologies to innovate services in their organizations.**

H9b: **The more prior experience IT managers have working with multiple technology vendors the more they will positively support using Internet technologies to innovate services in their organizations.**

Healthcare IT mangers working in higher tier organizations will be involved in a wider variety of

services. They will also have more distributed patient populations. These factors will converge to indicate a higher relative advantage from innovating remote services. Relative advantage also supports hypotheses eight A and B as the capacity of vendors to demonstrate value of the innovations from prior experiences will likely impact IT manager perceptions of relative advantage.

Compatibility refers to the degree of technology/services fit experienced by healthcare IT managers. The healthcare technology field in China remains highly chaotic and fragmented [33]. As a result, we do not expect systemic compatibility effects at this time.

3. Research Model

Our overall research model focuses on exploring factors that motivate healthcare IT managers to innovate services using mobile and Internet technologies (Figure 1). We have drawn from existing information systems theories to create insight into factors that may differentially influence IT managers in favor or against innovating. The most useful of these theories direct us to think about specific aspects of managerial environments and experiences with vendors that will influence their attitudes. This overall idea is depicted in our research model and addressed in detail in the above section.

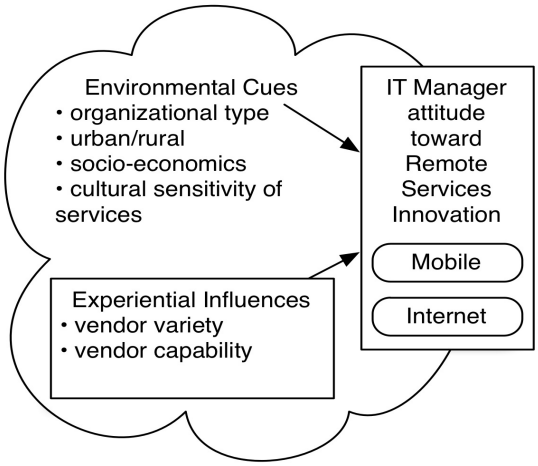

Figure 1 Research Model

To sum up, we believe that environment cues, including organizational type (e.g. private hospital, 3A hospital, women and children hospitals and special hospital), urban/rural location differences, area socio-economics (e.g. GDP) and cultural sensitivity to privacy and security will impact IT manager's attitude on remote service adoption. Additionally, IT manager's previous experiences with Internet or mobile service vendors also exert the impacts.

4. Methods

We conducted this study using archival data from a survey of more than 3000 healthcare workers in China conducted in 2010 by IBM Global Services. The goal of the survey was to investigate the healthcare workers' attitudes towards innovating using mobile and Internet technology and the choice of service vendors. A leading Chinese mobile and Internet services company commissioned the survey. We were assured that the data were collected independently without interference. The questions display no inherent bias we can detect. Within that sample there were 1052 healthcare IT managers with 808 usable responses containing complete data. This sample appeared a reasonable fit for exploring our questions, as it was taken during the middle stage of a national healthcare reform effort in China during which the national government was supporting increased innovation of mobile and Internet usage in services [26].

The sample had been drawn randomly and included hospitals well-representative of the provinces and types of care in China (Table 1). The total population of hospitals in China is 16,997, meaning our sample of 808 provides a low +/-3.36% margin of error. Due to the purpose of the survey,, it held many questions we could apply to examine our hypotheses.

As this was an archival sample, we had no control over the questions asked nor methods of data collection. Instead, we verified with the source company who provided the data to us that they had contracted the third-party company, IBM global service to conduct the survey and that there was neither payment for specific answers nor any intentional marketing bias condition added to the methods of survey delivery. Given the difficulty of collecting a nationwide sample of healthcare IT managers precisely during the implementation stage of a national healthcare reform effort, we considered ourselves fortunate and performed our analysis using this data.

Table 1 Distribution of survey respondents

		Hospital Type					
		3A	Special	Private	Women and Children	Other	Total
Rural Areas	Anhui	6	8	7	3	3	27
	Chongqing	2	2	0	1	3	8
	Gansu	5	6	4	4	3	22
	Guangxi	12	3	5	5	4	29
	Guizhou	2	2	2	2	2	10
	Hainan	4	2	2	1	1	10

	Hebei	16	3	8	1	18	46
	Heilongjiang	12	15	1	1	3	32
	Henan	43	18	25	0	0	86
	Hubei	6	3	2	1	4	16
	Jiangxi	7	4	3	4	0	18
	Jilin	4	6	4	5	3	22
	Neimonggu	7	7	3	4	5	26
	Ningxia	2	0	0	0	1	3
	Qinghai	4	3	3	4	0	14
	Sanxi	9	5	3	6	5	28
	Shanxi	3	2	2	2	1	10
	Sichuang	71	9	0	0	0	80
	Xingjian	25	0	0	0	0	25
	Xizhang	1	0	0	0	0	1
	Yunnan	17	3	0	0	6	26
Sub Total		258	101	74	44	62	539
Urban Areas	Beijing	8	7	7	3	6	31
	Fujian	5	0	5	4	2	16
	Guangdong	14	14	13	13	23	77
	Jiangsu	21	17	6	7	11	62
	Shandong	8	9	6	7	7	37
	Shanghai	2	2	2	1	1	8
	Tianjing	4	3	1	3	2	13
	Zhejiang	14	1	0	2	8	25
Sub Total		76	53	40	40	60	269
Total		334	154	114	84	122	808

We mapped data from the following questions to our constructs to perform our analysis. We added a couple of additional variables developed from alternate sources in order to perform our analysis. These mappings and sources are shown in the appendix.

5. Analysis and discussion

The following table (Table 2) presents the mean of mobile support and Internet support across the four hospital types included in the survey data. Note that 3A hospitals are all public. Special hospitals are a mix of hospitals focused on specific conditions, such as cancer, bones, etc. The 'private' hospitals are all private, and the 'other' category may include public and private hospitals. Thus, we could only use the "3A" and "Private" categories to examine H1.

Table 2 Mean mobile and Internet support by hospital type

Hospital Type	N	Mobile Support	Internet Support
3A hospital (Public)	334	5.875	3.290
Special hospital	154	5.877	3.172
Private	114	6.316	3.509
Women & children hospital	84	5.750	3.571
Other	122	5.926	3.639
Total	808	5.932	3.430

ANOVA test results show the differences on mobile support are significant (P = 0.02) while the differences on Internet support are not significant (P = 0.24) among the hospitals.[1] The private hospitals show a significantly higher level of support for mobile service innovation.

Next we look at H2 and H3. We examine IT managers' attitudes toward mobile and Internet support across the different provinces by checking their population density using two sources of population data. The results are shown in Table 3 and Table 4. In Table 3 we used OLS regression to predict Mobile Support and Internet Support based on population density in the province of the survey respondents. We can see that the only regression that is both significant (P < 0.01) and displays some accounting of variance (r-square = .14) is the rural, mobile support regression, which is positive.

We divided the Table 3 results by urban/rural groupings in order to discern the effects of population density (see appendix for variable definitions). The east/west divide helps control for extraneous effects due to east and west differences other than population density (adoption patterns, education, and socio-economics).

Table 3 Regressions of population density on support in rural/urban areas

	Urban Areas		Rural Areas	
	Mobile Support	Internet Support	Mobile Support	Internet Support
Intercept	-0.02	1.29**	-0.52**	-0.16*
Population Density	-0.02	-0.34**	0.37**	0.00
adj. R square	-0.003	0.11	0.14	-0.00
F test	0.92	0.89	0.00**	1.00

* = P< .05; ** = P < .01

In Table 4, we used the separated data on population and area of provinces to re-run the regressions from Table 3 in order to see if we would be able to differentiate these factors' effects from their population density (population / area) interaction to better understand what underlying factor may be driving the IT manager support attitudes (H2).

Table 4 Regressions of population density components on support in rural/urban areas

	Urban Areas		Rural Areas	
	Mobile Support	Internet Support	Mobile Support	Internet Support
Intercept	0.30*	-0.09	-0.49**	-0.55**
Population	-0.30**	-0.09	0.29**	0.08
Area	0.15	0.31**	-0.11*	0.26**
adj. R square	0.03	0.05	0.12	0.05
F test	0.01**	0.00**	0.00**	0.00**

* = P < .05 and ** = P < .01 throughout this paper.

Again, the rural, mobile support regression shows the most accounting for variance (r-square = .12), though not as high (rural, mobile r-square = .14 in Table 3), suggesting the interaction variable is the best predictor as hypothesized. Now we see evidence that the driver of this effect is the population size in the rural area. Interestingly, though a significant (P < .01) but very small effect (r-square < .05 in both cases), the larger the area served, the higher the Internet support (rural and urban) and lower the mobile support (rural only), perhaps indicating that coverage would be less predictable or complete and that mobile is more associated as a means to provide services to large numbers of patients rather than as a means for accessing the far-flung ones. Internet appears to be more associated with reaching large areas.

H4 predicts how perception of socio-economic conditions may influence IT manager support. This analysis is somewhat confounded with the H3 analysis since the urban areas tend to be more prosperous in China [28]. Thus, before examining the impact of local GDP, we separated our analysis into urban and rural pools of respondents to isolate the urban/rural effects. In table 5, we can see results of hierarchical regressions within the rural/urban sample, accounting for population density (to remove the effect of H1) and provincial GDP. Next we added mobile penetration and Internet penetration variables so that we could analyze H5.

We expected that the relative penetration of the technology in the local area should impact the support attitudes in relation to socio-economics in the following manner. Rural areas are already less wealthy. The data showed GDP had a negative relation to both types of support in the rural areas. Urban results were not clear. The variable or model was insignificant (Table 5, models 2, 5). After accounting for GDP, the tradeoff between mobile (lower costs for users) and Internet (higher costs) should be accentuated to IT managers, such that they will not only favor mobile, it will be in considering mobile support that they will worry about penetration in rural areas. Conversely, in the urban areas, mobile penetration is nearly universal. Internet penetration is already on par to rural mobile penetration and considered within the means of average citizens [28]. Thus, the Internet penetration tradeoff should be a more important concern in urban areas. We see evidence in the data as predicted for the tradeoff effect of penetration considerations for Internet support in urban areas (-.60/.53 betas, additional 2% r-square) versus mobile support in rural areas (.32/-.37 betas, additional 4% r-square).

Table 5 Tests of socio-economic and technology penetration factors in rural/urban areas

	Urban Areas						Rural Areas					
	Mobile Support			Internet Support			Mobile Support			Internet Support		
Model	1	2	3	4	5	6	7	8	9	10	11	12
Intercept	0.02	-0.28	-0.25	1.29**	1.14**	0.79*	-0.52**	0.14	0.99**	-0.15*	1.07**	-0.42**
Population Density	-0.02	-0.23	-0.53 *	-0.34 **	-0.44 **	-0.50 **	0.37 **	0.34 **	0.34 **	0.00	-0.06	0.05
GDP per capita		0.22	0.59 *		-0.11	0.20		-0.16 **	-0.23 **		-0.32 **	-0.45 **
Mobile Penetration			-0.52 *			-0.60 **			0.32 **			0.28 **
Internet Penetration			0.33			0.53 *			-0.37 **			0.04
adj. R Square	0.003	0.001	0.021	0.11	0.11	0.13	0.14	0.16	0.20	0.00	0.10	0.15
F-test	0.70	0.33	0.05*	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	1.00	0.00**	0.00**

Table 6 Tests of mobile and Internet support levels on security and privacy by hospital type

	Security				Privacy			
	3A hospital	Special hospital	Private hospital	Women & children hospital	3A hospital	Special hospital	Private hospital	Women & children hospital
Intercept	-0.13*	0.06	0.19	0.27*	-0.13	0.12	0.20	0.09
Mobile Support	0.17**	0.19*	0.32**	0.251*	0.18**	0.03	0.03	-0.06
Internet Support	0.26**	0.05	-0.16	0.149	0.37**	0.07	0.05	0.27*
Adj. R-Square	0.11	0.03	0.08	0.09	0.17	-0.01	-0.01	0.04
F-test	0.00**	0.03*	0.00**	0.01**	0.00**	0.53	0.79	0.07

The final environment hypotheses relate to privacy (H6) and security (H7) by hospital type (Table 6). We hypothesized that private organizations would have more overall concern for privacy in relation to their

support for innovating remote services. This is not the case in the results, as 3A hospital IT managers showed a consistent, positive concern for privacy the more they supported mobile (.18 beta) and Internet (.37 beta) innovations.

As for security, we expected the concern to be uniformly positive across hospital types regarding mobile innovation support. We see significant, positive relationships supporting this hypothesis across all hospital types.

The experience hypotheses focus specifically on prior experiences innovating with vendors. We used hierarchical regression in these models, because we wanted to account for the environmental effects from H1-H7 prior to looking for variance due to individual experiences with vendors. Next, we added our variables for network service provider market share and network service provider quantity. We see that the addition of these latter variables increased the adjusted r-square in both models (.09 for Internet support and .02 for mobile support; significant, positive betas for each case), supporting the basic notion that IT managers' vendor experiences do influence their Internet/mobile innovation support.

Table 7 Regression of vendor factors on mobile/Internet support

	Internet Support		Mobile Support	
	Model 1	Model 2	Model 3	Model 4
Intercept	-0.83 **	-1.61 *	0.45 **	0.07
GDP per capita	-0.53 *	-0.29 **	-0.45 *	-0.33 **
Population Density	0.16 **	0.02	0.48 **	0.41 **
Mobile Penetration	-0.08	-0.18	0.44 **	0.38 **
Internet Penetration	0.62 **	0.58 **	-0.44 *	-0.44 **
Network Vendor Market Share		0.24 **		0.14 **
Network Vendor Quantity		0.22 **		0.08 *
Adj. R square	0.12	0.21	0.11	0.13
F test	0.00 **	0.00 **	0.00 **	0.00 **

6. Implications and limitations

This study explores the factors influencing IT managers' innovation support. Reviewing our environment effect hypotheses, we see that the majority were supported. Our data suggest private hospitals do lead to greater support for innovation in their IT managers (H1). They support remote service innovation in order to reach the masses rather than the far-flung (H2), and the rural ones do support mobile innovation more (H3). The higher GDP goes, the lower mobile and Internet support goes in rural areas (Table 5, models 8,9,11,12) though the effect in urban areas is not clear (Table 5, models 2,3,4,5 either insignificant or account for very little additional variance) (H4). We see a clear, significant tradeoff effect regarding Internet support in urban areas due to relative penetration of mobile/Internet technology with the expected converse case regarding mobile in rural areas (Table 4 model 6 and 9) (H5). Surprisingly, the public hospitals showed the most concern for privacy (H6), but the concern for security was uniformly positive and significant for mobile as expected (Table 6) (H7).

Our partner experience hypotheses were also supported. Network vendor market share and quality variables each significantly, positively predicted IT manager Internet and mobile innovation of remote services (Table 7) (H8 and H9).

An issue raised in this research relates to how to cultivate an innovation culture and skillset in your IT managers. We see here that the experience with vendors does influence IT manager attitudes about innovation. Those experiences can be shaped and modified over time. Experience working with vendors with larger market share and a variety of vendors may build a manager's capability and confidence with regard to supporting innovation, thereby explaining their positive support for remote service innovation.

As far as we can tell, IS researchers have spent little time studying how to develop and train IT managers. We need more research on what they need to know in order to enable an innovation culture. This is in line with persistent calls from practice for transformation of IT functions into more strategic, innovation partner roles. We believe this research provides insight into how one might begin to analyze an IT workforce for such a transformation. It also gives some insight into key environment knowledge and partner experiences one may want to ensure IT managers have in order to develop them into better strategic partners. We hope this direction will be explored in future research. Perhaps the prior experiences of IT managers as analyzed here would also help explain and differentiate more innovative IT managers from the less innovative ones (in terms of support intent).

There are some limitations to our research. It was conducted in China using archival data. Though the sample is nationally representative and China presents some common characteristics of quickly growing developing countries, the generalization of its insights onto other contexts should proceed with caution. The r-

squares and incremental r-squares presented in our regressions are often small. There are many additional factors out there driving IT manager attitudes toward supporting innovation. We hope this research lead to more exploration of these factors.

7. Conclusion

This study makes three major contributions. First, it prompts the IS community to study IT managers' role as innovation catalysts. We need to be asking how important middle managers are in enabling innovation and how to shape and build their support. Prior research has left these questions neglected.

Second, this study operationalizes the concepts of environmental and partner experiences as dimensional and theoretically derived constructs. These constructs derive from the on-going organizational experiences of IT managers. Prior innovation work has focused on the value of personality characteristics or personal abilities in supporting innovation, we suggest and prove that job experiences can account for a significant effect on innovation support. Given that we used a national sample targeting a domain fraught with widespread technology innovation failure in China and the US, we believe the implications of these insights are highly useful for designing future policy and research devoted to spurring innovation in healthcare domains, particularly with regard to mobile and Internet technology.

8. References

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9. Appendix

Construct	Source
Network Vendor Quantity	Summed index from questions indicating vendors currently used by IT managers for services.
Network Vendor Market Share	Market share data overlaid onto vendors managers report using and summed.
Mobile Support (standardized)	Sum of IT manager responses to 6 questions asking about support for using mobile in different remote service scenarios.
Internet Support (standardized)	Sum of IT manager responses to 6 questions asking about support for using Internet in different remote service scenarios.
Security Concern (standardized)	Summed index from IT manager questions about security concerns.
Privacy Concern (standardized)	Summed index from IT manager questions about privacy concerns.
Rural / Urban	This variable groups hospitals based on the significant mobile/Internet development divide among 8 eastern provinces versus others in China identified in the Blackbook [28]
GDP per Capita	Chinese National Statistics Bureau
Population	Chinese National Statistics Bureau
Area	Chinese National Statistics Bureau
Population Density	Population / Area
Mobile Penetration	Found in the Blackbook [28]
Internet Penetration	China Ministry of Information and Technology official statistics
Hospital Type	Indicated categories listed in source survey data