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INVESTIGATING THE EVOLUTION OF HOTEL INTERNET ADOPTION

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This article draws upon Diffusion of Innovations and Configurational theories to investigate how website features and email responses by 200 Swiss hotels reflect evolving Internet adoption. Complementary multivariate and artificial neural network (ANN) techniques support classifying the hotels into three clusters based on their website features. These clusters and the results of a structural equation model confirm that Internet adoption evolves from static to dynamic use, as organizations add website features and provide quality responses to customer emails. Practically, differences among these clusters suggest caution in adopting some website features. Academically, the study extends diffusion research and introduces metrics, particularly domain name age and quality email responses, for future research of organizational Internet adoption. Finally, the study illustrates how ANNs complement and help overcome limitations of multivariate techniques.

Key words: Organizational diffusion of innovations; Configurational theory; Internet; Website evaluation; Domain names; Artificial neural networks

Introduction

Individuals and organizations often assume innovations are good and embrace technology. The Internet, for example, should lower labor, distribution, and marketing costs while increasing sales and service quality. Poor implementation and unintended consequences of overhyped technologies, however, offset the fabled technology benefits or even backfire (Brown & Duguid, 2000; Fidler, 1997; Tenner, 1996).

The saga of Internet venture Boo.com exemplifies a company that failed by embracing cutting-edge technology (Stockport, Kunnath, & Sedick, 2001). Despite Boo.com's demise and many other dot.com disasters (Mahajan, Srinivasan, & Wind, 2002), companies no longer question going online but rather how to leverage their online presence (Porter, 2001). Of those industries surging online, travel leads other service industries in its share of e-commerce (Dinlersoz & Hernández-Murillo, 2005). Yet questions about better Internet use remain, such as what Internet technologies tourism operators should adopt, how to apply these technologies to business activities, and what theories help explain and predict their successful adoption.

Internet use evolves, often beginning with an email address, progressing to simple websites and then adding website features to integrate the business with customers and suppliers (Beatty, Hsim,

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& Jones, 2001; Doolin, Burgess, & Cooper, 2002; Hanson, 2000; Teo & Pian, 2003). In addition to implementing the seemingly simple Internet tool of email, businesses face myriad decisions related to choosing and implementing web-based business processes (Dinlersoz & Hernández-Murillo, 2005).

A comprehensive review of about two dozen studies examining website use in the hospitality and tourism industry concludes that the art is not yet stated (Morrison, Taylor, & Douglas, 2004). In addition to a lack of standard evaluation perspectives and measures, "websites are in a constant state of evolution" and few studies take a longitudinal approach (Morrison et al., 2004, p. 243). This shortcoming highlights a key point in studying organizational diffusion: technology adoption is an evolving process rather than a yes/no process (Rogers, 1995). Finally, most studies examine only websites rather than both website and email use in successful Internet adoption (Murphy, Olaru, Schegg, & Frey, 2003).

This article addresses three questions related to successful Internet adoption. How do websites evolve in their use of website features? Does domain name age reflect evolving Internet adoption? Finally, what organizational characteristics and website features lead to successful Internet implementation, as reflected by proper email responses?

The ensuing literature review discusses how diffusion and configurational theories help explain organizational Internet adoption. The methodology and explanation of the independent and dependent variables then follow. Next, the results draw upon complementary multivariate and artificial neural network techniques to support evolving Internet adoption. The article closes with implications, limitations, and directions for future research.

Literature Review

Diffusion of Innovations

Research of innovations such as the telephone, radio, and television shows remarkable similarities. Society misuses and overestimates emerging technologies' short-run influence and underestimates their long-run effects (Brown & Duguid, 2000; Fidler, 1997; Rogers, 1995). For example, the media touted paperless offices as inevitable thanks to computers and email, but today's paperless office has more paper (Liu & Stork, 2000; Tenner, 1996).

Diffusion research shows similarities in how organizations adopt technologies (Damanpour, 1991; Wolfe, 1994). Leader characteristics and internal/external structure influence organizational innovativeness (Abrahamson & Rosenkopf, 1993; Fichman, 2000; Rogers, 1995; Srinivasan, Lilien, & Rangaswamy, 2002). Unlike a yes/no decision with individual adoption of innovations, organizational adoption ranges from awareness of an innovation to successful infusion of the innovation within the organization's work systems (Cooper & Zmud, 1990; Raho, Belohlav, & Fiedler, 1987; Wolfe, 1994).

Rather than business logic, fear of being different or performing below average can pressure organizations to adopt technologies (Abrahamson & Rosenkopf, 1993; Fichman, 2000; Rogers, 1995; Srinivasan et al., 2002). These bandwagon effects also drive businesses to adopt the Internet (Beatty et al., 2001; McBride, 1997; Murphy, Olaru et al., 2003). For example, small- to medium-sized Australian businesses rapidly adopted the Internet—perceiving it as unavoidable—but their adoption often had little relationship to their business strategy (Soutar, Allen, & Long, 2000).

Bandwagon effects can lead to gaps in assimilating the innovation (Fichman, 2000; Fichman & Kemerer, 1999), such as poor replies to customer emails. Not replying or not following basic business communication principles in the reply suggest poor infusion of email technology within the organization (Nguyen, Murphy, & Olaru, 2003). In line with organizational diffusion research, studies using email responses to reflect Internet adoption found that larger organizations provided better email responses—polite, personal, prompt, professional, and promotional—than smaller ones (Murphy & Gomes, 2003; Murphy & Tan, 2003; Nguyen et al., 2003; Schegg, Murphy, & Leuenberger, 2003). Few Internet adoption models, however, include email responses.

A business-to-business model proposes five stages of Internet adoption: an email address, basic website, website features to encourage prospecting, sales and secure online ordering, and supplier features (Teo & Pian, 2003). A business-to-consumer website model proposes three stages, providing:

information, interactivity, and personalization (Doolin et al., 2002; Hanson, 2000). Hotels, for example, could begin with an email address and basic room and contact information on their website. As their use evolves, hotels could add interactive website features such as language choices or brochure requests and establish email reply policies. Next the sites would add personalization such as online booking and payment. As noted earlier, hotels must infuse the innovations—website features and email—into their work systems.

Diffusion research suggests that branded domain names relate to a measure of infusion and quality email replies (Murphy & Gomes, 2003; Murphy & Tan, 2003; Nguyen et al., 2003). Hotel ABC, for example, could have the branded hotelabc.com, or no domain branding with members.aol.com/~hotelabc. Similarly, Hotel ABC could have a free hotelabc@hotmail.com Hotmail email address or the domain-branded reservations@hotelabc.com. Use of branded domain names, which are easy to recall and enhance online trust (Hanson, 2000; Ries & Ries, 2000), relates positively to organizational size (Murphy, Raffa, & Mizerski, 2003).

Research using domain name age as a temporal measure of adoption showed a positive relationship between domain name age and an organization's technology budget, Internet initiatives, and network prominence (Gosain & Faraj, 2001). Although Murphy, Olaru et al. (2003) found that domain branding related to website features and quality email responses, they failed to examine a temporal aspect of domain names—age—in order to model evolving Internet adoption. This study uses their database to help address a shortcoming of many hospitality and tourism website studies, the evolution of websites (Morrison et al., 2004).

Conceptual Development

Consistent with organizational diffusion (Damanpour, 1991; Rogers, 1995; Wolfe, 1994), larger, affiliated, and higher rated hotels lead the adoption of website features and quality email responses (Gherissi-Labben, Schegg, & Murphy, 2003; Schegg et al., 2003; Schegg, Steiner, Frey, & Murphy, 2002; Siguaw, Enz, & Namiasivayam, 2000; Wei, Ruys, van Hoof, & Combrink, 2001). Although these studies do not address evolving Internet adoption, the same organizational characteristics relate to a temporal adoption measure: domain name registration dates. Analyzing almost 3000 names registered by Swiss hotels in the .ch domain, Scaglione, Schegg, Steiner, and Murphy (2004) found that larger, affiliated, and higher rated hotels adopted this Internet technology earlier than their smaller, lesser rated, and nonaffiliated competitors.

Research suggests that websites add more features as they evolve (Doolin et al., 2002; Hanson, 2000; Teo & Pian, 2003). In addition to more website features, quality responses to customer emails reflect evolving Internet adoption by infusing email into business processes. As domain name registration dates reflect a time of Internet adoption, an organization's domain name age should relate to its presence of website features and quality email responses.

Proposition 1. There is a positive relationship between the presence of website features and the website's domain name age.

Proposition 2. There is a positive relationship between the quality of email replies and that website's domain name age.

A stream of management research argues that organizational form, or configuration, relates to success (Miller, 1996). Configurational theory, which posits that organizations cluster on dimensions such as strategy, innovations, and technology, may help explain evolving Internet adoption. For example, chain hotels that applied a particular organizational form—consistent naming—were more successful than chain hotels using local names (Ingram, 1996).

Configurational theory uses two equally valuable and complementary methods to represent organizational configurations: typologies based on conceptual development and taxonomies based on empirical results such as cluster analysis (Meyer, Tsui, & Hinings, 1993; Miller, 1996). Thus, one could configure hotels' Internet adoption based on conceptual development such as evolving Internet use, or a cluster analysis of website features.

How a dimension such as technology relates to organizational performance depends on how organizations cluster on that dimension (Meyer et al.,

1993; Miller, 1996; Whittington, Pettigrew, Peck, Fenton, & Conyon, 1999). Websites clustered on the presence of website features should reflect evolving Internet use, measured through domain name age and quality email replies.

Proposition 3. Hotel clusters based on the presence of website features will show a positive correlation with the presence of features and hotel domain name age.

Proposition 4. Hotel clusters based on the presence of website features will show a positive correlation with hotel email response quality.

The Study

The data stemmed from a Swiss study of hotel website features and email responses (Murphy, Olaru et al., 2003). Switzerland's four linguistic regions and many small- to medium-sized properties ensure a range of websites to examine. Their study drew a random sample of 200 hotels, stratified across hotel category, size, linguistic region, and geographic location. The sample comprised 53% three-star hotels, 25% four- to five-star hotels, and 22% one- to two-star hotels, had an average of 34 rooms, and one out of two hotels was in the Germanic part of Switzerland. Via a content analysis, the authors noted 30 website features categorized across four loyalty dimensions: customer service, database communication, creating value, and trust.

Each hotel's response to a short email asking about a room for two adults and two children over the upcoming Easter weekend was used to gauge email quality. Traditional (Ober, 2001) and online (Murphy & Gomes, 2003; Murphy & Tan, 2003; Strauss & Hill, 2001; Yang & Jun, 2002) business communication literature yielded nine binary measures of quality email replies. Did the hotel reply; reply in less than 24 hours; answer the questions; thank guests for their interest; address guests politely and personally; and include the hotel's identity and electronic receptionist's identity? Finally, as the guest corresponded in English, did the hotel reply in English?

Third-party databases provided a temporal adoption measure, the registration dates for Swiss .ch (www.switch.ch/search/whois_form.html) and global .com (www.uwhois.com) domain names. The 1999 introduction of competing registrars for global domains limits collecting their age to names registered before July 1999 (see www.icann.org for the evolution of domain name registries). Although companies may register multiple domain names for the same business (Murphy, Raffa et al., 2003), to standardize the analysis this study used the age of the domain name hosting the website.

Results

Domain Name Age

Changes in domain registries, expired domain names, and regions hosting hotel websites (i.e., the Zermatt and Leukerbad areas hosting zermatt.ch/zermatterhof or leukerbad.ch/astoria) limited gathering the domain name age to 172 of the 200 hotels. Domain name age for these 172 hotels ranged from 49 to 1907 days, and averaged 815 days (see Table 1).

As the results in Table 1 show, chain and higher rated hotels registered their domain name significantly earlier than independent and lower rated hotels. The number of rooms also showed a significant positive correlation ($r = 0.304$, $p < 0.001$) with domain name age. Similar to other research of hotel technology adoption (Schegg et al., 2002; Siguaw et al., 2000; Wei et al., 2001), large, luxury, chain hotels were the avant grade, with domain names significantly older than small, budget, independent hotels.

Website Features

Almost all hotels (95%) had three features—hotel facility information, room rates, and site nav-

Table 1
Hotel Characteristics and Domain Name Age ($n = 172$ Websites With a Valid Domain Name Age)

	Number of Hotels	Avg. Domain Name Age	ANOVA *F* Value	*p*
Affiliation				
Affiliated	33	1005	10.077	0.002
Nonaffiliated	139	770		
Category				
One to two stars	37	664	23.545	<0.001
Three stars	92	729		
Five stars	43	1128		
Total	172	815		

igation tools—corresponding with an early website stage, *providing information*. Many hotels (>50%) went beyond basic information and offered *interactivity* such as brochure requests or language options. Few hotel websites (<3%) offered three advanced features—reservation support, permission-based marketing, and online surveys—corresponding with an advanced website stage of *personalization*. Given the lack of discrimination of these six features, subsequent analysis used the remaining 24 features.

Website Features and Domain Name Age

Table 2 ranks the presence of these 24 features and the domain name age for sites with and without the feature. The results of a Pearson correlation show a significant negative correlation ($r = -0.591$, $p = 0.001$) between the percentage of sites using a feature and domain name age. The less prominent a feature, the older the domain name for sites with that feature.

Furthermore, a one-way univariate ANOVA test (given unequal cell sizes and a small sample, we assessed one factor at a time) showed that for 10 features, sites with the feature had a significantly older domain name than sites without the feature (see bold rows in Table 2). These 10 features aligned with *interactive* (viral marketing and download/print document) and *personalized* (e.g., cancel booking) websites. The results of the Pearson correlation and univariate ANOVA tests support the first proposition that the presence of website features grows over time, reflected by the age of a website's domain name.

Email Replies

About one in four hotels (52 out of 200) never replied to the potential customer's email request,

Table 2

Website Features and Domain Name Age ($n = 172$ Websites With a Valid Domain Name Age)

		Avg. Domain Name Age (Days)			
Feature	Sites With Feature	Sites With Feature	Sites Without Feature	ANOVA F	p
Branded website address	96%	814	834	0.017	0.896
Hyperlinks	85%	811	836	0.086	0.770
Booking request	78%	828	768	0.67	0.414
Use different languages	65%	833	782	0.666	0.416
Branded email address	62%	837	778	0.92	0.339
Animation	60%	**869**	**733**	**5.192**	**0.024**
Brochure request	52%	865	761	3.009	0.085
News	37%	850	795	0.797	0.373
Credit card payment	26%	**922**	**778**	**4.542**	**0.035**
Online promotions	**22%**	**927**	**783**	**4.069**	**0.045**
Use cookies	20%	924	787	3.4	0.067
Entertainment features	20%	**937**	**785**	**4.172**	**0.043**
Online guest book	18%	852	807	0.342	0.560
Availability check	**15%**	**1041**	**776**	**10.253**	**0.002**
Control of personal data	13%	879	805	0.708	0.401
Personal profile	12%	926	799	1.948	0.165
Sign in option	11%	899	804	0.992	0.321
Online service features	11%	916	802	1.422	0.235
Download/print document	11%	**1035**	**787**	**6.978**	**0.009**
Newsletter	5%	799	816	0.014	0.905
Viral marketing	4%	**1231**	**797**	**8.576**	**0.004**
Press releases	3%	**1252**	**802**	**6.616**	**0.011**
SSL	**3%**	**1411**	**797**	**12.716**	**<0.001**
Cancel booking	2%	**1312**	**806**	**5.002**	**0.027**

suggesting a problem infusing email into their business processes. Of the 148 hotels that replied, three out of four answered the potential customer in a day and the last response took 11 days. Just over half the hotels answered the questions concerning room availability and children's amenities. About one in five hotels failed to thank the guest for their interest. Even though the query included the guest's name (e.g., Susanne Forbes), just two replies out of three began with "Dear Susanne Forbes." In addition to not identifying the potential customer, many hotels forgot to identify themselves (43%) or the employee that replied (62%).

Email Replies and Domain Name Age

The results of univariate one-way ANOVA tests of relationships between domain name age and quality email responses tended to support the second proposition. Responding hotels had a marginally older domain name (817 days) than hotels that did not respond (809). The differences were stronger with hotels that addressed the customer with "Dear" (876 vs. 555 days, $F = 12.81$, $p < 0.001$) and personally (856 vs. 703 days, $F = 3.4$, $p = 0.067$). Similarly, hotels that addressed most other quality criteria had older domain names: correct language (824 vs. 585 days); sender identified as a hotel (864 vs. 747 days) and by name (822 vs. 789 days); and answered the question about rooms (849 vs. 806 days).

Clustering Website Features With Complementary Techniques

Given a small sample size and nonparametric data, complementary multivariate and artificial neural network (ANN) techniques investigated the third and fourth propositions. Although academics found pioneering ANN applications difficult to interpret, recent research sheds light on ANN advantages such as relaxed data assumptions and similarities with multivariate techniques (Alon, Qi, & Sadowski, 2001; Kim, Wei, & Ruys, 2003). ANN training resembles statistical learning. Data from a training set estimate weights (parameters) for procedures such as least squares, maximum likelihood, and Bayesian inference.

Cluster analysis organizes variables in related groups, producing the taxonomies described in configurational theory. This tool, based on similarity measures, associations, and data structures, always produces a classification. Part science and part art, the researcher must sensibly choose the data, similarity measures, variables, and number of clusters. Comparing multivariate and ANN results reduces this subjectivity and profits from ANN's flexible data assumptions (Alon et al., 2001; Kim et al., 2003; Kohonen, 2001). This study used SPSS for the multivariate clustering and NeuroShell 2 for Kohonen networks, an ANN clustering technique.

The multivariate Ward hierarchical technique (Everitt, 1993) clustered hotels on the presence of 24 features (binary variables) and then sequentially eliminated the least significant discriminator, deriving solutions for 21, 19, and 16 features. After testing three, four, and five clusters, three clusters across 19 features best distinguished among groups. Regardless of the number of clusters though, the results were unstable; cluster membership changed depending upon the number of features analyzed.

The Kohonen network produced similar, albeit more stable, results. The ANN three-, four-, and five-cluster solutions were identical with 24 and 21 variables, similar with 19 variables, and differed with 16 variables. Table 3 shows a significant relationship and 95% agreement between the best ANN and multivariate solutions: three clusters and 19 variables.

To eliminate noise, a second analysis clustered website features on just the 148 hotels that evolved in their Internet adoption to the point of answering email. The three- and four-cluster solutions were appropriate, but the three-cluster solution was more stable across 24, 21, 19, and 16 website features. Memberships in the three Kohonen clusters stayed virtually constant across 24, 21, 19, and 16 website features. Both techniques gave more stable results using the 148 hotels that seemed to have infused email into their business processes.

A significant relationship and 87% agreement (see Table 3) between the best multivariate and ANN solutions (three clusters and 19 features) cross-validates both techniques. The ANN solution, though, provided more equally distributed cluster sizes and better discrimination amongst

Table 3
Comparison of ANN and Multivariate Clusters

	Multivariate K-Means						
ANN-Kohonen	Cluster 1	Cluster 2	Cluster 3	Total	Chi Square (*df*)	*p*	% Agreement
19 Website features for all 200 hotels					335.67 (4)	<0.001	95
Cluster 1	55	7		62			
Cluster 2	2	112		114			
Cluster 3	2		22	24			
Total	59	119	22	200			
19 website features for the 148 hotels that responded					201.99 (4)	<0.001	87
Cluster 1	70			70			
Cluster 2	14	47		61			
Cluster 3		4	13	17			
Total	84	51	13	148			

clusters. The multivariate solutions showed significant cluster differences on 16 website features, while the ANN clusters showed significant differences on all 19 features (see Tables 4 and 5).

The clustering results help support the third proposition. Across both solutions the first cluster had the smallest presence of features and the third cluster had the greatest presence. More importantly, the average domain name age for each cluster differed significantly, with the first cluster having the youngest domain name age and the third cluster having the oldest domain name age (see

Table 4
Profile of Multivariate Clusters (148 Hotels and 19 Features)

Feature	% in Cluster 1	% in Cluster 2	% in Cluster 3	Chi Square	*p*
Branded website address	81	94	92	5.12	0.077
Hyperlinks	75	98	69	**13.35**	**0.001**
Booking request	58	98	100	**31.76**	**<0.001**
Use different languages	54	84	77	**14.14**	**0.001**
Branded email address	50	63	77	4.46	0.107
Animation	29	75	100	**40.66**	**<0.001**
Brochure request	30	71	77	**25.98**	**<0.001**
News	6	98	23	**114.47**	**<0.001**
Credit card payment	13	20	100	**48.55**	**<0.001**
Online promotions	4	51	31	**41.76**	**<0.001**
Use cookies	6	24	77	**39.48**	**<0.001**
Entertainment features	5	35	46	**26.18**	**<0.001**
Online guest book	6	18	62	**27.96**	**<0.001**
Availability check	1	6	100	**110.51**	**<0.001**
Control of personal data	0	2	100	**136.55**	**<0.001**
Personal profile	0	0	100	**148**	**<0.001**
Sign in option	0	0	92	**135.61**	**<0.001**
Online service features	2	20	23	12.96	0.002
Download/print document	**6**	**20**	**8**	**6.28**	**0.043**
Newsletter	0	12	15	**11.37**	**0.003**
Viral marketing	0	6	23	**16.08**	**<0.001**
Press releases	0	8	8	**6.79**	**0.033**
SSL	0	4	8	4.76	0.093
Cancel booking	0	0	15	**21.05**	**<0.001**
Valid *N*	84	51	13		

Table 5
Profile of Kohonen Network Clusters (148 Hotels and 19 Features)

Feature	% in Cluster 1	% in Cluster 2	% in Cluster 3	Chi Square	*p*
Branded website address	77	95	94	**9.93**	**0.007**
Hyperlinks	71	97	77	**14.87**	**0.001**
Booking request	51	97	100	**42.5**	**<0.001**
Use different languages	47	84	82	**21.61**	**<0.001**
Branded email address	44	64	82	**10.25**	**0.006**
Animation	26	66	100	**39.41**	**<0.001**
Brochure request	21	71	77	**37.69**	**<0.001**
News	4	79	41	**75.75**	**<0.001**
Credit card payment	16	13	88	**46.35**	**<0.001**
Online promotions	3	38	47	**29.64**	**<0.001**
Use cookies	6	16	77	**46.15**	**<0.001**
Entertainment features	6	25	53	**22.06**	**<0.001**
Online guest book	6	13	59	**30.74**	**<0.001**
Availability check	1	2	89	**111.27**	**<0.001**
Control of personal data	0	0	83	**119.15**	**<0.001**
Personal profile	0	0	77	**109.82**	**<0.001**
Sign in option	0	0	71	**100.63**	**<0.001**
Online service features	1	13	35	**18.24**	**<0.001**
Download/print document	4	18	12	**6.41**	**0.041**
Newsletter	0	8	18	**9.91**	**0.007**
Viral marketing	0	2	29	**31.98**	**<0.001**
Press releases	0	5	12	**6.55**	**0.038**
SSL	0	2	12	**9.61**	**0.008**
Cancel booking	0	0	12	**15.62**	**<0.001**
Valid *N*	70	61	17		

Table 6). Yet on a few features, discussed later in this article, the second cluster outperformed the third cluster.

Similar to diffusion research showing a positive relationship with hotel size and technology adoption (Schegg et al., 2002; Siguaw et al., 2000; Wei et al., 2001), across both solutions the first cluster had the least number of rooms and the third cluster had the most rooms (see Table 6). There were no significant cluster differences in either solution, however, across hotel category and chain affiliation.

Cluster Membership and Email Performance

Configurational theory argues that organizational performance depends upon clustering across dimensions such as technology (Meyer et al., 1993; Miller, 1996; Whittington et al., 1999). Hotels in the third cluster had the oldest domain name age and tended to have more website features, suggesting further Internet evolution. If so, hotels in this cluster should provide better responses to customer emails. Table 7 illustrates that this was usually the case.

Hotels in the feature-poor first cluster tended towards the poorest quality responses and the feature-rich third cluster hotels tended towards the best responses. Both solutions revealed significant cluster differences on identifying the sender as a business and by name. The ANN solution also showed a significant difference on thanking the guest. Yet similar to the second cluster outperforming the third cluster in the presence of some website features, the second cluster outperformed the third cluster on identifying the sender by name and answering the question about room prices. Two other complementary analyses explore this counterintuitive result, using theoretical typologies rather than analytically derived clusters.

Structural Equation Modeling of Evolving Internet Adoption

Configurations, such as clusters based on website features, are "something of a black box, with

Table 6
Hotel Characteristics and Cluster Membership (148 Hotels and 19 Features)

	ANN Solution					Multivariate Solution				
	1	2	3	*F* Value	*p*	1	2	3	*F* Value	*p*
Avg. number of rooms	36	54	59	5.07	**0.007**	39	53	67	5.73	**0.006**
Avg. domain name age (days)	759	790	1101	4.86	**0.009**	743	867	1029	3.19	**0.045**
	Percentage of Hotels in Each Cluster (May Not Total 100% Due to Rounding)									
	ANN Solution					Multivariate Solution				
	1	2	3	Chi Square	*p*	1	2	3	Chi Square	*p*
Chain affiliation				5.36	0.068				5.93	0.052
Affiliated	36	42	23			45	36	19		
Independent	50	41	9			34	60	6		
Hotel category				4.01	0.135				1.59	0.452
One to two stars	38	53	9			53	38	9		
Three stars	63	30	7			70	25	6		
Four to five stars	27	51	22			37	49	15		

no analysis of the contribution of individual elements to the performance of the whole or testing of systemic effects over and above the sum of individual contributions" (Whittington et al., 1999, p. 585). Structural equation modeling (SEM) and a complementary ANN technique, backpropagation networks (Haykin, 1999), help address this limitation and reveal further insights into relationships among domain names, website features, and email responses.

Table 7
Responses to Customer Emails [Percentage of Hotels ($n = 148$) in Each Cluster]

	1	2	3	Chi Square	*p*
Multivariate clusters					
Replied in 24 hours	75	77	77	0.15	0.929
Replied in English	94	98	100	1.90	0.386
Addressed the customer by name	68	75	92	3.55	0.169
Addressed the customer with "Dear"	77	82	100	3.84	0.147
Used informal greetings such as "hello"	16	12	0	2.49	0.288
Thanked the guest for their inquiry	79	84	100	3.76	0.153
Identified the sender as a business	**46**	**73**	**77**	**10.97**	**0.004**
Identified the sender by name	**76**	**96**	**85**	**9.25**	**0.01**
Addressed the question about rooms and prices	67	73	69	0.51	0.774
Addressed the question about special offers	18	26	46	5.37	0.068
Kohonen network clusters					
Replied in 24 hours	76	75	82	0.39	0.825
Replied in English	93	98	100	3.35	0.187
Addressed the customer by name	64	79	82	1.76	0.414
Addressed the customer with "Dear"	77	84	88	4.70	0.096
Used informal greetings such as "hello"	19	10	0	3.97	0.138
Thanked the guest for their inquiry	**74**	**87**	**100**	**6.37**	**0.041**
Identified the sender as a business	**44**	**69**	**77**	**12.89**	**0.002**
Identified the sender by name	**71**	**98**	**82**	**17.43**	**<0.001**
Addressed the question about rooms and prices	69	71	65	0.20	0.907
Addressed the question about special offers	20	21	41	3.95	0.139

Rather than clusters, the SEM uses conceptual typologies based on the latter two phases of adoption (Doolin et al., 2002; Hanson, 2000) to test propositions 1–4 by simultaneously analyzing complex relationships. The SEM analysis used AMOS software and followed Anderson and Gerbing's (1988) two-step approach, fitting the measurement model and then representing dimensions in a structural model with latent constructs. This approach suits small samples, yielding structural models with a low ratio of sample size to parameters.

The model contains three email response variables: two latent constructs of politeness and completeness, and one observed variable, response in 24 hours. Two domain name variables of email and URL branding, domain name age, and two latent constructs of interactive and personalized website features relate to a staged adoption model (Doolin et al., 2002; Hanson, 2000). Website features such as brochure requests and guest books help users *interact* with a website and resemble a second stage website. *Personalized* features relate to the third stage, adding customization and transaction possibilities to websites.

Table 8 lists the Cronbach alpha, internal consistency estimates, and goodness of fit for three robust factors, verified as congeneric models. Composite reliability was acceptable for the robust factors (Nunnally, 1978), ranging from 0.79 for interactive to 0.99 for personalization features. Significant ($p < 0.05$) factor loadings, from 0.3 to 0.99 and averaging 0.71, confirmed the reliability of these three factors.

Several measures indicated a good fit for the model (Fig. 1) (Arbuckle & Wothke, 1999): $\chi^2(20) = 14.77$, $p = 0.789$; GFI = 0.975; NFI = 0.863; Tucker-Lewis Index = 1.092, CFI = 1.000; RMSEA = 0.000; AIC = 46.77; Hoelter 0.01 index = 313. The SEM model suggests evolving Internet adoption from having branded domain names followed by interactive website features and then personalized website features and providing quality email responses.

Domain name age related positively to both interactive and personalized website features, supporting the first proposition. Interactive website features and URL branding also related positively to proper email replies (politeness and completeness, respectively). Interactive website features also predicted the adoption of personalized website features. Finally, politeness related positively to answering the email within a day. Similar to the cluster analysis showing mixed results with email responses, domain name age and personalized website features showed no significant relationships with email response quality.

Accounting for total effects rather than direct effects revealed several more relationships. Hotels with older domain names and with branded email were more likely to answer politely and within a day. Hotels with branded email address were also more likely to have more personalized features on their websites. Finally, hotels with more interactive website features were more likely to answer within a day.

Comparing the scores from the theoretical interactive and personalization factors across the analytically derived cluster solutions illustrate evolving Internet adoption (see Table 9) and support

Table 8
Composite Reliability

Composite	Cronbach Alpha	Reliability Composite	Congeneric Model Chi Square
Interactivity (booking request, use of different languages, brochure request, online guest book, service features, news, online promotions, entertainment features, press releases, newsletter, animation, download/print documents)	0.736	0.791	$\chi^2(53) = 56.715$, $p = 0.338$
Personalization (personal profile, sign-in option, control of personal data, availability check, cookies, credit card guarantee/payment, viral marketing, SSL, cancel booking)	0.863	0.993	$\chi^2(20) = 29.732$, $p = 0.074$
Politeness (using the customer's name, using dear, thanking the customer and no informal expressions)	0.749	0.969	$\chi^2(2) = 0.205$, $p = 0.902$

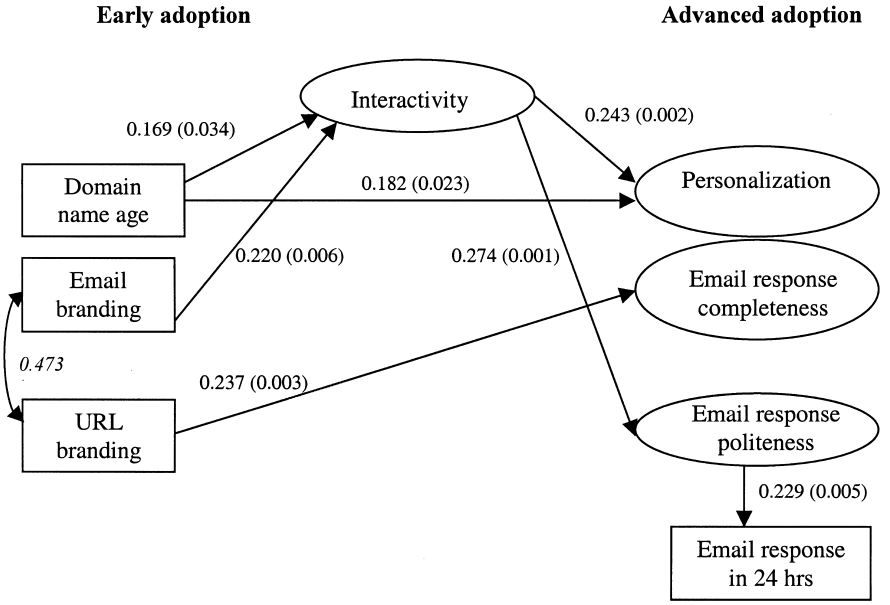

Figure 1. SEM with solid lines representing significant relationships. The number in italics is a correlation; all other numbers represent the standardized regression coefficients and their significance level. The model included regression weights from branding to interactivity and personalization, as well as regression weights from domain name age, interactivity, and personalization to email response quality. Only the significant parameters are shown.

Proposition 3. The results show significant differences in website features across the three clusters. The factor scores for response politeness across both cluster solutions are in the proposed direction, albeit insignificant. Cluster three distances the other clusters in having Internet technologies but only partially distinguishes itself in implementing the simplest Internet technology, email (Proposition 4).

The SEM results are subject to at least two limitations. The sample size is smaller than the recommended 200 observations (Boomsma & Hoogland, 2001). In addition, the exogenous and endogenous variables violate normality assumptions (Kolmogorov-Smirnov test), with a Mardia's coefficient of 16.93. Transformations marginally improved the coefficients. Two bootstrapping methods, maximum likelihood and Bollen-Stine,

Table 9
Factor Scores for Composites

	Cluster 1	Cluster 2	Cluster 3	*F* Test	*p*
Multivariate clusters					
Interactivity	**–0.557**	**0.575**	**0.619**	**87.331**	**<0.001**
Personalization	**–0.335**	**–0.277**	**2.336**	**260.87**	**<0.001**
Politeness	–0.093	0.033	0.472	1.945	0.147
Valid *N*	84	51	13		
Kohonen network clusters					
Interactivity	**–0.512**	**0.379**	**0.744**	**30.364**	**<0.001**
Personalization	**–0.294**	**–0.376**	**2.022**	**151.98**	**<0.001**
Politeness	–0.122	0.021	0.428	2.25	0.112
Valid *N*	70	61	17		

assessed parameter stability and accuracy. The chi-square goodness-of-fit for the latter, with $p = 0.65$, suggests not rejecting the null hypothesis of a correct model (Arbuckle & Wothke, 1999).

Modeling Evolving Internet Adoption With ANNs

ANNs can validate SEM relationships and discover nonlinear relationships and interactions. A backpropagation network (Haykin, 1999) replicated the SEM relationships among hotel organizational characteristics, website features, and email responses. Testing about 70 ANN configurations and parameter combinations yielded a suitable architecture and connection weights for convergence during learning and generalization. The process sought the smallest network able to capture the assumed relationships. A pruning algorithm started with the largest hidden layer network, varying the number of hidden neurons and gradually removing unnecessary nodes (Maier & Dandy, 2001).

For the parameters, adding momentum and noise improved the training and reduced oscillations. The General Regression Network with the logistic activation function (smoothing factor = 0.181) provided the best results (see Table 10). To limit overfitting and increase generalizability, an early stopping mechanism terminated training when the testing error began to rise (Haykin, 1999).

Similar to direct and indirect effects for SEMs, ANN contribution factors show each variable's contribution to prediction or classification. Input variables with strong contribution factors to polite email replies were interactive website features (0.294), email branding (0.202), and the logarithm of domain name age (0.193). Contribution factors for complete email replies were URL branding (0.234), interactive website features (0.209), the logarithm of domain name age (0.208), and personalized website features (0.189).

The multivariate and ANN models agreed with regard to website features. The SEM found URL branding as a significant predictor of reply completeness, and interactive features as a significant predictor of politeness. The ANN, however, showed that email branding, interactive website features, and domain name age were significant predictors of all three measures of proper electronic responses: completeness, politeness, and responding within a day.

The backpropagation network results supported the SEM findings, suggested additional relationships, and helped overcome SEM limitations of multivariate normality and linearity (e.g., see Davies, Goode, Mazanec, & Moutinho, 1999; Maier & Dandy, 2001). The small sample size is still a restraint, due to dividing the sample into training and testing sets.

Conclusions and Future Research

This study investigated the evolution of two complementary Internet technologies: websites and email. The results of two multivariate and another two ANN techniques suggest progressive Internet adoption by organizations, from basic website features to advanced website features and quality email replies. Drawing upon configurational theory to reflect technology orientation, the third cluster had the oldest domain name age and tended to have more website features and provide better email responses. Although this research of Swiss hotels fails to generalize to other countries or industries, it offers a rich palette of managerial,

Table 10
Choosing the Best Network

Architecture (Input–Hidden Neurons–Output)	Learning Rate	Momentum	Activation Function	Convergency	R^2
Traditional backpropagation 7–(5 to 119)–3	0.1–0.6	0.25–0.75	logistic, linear, tanh	No, high value for connection weights	<0.2
Ward net 7–2 and 3–3	0.1–0.75	0.25–0.75	logistic, linear, tanh	Poor, high values for connection weights	<0.3
General regression network	N/A	N/A	logistic, linear, tanh	Smooth and stable, most connection weights <1	0.35–0.88

There were 119 cases used for training and 29 cases used for testing.

academic, and methodological conclusions as well as future research avenues.

The results highlight ANNs' capacity to complement traditional statistics, unmask hidden information, and reduce modeling assumptions. Comparing the cluster solutions, the Kohonen network provided more stability and discrimination. The ANN backpropagation network validated the SEM relationships and uncovered nested relationships such as the overall contribution of email branding, domain name age, and both interactive and personalized website features to quality email replies.

Academic Discussion

Hospitality and tourism literature contains dozens of website evaluation studies, but few studies treat websites as dynamic (Morrison et al., 2004). Most studies assume a binary adoption process; the website has or does not have a particular feature. Yet organizational adoption of technology evolves (Rogers, 1995; Zmud & Apple, 1992); over time hotels should add more website features and infuse the features into their work processes. Furthermore, few studies go beyond evaluating websites and include a common Internet technology—email—in the evaluation.

The study adds to the limited research of evolving Internet adoption and supports the first proposition. As a rule, the domain name age reflects the presence of advanced website feature. The more advanced a feature, the older the domain name age for hotel websites with that feature, and the fewer websites displaying it. Similarly, domain name age shows a positive correlation, albeit not always significant, to quality email replies, partially supporting the second proposition. As this study shows, domain name age is a valuable temporal measure of Internet adoption.

With regard to the theoretical typologies, the SEM shows that interactivity relates positively and significantly to politeness email responses. The ANN shows that email branding and domain name age relate positively to quality email responses, further supporting the first two propositions. The typologies, however, failed to show any relationships with personalized website features and email response quality.

There were intriguing results with the derived clusters. In line with the third and fourth propositions, the third cluster had the most advanced website features: the oldest domain name age and usually the best email responses. Although hotels in the third cluster began their Internet adoption (registered their domain name) almost a year earlier, hotels in the second cluster outperformed the third cluster hotel websites in having hyperlinks, use of different languages, news items, and the ability to download or print documents. Similarly, hotels in the second cluster outperformed the third cluster hotels in two email response criteria: identifying the sender by name and addressing the question about rooms and prices.

Compared to the other clusters, hotels in the third cluster adopted advanced and expensive website features. Hotels in the second cluster seem to have prioritized basic and inexpensive features such as hyperlinks and print document options. Yet there was little difference between the second and third clusters in quality email replies. Perhaps staged models of Internet adoption (Doolin et al., 2002; Hanson, 2000; Teo & Pian, 2003) should consider effective website features as well as the quantity of features. Exploring these technological configurations and organizational performance is one of many future research avenues.

Managerial Discussion

Management must reflect on adding website features and using email. As alluded to in the introduction, cutting-edge technologies may not guarantee success. The results of this study suggest that the second cluster hotels lead the feature-rich third cluster hotels in the adoption of some inexpensive website features. Although the third cluster had the greatest presence of expensive website features, there was little difference between the second and third clusters in email response quality. Of all clusters, the second cluster may be the cleverest in adopting Internet technologies and provide the best model for website features to add.

An inexpensive feature related to quality email responses, branded URL addresses, help strengthen the brand name. As anyone or organization can buy names in the .com domain— first-come, first-served—for little as US$10.00 per year, busi-

nesses should immediately buy their brand name in the .com domain (Murphy, Raffa et al., 2003). Adding features, though, fails to improve email customer service. Companies should establish and train staff on email policies as well as anticipate email questions through a Frequently Asked Questions section on their websites (Murphy, Olaru et al., 2003; Schegg et al., 2003).

Finally, organizations should reflect upon their return on investments in Internet technologies (Morrison et al., 2004). For example, hotels could compare their online versus offline reservations, particularly if they added expensive website features related to reservations.

Future Research

The results offer several variables and factors for future research of Internet adoption. Domain name age is a valuable proxy for time of adoption. Email and URL branding may reflect an intermediate stage of Internet adoption. The cluster results suggest revisiting the proposed stage two interactive and stage three personalized website features (Doolin et al., 2002; Hanson, 2000). The SEM results also suggest two email response quality factors—politeness and completeness—that answer calls for metrics of electronic service (Cox & Dale, 2001; Rust & Lemon, 2001).

These electronic service metrics also help answer calls for measuring the return on Internet investments (Morrison et al., 2004). While many studies model website performance based on the presence, importance, or usability of website features (Chung & Law, 2003; Law & Cheung, 2006; Yeung & Law, 2004), few studies relate website features to performance measures (Scharl, Wöber, & Bauer, 2004). Email response quality can serve as a dependent variable related to the independent variable of Internet investments. All things equal, the greater a hotel's Internet investment, the better that hotel's electronic service should be.

This study implies further research of latent constructs, particularly in conjunction with standardized heuristic website evaluation models (Morrison et al., 2004). The SEM assessed the seemingly transparent measurement model before the structural part. The backpropagation neural network's hidden layer *replicated* the factor analysis, showing higher connection weights for high factor loadings and values close to zero when indicators failed to load.

ANN applications can outperform (Kim et al., 2003; Krycha & Wagner, 1999) or fall short (Mazanec, 1992) of their classical statistics counterparts. Further research comparing these approaches, such as classification trees versus ANN techniques, can reduce black box skepticism and temper overconfidence in ANNs' miraculous powers. Extending Kohonen networks via contiguity-constrained clustering (Kiang, 2001) would overcome imposing the number of clusters. Other future possibilities include using simulated data, other network architectures, weight decay techniques, and hybrid networks that should work well with both categorical and metric data (Brouwer, 2002).

Future studies should use a larger sample size, more interval level data, and more independent variables such as organizational leadership, company ownership, and profitability. The SEM applied typologies of organizational configurations to address the first two propositions; a bigger sample would enable incorporating the taxonomies into the model using multigroup analysis and testing all four propositions.

Possible dependent variables to add include email formatting, grammar, and other website features. A content analysis of the responses and site features by multiple coders would increase reliability (Krippendorf, 1980). An automated content analysis would help address reliability issues as well as provide more website features (Scharl et al., 2004; Schegg et al., 2002).

Longitudinal studies as well as replicating this study in other countries and other industries may shed light on generalizable conclusions. Cultural factors (Hofstede, 1980) and evolving Internet adoption at both individual and organizational levels (Rogers, 1995) may also influence future results. For instance, assuming positive relationships with information technology alignment with business strategy and organizational performance (Sabherwal & Chan, 2001), future research could incorporate business strategy as a dependent variable.

As company replies should build and maintain customer relationships and increase company profitability, future research should also investigate the customer's reactions to email customer ser-

vice. What importance do customers place on this service and how does email customer service influence a company's costs and revenues?

Some hotels in this study may face customer service gaps rather than assimilation gaps. As US companies may provide better customer service via the phone than via email (Lennon & Harris, 2002), future research could test email customer service versus customer service in traditional and new media such as mobile phones (Barwise & Strong, 2002) and interactive television.

Biographical Notes

Jamie Murphy's hospitality background and MBA led to an international marketing career and a Ph.D. studying the Internet. His industry and academic career spans five continents and includes publications in both academic journals and leading newspapers such as *The New York Times* and *Wall Street Journal*. His research focus is effective use of the Internet for citizens, businesses, and governments.

Dr. Roland Schegg is a research officer at the University of Applied Sciences in Valais, Switzerland. Between 2000 and 2004 he was with the Ecole Hoteliere de Lausanne. He earned his B.S. from the Swiss Federal Institute for Technology and his Ph.D. from the University of Geneva. His research interests include eService metrics, technology adoption, and sustainable development such as saving energy in tourism.

Doina Olaru lectures in information management and transport at The University of Western Australia. Her work experience includes academia and industry, most recently with Australia's Commonwealth Scientific and Industrial Research Organisation. A transport modeler by background, Dr. Olaru's research interests also include econometrics and artificial intelligence applications in business, tourism, B2B relationships, and logistics.

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