Next-Generation Strategic Business Model for the U.S. Internet Service Providers:
Rate-Based Internet Subscription

Charles C. Willow, Monmouth University, USA

ABSTRACT

The (information digital) network bandwidth and its usage through Internet subscription, by far, is perhaps the only uni-modal commodity provided to today's consumers at a flat rate. Regardless of his/her actual bandwidth usage, a consumer is charged a uniform subscription fee by the Internet Service Providers (ISP). Meanwhile, the ISPs have a considerable stake in the overall infrastructure which supports the local perimeters of the Internet. This article presents a rigorous statistical analysis with the objective of determining the optimal billing or pricing policy for the ISPs of the U.S. on the basis of the proposed 'variable subscription-rate' business model. Two leading global consumer profiles were selected for data comparison on a cardinal scale; NYC, NY, U.S.A. and Seoul, South Korea. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: *Business Model; Consumer Behavior; Digital Contents; Digital Data Packet; Information Network Bandwidth; Internet Service Provider; Price Elasticity; Price Discrimination; Statistical Input Analysis; Variable Rate Subscription*

INTRODUCTION

The (information digital) network bandwidth and its usage through Internet subscription, by far, is perhaps the only uni-modal commodity provided to today's consumers at a *flat* rate. Regardless of his/her actual bandwidth usage, a consumer is charged a *uniform* subscription fee by the Internet Service Providers (ISP). Meanwhile, the ISPs have a considerable stake in the overall infrastructure which supports the local perimeters of the Internet. Constant upgrades encompassing but not restricted to network infrastructure, servers, proxies, security, middleware, applications software, fault tolerance, redundancy, contingency plans, and even customer service are expected on a daily basis, as the Internet

usage increases geometrically if not exponentially. Moreover, statistics indicate that approximately 10% of the Internet consumers are roughly occupying 90% of the bandwidth at all times (FCC, 2007). In addition, *digital convergence* of household electronic products comprising the voice-phones, video-phones, Internet Protocol Television (IPTV), digital Hi-Definition TV, home networks and automation, and even IP-based refrigerators or washing machines is rapidly reshaping the Internet usage among consumers across the globe. As a consequence, the network bandwidth shortage and even depletion problem is further aggravated.

Early research on 'rate-based' variable Internet subscription fees was performed by the British Telecom (BT), a state-owned organization centrally located in London, U.K. This new business model for the ISP has been actively penetrating most areas of Britain, other than Wales and Scotland (KT, 2006). The success of the business model has brought a number of imitators, with such leaders as South Koreans. The U.K and Korea models have close ties in that most ISPs are State-funded and managed and that they are single-state nation, relative to the U.S. Their differences, however, are yet to be explored.

The purpose of this article is to investigate the *pros* and *cons* of the 'variable-rate' business model by conducting an empirical analysis before its introduction to the U. S. The estimated market – after adoption – is approximately $3.0B annually in the U.S. alone, covering 50 continental States other than Hawaii, Puerto Rico, and Virgin Islands (FCC, 2007).

Unlike their South Korean counterparts, the U.S. Internet Service Providers (ISP) carry major disadvantages:

- Extension of the information network infrastructure which far outsizes that of Korea due to its geographical coverage area.
- Network bandwidth bottleneck problem, often characterized as the 'last-mile problem'. Whereas the population density and congested residential apartments benefit the South Korean ISPs, the reverse is true for the U.S. counterparts. By way of an example, a resolution to a single last-mile problem by using say, fiber optic cable, which may deliver data transfer rate of up to 1.3 Giga bits per second (Gbps) for an apartment complex may enable a Korean ISP to acquire thousands of additional customers. In contrast, as for the U. S. consumers, however, their majority reside in private houses, apart from one another, which eventually may require the ISP to tackle the 'last-mile' problem individually on a per household basis.

The outlined advantages may justify the world's highest Internet penetration among consumers in nations such as Korea and Japan (Park, 2001). Thus, the adoption of partly successful 'variable rate-based' Internet subscription pricing or utility business model of South Korea may not be adequate for the U. S. ISPs. The purpose of this article, however, is to investigate the effectiveness of such adoption (of business model) to the U. S. through empirical analysis. In order to perform a sound comparative statistical analysis, a sound design of experiments is the prerequisite. Therefore, the cardinal scale of comparative data is sought by restricting the sample to be selected in highly dense metropolitans in both nations; Manhattan, or formally NY, NY against Seoul, Korea.

Determination of the optimal pricing policy for such service-oriented commodity as *knowledge* from the Internet may confound both the consumers and ISP, the business entity. Possible ramifications are:

- The consumer does not have sufficiently accurate *a priori* information as to how s/he will be charges or billed for the service s/he seeks to receive from the ISP via the Internet, as opposed to other utility services such as power, energy, traditional entertainment, or even commodities such as food.
- Associated with the aforementioned, the units of billing are unclear to the consumer, and may in fact bring their reluctance if not complete resistance to continued subscription. This clearly indicates that the pricing may be *elastic*, depending on external variables, which motivated the initiation of this research.

This article is comprised of five sections, and is organized as follows. Studies of relevant literature are presented in the following section. The third section focuses statistical input data analysis to validate the samples prior to performing statistical analysis in the fourth section for the proposed price discrimination model. Summary, conclusions, and advice on extensions to this research are contained in the final section.

REVIEW OF LITERATURE

In his confines of proposition, Odlyzko (2004) delivers the rationale behind the ultility- or demand-based business model (Rappa, 2008) for Internet subscription through price discrimination. Indeed, he further suggests in his remarks for future research the possibility of such qualitative incumbents (*i.e.* variables in the business model) such as price fluctuations, elasticity of price itself for a serviced utility, and consumer behavioral characteristics.

Han (2005) explored the correlation between the price and product searches on the Web through a series of statistical hypotheses testing and Analysis of Variance (ANOVA). His conclusion was that there was a marked difference in consumer behavioral patterns between the traditional and electronic markets. The rational consumer in traditional market did not necessarily continue his/her behavior in the e-Market.

Porter & Donthu (2006) studied consumer acceptance for technology and in particular, the Internet. Some clear patterns were obtained relative to the demographics data by incorporating the enhanced Technology Acceptance Model (TAM). Factors such as age, income level, education, and race were associated differentially with beliefs about the Internet. In effect, the authors (Porter & Donthu, 2006) conjecture that these beliefs influence a consumer's attitude toward and the use of the Internet, based on their Chi-Square (χ^2) goodness-of-fit tests.

Roycroft & Anantho (2003) report on the demographics of Internet subscription in the African continent. Proposed models of this article may be extended to include future global consumers of the Internet.

A reliable and tolerant, yet secure digital information network is critical, should ISPs seek the proposed 'variable-rate subscription' policy of this article strategically. A middleware dedicated to providing a seamless connection with the application-layer network protocol was suggested by Sousa

and Freitas (1998). Network node tolerance to better locate the faulty connections caused primarily by inoperable devices is delineated in Horneffer (1998). Simulation studies of this location detecting techniques and its extension with Genetic Algorithm were sought by Luo *et al.* (2004). Wills *et al.* (1998) seek to tackle this tolerance problem by a preventative means. By far, according to them, the design of a network at the outset of its construction outperforms any known mechanism or method for managing a fault-tolerant network. A comprehensive design method, such as the Integrated Systems Design Methodology (ISDM), developed by Willow (2007*b*) may be employed. Further, the ISDM may be applied to a wide array of problems associated with Information Systems and Technology (IST), as described in Willow (2007*a*).

Critical mass provides the ISPs with maximized profit, and is reached only when the demands of consumers are met continuously. Internet subscribers demand a variety of digital contents through an integrated, reliable, and ubiquitous access to the ISP network. Target market segments encompass but are never limited to medical imaging, its compression, and even telemedicine (Choong *et al*., 2007), multimedia (Hanaro Telecom, 2007), legal boundaries of the Peer-to-Peer networking (P2P) (Banerjee *et al*., 2008; Viswanathan, 2007), and/or live broadcasts (Sorte *et al*., 2008).

INPUT DATA ANALYSIS

Thus far, a common practice related to statistical data analyses has been associated with over-emphasis on output data exclusively (*i.e.* verification tests). To the contrary, however, the key to ensure success for empirical studies lies in accurate *input* data analysis. That is, the procedures governing the sample data collected as to why and how they fit into the scope of the research, ensued by rigorous statistical analysis must be completed prior to making any immature and at times incomplete conclusions. Unfortunately, the majority of empirical research to date still relies on simple deliberations provided by automated software such as SAS and/or SPSS/GPSS without a clear illustration why such a sample was selected and how. This indispensable procedure in statistical analysis, often referred to as the 'Input Analysis' or 'Validation Tests' should be sought to increase the cogency of the research. In essence, whereas the verification test alone may be regarded as the necessary condition for a successful empirical study, it is the validation test which provides the sufficient condition, its integrity.

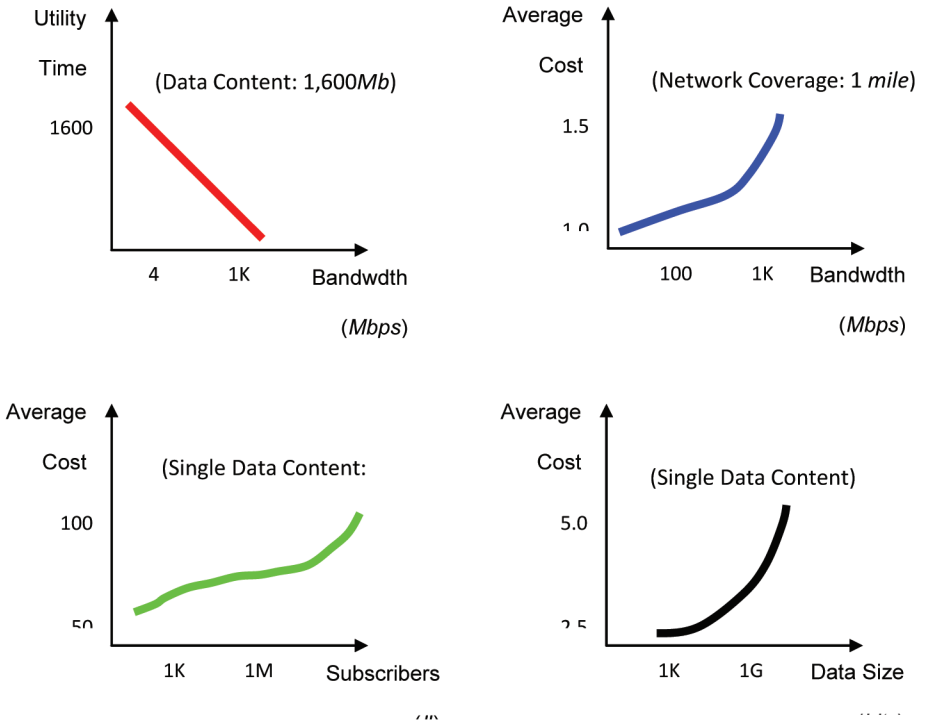
Units of price discrimination for Internet subscription may be inconsistent and at times, dubious, as emphasized in section I. Arguably, usage time, similar to 'air time' for cell phones, may be a possibility. However, digital contents vary widely in data size measured in bits, and consumer utility time may well distort the pricing policy. For example, a single two-minute High Definition (HD) digital movie, which averages 200 Mega Bytes (MB), is equivalent to 1,600 Mega bits (Mb) or alternatively 1.6 Giga bits (Gb), assuming a 8-bit Byte. This translates to a transfer speed of approximately one second over a fiber-optic network, whereas for the Asymmetrical Digital Subscriber Line (ADSL) on Plain Old Telephone System (POTS) network, up to 400 seconds or as much as 7 minutes of download. To this end, the ISPs may not introduce price

discrimination on utility time alone, unless comparable performance of their network infrastructure (*viz*. bandwidth) is available to every subscriber.

Another conflicting yet compelling factor, which may be unpredictable if not completely random, is the resource capacity of the ISP. That is, the information as to which customer may occupy how much bandwidth as a result of being serviced with which type of digital content at a certain time instant is completely stochastic in nature. In essence, utility time of the Internet produced by each subscriber, coupled with his/her desired digital content, as well as the total number and the variety of the content heavily influence both the capacity and performance of the ISP network resource. When the maximum capacity of the (ISP) network bandwidth is reached, other customers may be denied service, similar to the traffic congestion on major motor vehicle highways. However, the financial budge limitation on information infrastructural improvement may not always allow the ISP to increase its network bandwidth constantly to meet the subscriber demands. These resource constraints precisely dictate the problems of most ISPs of the U. S., which support the rationale for the proposed 'variable-rate price discrimination' model of this article. Figure 1 follows to illustrate these correlations based on the data provided by the FCC (2007). Note the depiction is not calibrated to scale.

A series of hypothesis tests were completed to *validate* the design of experiment, and thus the input data prior to (experiment)

Figure 1. Correlation of resource constraining variables



sampling. In essence, the input data analysis is analogous to a pilot run of statistical sampling for the entire empirical experiment. Section III.1 follows to illustrate.

Hypotheses

Both Korea Telecomm (2006) and Hanaro (2007) of South Korea report a clear and consistent pattern of acceptance for price discrimination among Information Technology (IT) professionals. Thus, an assumption is made in this article to restrict the demographics samples to be chosen to IT professionals. IT professionals were defined as those who engage more than 4 hours a day in networked applications software, middleware, and/or hardware (Korea Telecomm, 2006).

A total of three consumer behavioral attributes, derived from Figure 1 above, were selected for the tests:

H1: *IT-savvy professionals are willing to pay more for the digital content they desire, regardless of their physical location for the ISP service. That is, given the flexibility in logistics (viz. roaming), they are not reluctant to the idea of subscribing to digital contents with price discrimination.*

H2: *IT professionals are willing to accept variable rate pricing for different digital content of the same type, regardless of the utility time. For instance, they are willing to pay more for a digital movie A (60-minute running time), compared with movie B (120-minute running time), provided that they could watch it online without interruptions. Notice the online running time depends on the technical parameter, bits of the data content, as opposed to its analog counterpart, which is the actual movie running time designed by the movie producers and/or studios.*

H3: *IT professionals are willing to accept variable rate pricing for digital content of different types, regardless of the utility time. For example, they opt to assign higher priority to a digital movie A (120-minute running time) than a piece of digital audio such as a major hit song β (5-minute running time), provided that they could watch or listen to it online without interruptions. Note again the online running time depends on the technical parameter, bits of the data content. It is highly affected by the attributes of the original data content (i.e. knowledge) such as (analog) resolution, 3-D images, Virtual Reality (VR), stereo, dolby systems, or super woofer, among others, as well as technical attributes encompassing analog-to-digital conversion, digital resolution, etc.*

Pilot Sampling

IT professionals, as discussed in the previous section, were classified into three categories relative to their duties; managerial, development, and support. Measurement was then carried out based on the IT architecture; software, middleware, and hardware. To achieve the cardinal scale for data comparability, not less than 20 but no more than 35 individuals from each IT category and job-duty class were selected for the sample. In effect, a randomized *stratified cluster sampling* was completed to maximize the statistical soundness for the design of experiment. Clusters of the sample were the IT category, whereas the strata were the job duties of the IT professionals. Demographics were limited to Korea Telecom (KT), Korea and Cisco, Inc. of NY. Table 1 summarizes the pilot

sampling for NYC, NY, USA and Seoul, Korea for the three hypotheses.

Table 1 clearly indicates data distortion even at the pilot-experiment level, and indeed serves the purpose of this input data analysis. Both hypotheses, H-1 and H-2, are therefore, rejected without further statistical analysis. With the acceptance of H-3 exclusively, χ^2tests, followed by its Analysis of Variance (ANOVA) are sought in section IV.

STATISTICAL ANALYSIS

Once the design of empirical experiment is validated with the input data analysis, successful pilot experiment is extended to incorporate the entire data necessary to complete the experiment. Therefore, the stratified cluster sampling to test the hypothesis H-3, delineated in section III.2, is extended to its full scale. The sample size is now increased to 50 (for each stratified cluster), with data listed in Table 2.

The Chi-Square (χ^2) goodness-of-fit tests are particularly effective in cases in which the demographic characteristics are suspected to be contaminating each other (Law, 2007; Han, 2005). Note the major statistical demographics data for H-3 are the IT architectural tier and the job-duty category for the IT professionals. In order to ensure their fit to the Normal Distribution at both the 95% and 99% confidence levels, the following parameters are observed:

Table 1. Input data analysis for hypotheses [unit: frequency]

H-1	NYC, NY, USA			Seoul, Korea		
	Software	Middleware	Hardware	Software	Middleware	Hardware
Managerial	16	12	9	30	20	14
Development	32	28	5	35	35	10
Support	30	2	20	27	0	9

H-2	NYC, NY, USA			Seoul, Korea		
	Software	Middleware	Hardware	Software	Middleware	Hardware
Managerial	33	28	18	2	7	3
Development	28	28	11	4	1	1
Support	19	18	6	0	0	0

H-3	NYC, NY, USA			Seoul, Korea		
	Software	Middleware	Hardware	Software	Middleware	Hardware
Managerial	16	27	30	30	29	35
Development	32	28	34	35	35	26
Support	30	21	22	27	30	30

Table 2. Sampled data for hypothesis H-3 (unit: %)

H-3	NYC, NY, USA			Seoul, Korea		
	Software	Middleware	Hardware	Software	Middleware	Hardware
Managerial	82.8	84.1	90.7	94.6	92.1	95.8
Development	91.0	97.5	98.2	98.9	99.0	99.2
Support	89.8	68.6	52.4	93.4	90.3	99.2

$n = 150$;
Degree of Freedom = (# clusters) – (# estimated parameters of the Normal Distribution)
= 3 – 2
= 1
χ^2 0.95, 1= 3.841; χ^2 0.9, 1= 6.635

Test statistic, $\boldsymbol{X}^2$ values follow, and are summarized in Table 3.

A considerable lack of fit to the Normal distribution at both the 95% and 99% confidence levels were observed, to be statistically conservative. In fact, H-3 may be accepted only for those IT professionals of South Korea for this particular empirical study. Table 3 indicates that H-3 may hold for the following groups: IT software and hardware persons, management, and the development professionals.

The following statistical conclusion may be drawn from the results:

1. The U.S. ISPs should seek alternative price discrimination strategies to their South Korean counterparts', based on their own customer demographics. Further, they are advised to research the differences in their market with the premise that *localization* strategy is the key to adopting 'variable-rate' subscription policy in the U. S. market.
2. Future research should be pursued to identify the possible correlation between the *data-content* consumer groups and *utility-time* groups. As the U. S. population is educated to become more IT-savvy in general, subscriber behavioral patterns may alternate drastically, and the possibility to accept an optimal discriminant pricing policy offered by the ISPs may become the reality for the management in the near future.

Table 3. Chi-square statistic values for strata and clusters

χ^2	NYC, NY USA			Seoul, Korea		
Cluster: *IT arch*	4.43	14.46	24.57	**2.89**	4.59	**1.96**
Strata: *Job Duty*	4.24	3.97	18.76	**1.89**	**0.15**	4.52

CONCLUSION

A complete iteration of a statistically sound empirical study was conducted in this article, with the objective of performing a comparative analysis. The 'variable-rate' subscription for the Internet with price discrimination was tested and compared between the data of the USAnd South Korea.

An input data analysis to complete a pilot run of the statistical analysis was presented to achieve the cogency of this article, followed by a full-scale data analysis. Stratified cluster sampling was utilized to maintain the statistical soundness of the study, while comparable markets were selected as the sample space (*i.e*. NY, NY, USA *vs* Seoul, Korea). The Chi-Square (χ^2) goodness-of-fit tests were applied to the hypotheses constructed in this article. Results indicate it may yet be too early for the U. S. ISPs to introduce price discrimination to the market.

Future research may be pursued in two major directions:

- Optimal price discrimination strategy should be sought for each market segment that is of interest to the management of ISPs.
- Accurate correlation study between the transfer rate of the network, size of the digital data contents, types of the data contents, and consumer behaviors on the Internet should be the impetus for future extensions to this article.

ACKNOWLEDGMENT

This article was funded by the 2007 Business Council Research Grant from the School of Business Administration, Monmouth University, West Long Branch, NJ 07764-1898, USA.

The author is indebted to his colleagues, Drs. Robert Scott Jr. and Edward Christensen for their time and thoughtful insights during *ad hoc* research gatherings. In addition, the author wishes to extend his gratification to the anonymous reviewers for their time, assistance, and patience.

As always, this article is dedicated to his little precocious son, Ocean D. Willow.

REFERENCES

Banerjee, A., Faloutsos, M., & Bhuyan, L. (2008). The P2P War: Someone is Monitoring your Activities. *Computer Networks*, *52*(6), 1272-1280.

Choong, M. K., Logeswaran, R., & Bister, M. (2007). Cost-effective Handling of Digital Medical Images in the Telemedicine Environment. *International Journal of Medical Informatics*, *76*(9), 646-654.

Federal Communications Commission (2007). *Statistical Reports and FCC State-Link*. Retrieved May 1, 2007

Han, T. (2005). Exploring Price and Product Information Search in e-Market. In *Proceedings of the International Conference on Information Technology* (pp. 397-402). Las Vegas, NV, U.S.A.: IEEE Computer Society Press.

Hanaro Telecom (2007). *Multi-bell and Various Value Added Services.* Retrieved July 7, 2007, from http://www.hanaro.com/eng/iproduct/home.asp

Horneffer, M. (1998). Methods for performance-analysis of internet access points. *Computer Networks and ISDN Systems*, *30*(16), 1607-1615.

Korea Telecomm (2006). *Consumer Demographics White Pages*. Retrieved July 20, 2006,

Law, A. (2007). *Simulation Modeling and Analysis* (4 ed.). McGraw-Hill Publishing.

Luo, S., Kezunovic, M., & Sevick, D. R. (2004). Locating Faults in the Transmission Network using Sparse Field Measurements, Simulation Data, and Genetic Algorithm. *Electric Power Systems Research*, *71*(2), 169-177.

Odlyzko, A. (2004). The Evolution of Price Discrimination in the Transportation and its Implications for the Internet. *Review of Network Economics*, *3*(3), 323-346.

Park, K. A. (2001). Development of ICT Indicators of Korea. *2001 Annual Government Statistics Report*, Tokyo, Japan. Retrieved June 1, 2007, from http://www.stat.go.jp/English/info/meetings/iaos/pdf/park.pdf .

Porter, C. E., & Donthu, N. (2006). Using the Technology Acceptance Model to explain how Attitudes determine Internet Usage: The role of Perceived Access Barriers and Demographics. *Journal of Business Research*, *59*(9), 999-1007.

Rappa, M. (2008). Business Models on the Web. *Managing the Digital Enterprise*, *Lesson 5*. Retrieved January 9, 2008

Roycroft, T. R., & Anantho, S. (2003). Internet subscription in Africa: Policy for a Dual Digital Divide. *Telecommunications Policy*, *27*(1), 61-74.

Sorte, D. D., Femminella, M., & Reali, G. (2008). QoS-enabled Multicast for delivering Live Events in a Digital Cinema scenario. *Journal of Network and Computer Applications*.

Sousa, P., & Freitas, V. (1998). A Framework for the Development of Tolerant Real-Time Applications. *Computer Networks and ISDN Systems*, *30*(16), 1531-1541.

Viswanathan, V. (2007). Information Hiding in Wave Files through Frequency Domain. *Applied Mathematics and Computation*.

Wills, C. E., Brown, D. C., Dunskus, B. V., & Kemble, J. (1998). Evaluating Network Serviceability. *Computer Networks and ISDN Systems*, *30*(24), 2283-2291.

Willow, C. C. (2007*a*). Comprehensive Design for Information Systems with Integrated Systems Design Methodology. *International Journal of Taiwan Academy of Business Management Review*, *3*(1), 49-72.

Willow, C. C. (2007*b*). Qualitative Decision Making with Integrated Systems Design Methodology. *Journal of Engineering Management and Technology*, *24*(3), 262-282.

Charles Willow, PhD, is a professor of management information systems (MIS) and Management of Technology (MOT) in the School of Business Administration at the Monmouth University, West Long Branch, New Jersey, USA. As an engineer-and-computer-scientist-turned-management-faculty, Dr. Willow's research agenda has been extensive, ranging from information systems development to case-driven strategic management issues, systems engineering, and operations research. His current research interests include information systems and network security, neural network applications, intelligent software agents, databases, computer-generated graphics, cost-model analysis of Internet-based business, and strategic management of technology. Dr. Willow's papers have appeared in journals such as ACM Transactions on Information Systems, Journal of Intelligent Manufacturing, IEEE Transactions on Systems, Man, and Cybernetics, Springer Lecture Notes on Computer Science, International Journal of Intelligent Information Technologies, and the Journal of Engineering and Technology Management*, among others. He is a member of the IEEE Computer Society, ACM, INFORMS Computing Society, Association of Information Systems, and the National Society of Professional Engineers (NSPE). At present, Dr. Willow is on the editorial board for the Journal of Management Information Systems (JMIS), MIS Quarterly (MISQ), and Information Systems Research (ISR). Outside academia, he has been an active member of the International Simultaneous Interpreters Society (ISIS) and the International Judo Federation (IJF).*