How did COVID impact user perceptions and web services adoption? An empirical study across multiple web services.

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Abstract

This paper proposes a model for web services adoption using pre-COVID user perception data across five business-oriented web service categories. The model was then tested on post-COVID user perceptions. We identify six significant factors, in a structural model that fits certain web service categories well and needs adaption for others. The pre-COVID and post-COVID data sets were found to be statistically distinct. The underlying factors mostly held true, but the model had significant variations. Although this paper looks at one aspect of adoption, it provides directions on post-COVID expectations for changes in technology adoption. The results contribute to academic research in this area and are of practical relevance to technology providers.

Keywords: Web services, adoption, COVID, pandemic, technology adoption.

1. Introduction

Business web services that facilitate communication and interaction between different organizations and applications, have proliferated in the new millennium. Their use is pervasive in the various functions of business, ranging from small to large tasks and there is wide variation in their utility and features. At the heart of the use of web-based services is the notion that they serve one or more important business functions in a manner that enhances customer satisfaction. Web services help businesses in their efforts to differentiate the product or value provided to the customer. Often web services help businesses achieve greater customization for their customers (the pursuit of the market of one) and superior agility in their operations and activities.

Understandably, some business web services such as office ware (Office365, Google Drive) have been extremely successful and are now widely adopted by business users. On the other hand, there have also been web services failures such as enterprise mashups. Mashups are web services that allow end-users to easily assemble customized software from pieces of ready software. Launched by IBM, Yahoo, Microsoft, Google, ARIS, and many others, they have now been largely shelved because of a lack of adoption. Another one is webtop services that provide an entire desktop experience in a web browser. Such services were provided by many, such as SilveOS, Cloudo, EyeOS, ZeroPC, and many others. They went away from the market due to a severe lack of adoption. But webtop services suddenly found a strong adoption during the COVID pandemic as businesses tried to provide the exact same software and systems to each of their employee's home computer, irrespective of the operating system. This leads to the question of what factors drive the adoption of web services and if every web service has the same factors and the same adoption model. It also leads to the question: with the pandemic and its restrictions behind us, are the perception back to the pre-pandemic levels. Or, did the life-altering event of the pandemic permanently change user perceptions to reach a new normal.

The first question gains special significance in light of the conclusion drawn by some researchers that business-oriented web services are at an early stage in their life cycle (Andriole, 2014; Manyika et al. 2013) and seem to be immune to the efforts made by business executives to positively influence their adoption. At the same time, it is increasingly clear that web services impact business competitiveness strongly and that firms invest significant money, time, and talent in them. Therefore, gaining a better understanding of the factors that drive user adoption of web services is of interest to academic researchers and is also of immediate significance to the business community. In this paper, we aim to provide such an understanding

URI: https://hdl.handle.net/10125/106978
978-0-9981331-7-1

by examining the adoption of a broad cross-section of business web services.

Extant research provides some evidence on specific business-oriented web services such as wikis, or blogs but the joint examination of a wide range of web services is largely missing in the literature. Such an examination is a critical necessity to help understand commonalities among different types of web services, as well as where they may differ. Further, the specific issue of adoption itself has not received sufficient research attention. An early study that does approach the issue of adoption is by Kim (2010) who examines South Korean companies. However, the study does not specify the web services that were examined. Our research objective is to address this gap in the literature by constructing a structural model to better understand the factors that drive user adoption of web services. We then estimate this model using large scale user survey data collected over a decade and covering a range of web services.

The COVID pandemic has been a strong exogenous force, especially for technology, as businesses turned online for all internal and external activities. Studies prior to 2020, prior to COVID, may or may not hold true in the post-COVID era, where work-from-home has become a normal part of many jobs.

Based on prior research as well as a pilot study, we identify six factors in user perceptions that may drive user adoption of web services. These are, ease of use, internal and external collaboration benefits, business innovation benefits, the monetary cost-benefit trade off, and the importance of the web service. We relate these factors in a structural equation model. The model is estimated using 2899 survey responses, across five categories of web services: Accounting, Business Process, Office, Webtop, and Web conferencing. All six factors were found significant across the five different web service categories. Overall, the findings suggest a commonality of factors that drive user adoption and to a lesser degree a commonality of the models across the five web service categories. We also note that COVID related changes to the model are substantial and significant, but the model is not inversed, or unrecognizable. The pre-COVID data was statistically different from the post-COVID data, showing that we may have reached a new normal in user perceptions.

The rest of the paper is organized as follows. In the next section, we review the related literature and develop hypotheses. We then discuss the research method and present the estimation results for the structural equation model. Thereafter, we discuss the results and finally present the conclusions and limitations of the study.

2. Literature review and hypotheses

The established technology adoption model of TAM (2003) and ISSM (DeLone and McLean, 1992, 2003) examine business technologies prior to the era of web services that began around the year 2010. Web services offer many new adoption motivators such as real time communication, sharing, and active collaboration, that earlier technologies could not. Kosalge (2015, 2016) and Kosalge et. al. (2020) are one of the first empirical studies that examine web services adoption. They capture eleven possible benefits of web services from extent literature, as motivators. An exploratory factor analysis in these studies identified factors such as, Cost Benefits, Internal collaboration, Business innovation, Ease of use, Importance. The current study uses the same data collection instrument, with data overlaps. Each of the factors are discussed below.

The systems adoption literature concludes that performance benefit is one of the major drivers of user perception (Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh, Thong, & Xu, 2012). Recent research on one specific web service suggests that performance benefit may be further resolved into multiple distinct factors (Kosalge, 2016) – internal collaboration, business innovation, and the cost-benefit tradeoff. The same factors were also found in this study. Further, Venkatesh et al. (2003) and Venkatesh et al. (2012) find that effort expectancy, i.e., the ease of use of a web service, is also an important factor that determines the likelihood of adoption of a web service. Web services emphasize quick on-boarding of users, without dedicated training. Given its established impact on user adoption, we begin forming a structural framework with this factor.

Hypothesis 1: Ease of use of a web service will positively influence the intention to adopt a web service.

Consistent with web services promoting democratic operations (Alberghini, Cricelli, & Grimaldi, 2014; Turban, Liang, & Wu, 2011) and making knowledge management possible across geographical and technological landscapes (Alberghini et al., 2014; Arazy & Gellatly, 2013; Pugh & Prusak, 2013), web services have a great potential for internal collaboration, and if the users are satisfied, they can extend it to external collaboration to increase the benefits. A higher potential for use inside a business may also positively predispose users to ignore or underestimate the difficulty of using the web service.

H2a: Internal process collaboration benefits will positively influence the ease of use for a web service.

H2b: Internal process collaboration benefits will positively influence the external process collaboration benefits for a web service.

Web services often drive process innovation (Basoglu, Daim, Dogan, Taskin, & Gomez, 2013; Tewary & Kosalge, 2013; Tewary, Kosalge, & Motwani, 2010). For example, practitioners propose radical shifts (H. D. Kim, Lee, & Lee, 2013; Kiron, 2012), such as Marketing 2.0 and Enterprise 2.0. Standing and Kiniti (2011) show how web services help in various stages of innovation to create new products and services, better and faster. Further, businesses can also add new, hitherto inaccessible, aspects such as transparency in internal and external operations (Maru et al., 2009). While customers and suppliers often do not play an active part in process execution (P. Kosalge & Chatterjee, 2011), web services can help overcome this through collaborative features (Akoumianakis, 2014; Gogoulos et al., 2014; Huang & Benyoucef, 2013) and can compel firms to be more customer-centric by pushing the customer's voice throughout the business process, and across supply chains (Kiron, 2012). Thus, innovation-related benefits can drive the adoption of web services and many such innovations will be driven through external collaborations.

H3: Business innovation benefits will positively influence the intention to adopt a web service.

H4: External process collaboration benefits will positively influence the business innovation benefits for a web service.

Finally, web services reduce operational expense (Gupta & Narain, 2012). Compared to traditional software, there is minimal direct cost as it is web-based, (H. D. Kim et al., 2013; Koch, Leidner, & Gonzalez, 2013). Training needs are also minimal (Cunningham & Wilkins, 2009). These cost-benefits can drive users to seek its use for internal collaboration. Cost-benefits from a web service may enable business innovations on-a-dime, allowing quicker implementation and faster results.

H5a: The marginal cost-benefit of web services will positively influence the business innovation benefits for a web service.

H5b: The marginal cost-benefit of web services will positively influence the internal process collaboration benefits for a web service.

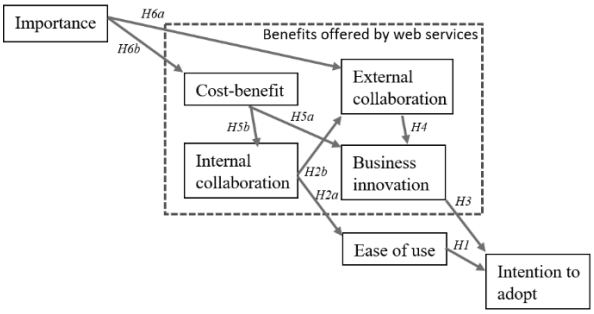

Figure 1. Structural model for web services adoption

While all of the above motivational factors are regarding the performance benefits from web services, the importance performance literature shows that the perceived importance of a service is just as important as its performance (Martilla & James, 1977; Slack, 1994). Perceived importance is also directly linked to the performance and varies with it (Matzler, Bailom, Hinterhuber, Renzl, & Pichler, 2004; Roskowski, 2003). Importance performance analysis is also used to guide executives in improving the quality of their services and strategies (Chen & Ann, 2016; De Nisco, Riviezzo, & Napolitano, 2015; Lai & To, 2010). While it is important to conduct independent assessments regarding the importance or performance of an attribute, it is also necessary to simultaneously consider both in order to realize the information's full potential (Graf, Hemmasi, & Nielsen, 1992; Martilla & James, 1977; N. C. Shaw, DeLone, & Niederman, 2002). Shaw, DeLone and Niederman (2002) used gap analysis to measure service quality of IS/IT systems and concluded that gap analysis is rigorously grounded and can be appropriately used in an IS context. Hence, we consider perceived importance of a web service as an important factor that can drive a user to try and derive direct personal benefit and more easily perceive cost benefits from the web service. As the importance is at the business level, it may likely impact external collaboration.

H6a: Importance of a web service will positively influence the external collaboration benefits of a web service.

H6b: Importance of a web service will positively influence the cost benefits of a web service.

As the pandemic focused on the critical need of information systems for every business operation, it is likely that the 'Importance' factor may potentially drive many other factors in the model.

3. Research method

The research is part of an on-going examination of several web service categories over the last decade. Over time, some services died off, while some others emerged. There were five categories of web services for which there was enough pre-COVID as well as post-COVID data available for analysis and comparison.

	Web service category	Representative web service	Pre-COVID years	N	Post-COVID years	N
1	Accounting	FreshBooks, FreeAgent	2012 – 2019	214	2021 – 22	320
2	Office	Office365, Google Drive	2018 – 2019	208	2021 – 22	212
3	Process	Salesforce	2012 – 2019	266	2021 – 22	377
4	Webtop or Virtual Desktops	Windows virtual desktop, SilveOS	2011 – 2019	307	2021 – 22	385
5	Web conferencing	Zoom, Skype, Google Meet	2011 – 2019	215	2021 – 22	395
			TOTAL	**1210**		**1689**

Table 1: Web service categories and responses

Survey respondents for the study needed to reflect on the power shift that the new technologies bring: where individual business users, rather than top business executives, drive their selection and implementation (Ariza-Montes & Muniz, 2013; Bakri & Kisswani, 2015; Esichaikul, Win Myint, Bechter, & Rehman, 2013; Koch et al., 2013; Kuettner et al., 2013). Web services rely little on top-down control for its adoption and operation (Hasan & Pfaff, 2012; Konieczny, 2009; Pfaff & Hasan, 2011; A. Shaw & Hill, 2014). Consistent with this thinking, post millennials today, a bigger cohort than the millennials, are heralded as the true digital natives (Williams, 2015). We respond to the implicit imperative to consider the new, digital generation that is joining the workforce and choose senior year business majors in a 4-year public university. For each type of web service, only those responses that indicated the user had some firsthand experience with the specific web service were considered.

To understand the user experience from the perspective of discovering new factors and features of web services that may concern a user, the first phase of the data collection used open-ended questions, including the following:

- What major performance benefits could this web service provide?
- What are your major concerns about the web service?
- What issues may affect your intention to adopt this web service in the workplace?
- What is the general concept of this web service? For instance, the concept of Google is 'search the web'.
- Do you think this concept is important for functional areas in a business?
- Do you think the web service delivers the expected performance?

Responses from the initial phase showed that user-identified web service performance requirements were consistent with the known performance benefits for web services. In the second phase, a 5-point Likert scale survey was designed to collect user assessment of various web services. Here also the instrument included open ended questions at the end of each section to elicit any new aspect that was missed. The web-link to the survey was made available on the student intranet with a potential estimate of 7790 possible responses. Participation was encouraged through email follow-up. We received 2899 complete and usable responses.

4. Analysis and Results

We began with an exploratory factor analysis of all the survey responses. We found the various web service benefits loaded on to four different factors, while web service importance, and ease of use, loaded as separate factors. We then conducted a confirmatory factor analysis (CFA) in SAS to establish construct reliability. Indicator reliability (Long, 1983) should ideally be greater than 0.39, composite reliability (Fornell & Larcker, 1981) greater than 0.8, and variance extracted estimates greater than 0.5. These reliability measures were found to be met in the collected data. The Cronbach coefficient alpha for all items were above 0.8, relative to a recommended value greater than 0.7 and do not exceed the maximum value of 0.95 (Nunnally, 1978).

Construct	var	Mean	Std Dev	Alpha	Std Loading	Indicator Reliability	T value, p <.001	Composite Reliability	Variance extracted estimate
Intention to Adopt	IA1	3.19	1.14	0.946	0.8776	0.7702	92.19	**0.88**	**0.72**
	IA2	3.31	1.11	0.946	0.9169	0.8407	109.10		
	IA3	3.63	1.07	0.945	0.7426	0.5515	51.08		
External Collaboration	EC1	3.57	1.18	0.943	0.8726	0.7614	105.30	**0.92**	**0.79**
	EC2	3.37	1.12	0.944	0.9019	0.8134	128.40		
	EC3	3.35	1.09	0.944	0.8885	0.7894	117.10		
Internal collaboration	IC1	3.42	1.20	0.943	0.8948	0.8007	125.90	**0.93**	**0.82**
	IC2	3.56	1.24	0.943	0.9245	0.8547	157.20		
	IC3	3.40	1.25	0.944	0.8927	0.7969	124.00		
Business innovation	BI1	3.74	1.01	0.944	0.8777	0.7704	106.40	**0.91**	**0.77**
	BI2	3.57	1.05	0.944	0.8412	0.7076	85.51		
	BI3	3.67	1.14	0.943	0.9118	0.8314	132.40		
Ease of use	EU1	3.68	1.13	0.945	0.9332	0.8709	181.50	**0.94**	**0.85**
	EU2	3.65	1.11	0.945	0.9534	0.9090	214.70		
	EU3	3.64	1.10	0.944	0.8787	0.7721	117.70		
Cost benefit	CB1	3.46	1.08	0.945	0.9029	0.8152	99.07	**0.92**	**0.84**
	CB2	3.55	1.04	0.945	0.9352	0.8746	110.40		
Importance	I1	2.97	1.26	0.948	0.7595	0.5768	50.66	**0.85**	**0.66**
	I2	3.22	1.29	0.946	0.8815	0.7770	77.67		
	I3	3.02	1.29	0.948	0.7965	0.6344	57.92		
								Average:	**0.78**

Table 2: Web service categories and responses

4.1 Testing for differences in respondent composition:

For many web service categories, data was collected over multiple years ranging from 2011. A few categories, such as mashups (IBM, Yahoo), was pulled out of market by 2016, and was removed from analysis. These and other such market changes could possibly lead to changes in user perceptions from one year to the other. To test for differences in participant responses in different years, we conducted one-way MANOVA for each web service. This dovetails into the tests to define and separate the COVID period responses, as described below.

The COVID period (March 2020 to May 2022) with its health-related restrictions on normal movement related to business and personal life and a sharp shift to remote work, often in an online environment, constitutes a natural experiment on user perceptions about the utility and important of information systems. To test for differences in the groups of participants in different years, one-way MANOVA was conducted for each of these web services.

Null hypothesis 1: There is no difference between any of the years, COVID or not.
Table 3a shows the F values, p values and the R2 values. The F values were not close to 1, and R2 values were consistently greater than 0.01 for each indicator variable, for each web service, rejecting the null hypothesis that there is no significant difference across the years for the participants.

	F Value	Pr >F	R^2 value	Null hypothes
Accounting	20.21	<0.0001	0.21	Rejected. Means significant difference between the years.
Office	116	<0.0001	0.332	Rejected
Process	3.2	0.0014	0.034	Rejected
Webtop	30	<0.0001	0.258	Rejected
Web conferencing	134	<0.0001	0.399	Rejected

Table 3a: MANOVA for testing differences across groups of participants, across the pandemic years, all observations

What if either or both the years 2020 and 2021 were COVID-related outliers?

Null hypothesis 2: There is no difference between any of the years, if we only exclude the COVID years 2020 and 2021.
We ran the test again after removing observations from just 2020 as well as 2020 and 2021. As seen below, this null hypothesis was still rejected.

	F Value	Pr >F	R^2 value	Null hypothesis
Accounting	7.7	<0.0001	0.129	Rejected. Means significant difference between the years.
Office	206	<0.0001	0.34	Rejected
Process	1.96	.07	0.0267	Rejected
Webtop	9.58	<0.0001	0.121	Rejected
Web conferencing	7.1	<0.0001	0.049	Rejected

Table 3b: MANOVA test excluding COVID years 2020 and 2021

For the Process category the F value is close to 1, the p value does not hold, and the R2 value of 0.0267 means about 2.67% of the variance is still attributable to the years. We could accept the process category as having no COVID related variations. However, there were many indicators with an F value more than 5 with Pr>F of <0.001 and hence it was rejected.

Next, we compared the data from only the years 2020, 2021, 2022 to see if there is significant difference across these 3 years and if they can they be grouped. The results showed significant difference between the years. But when only the years 2021 and 2022 were compared, the results suggest that there is no statistical difference. Which means the years 2021 and 2022 could be grouped, and 2020 is the only COVID outlier.

Null hypothesis 3: There is no difference between the years 2021 and 2022.

	F Value	Pr >F	R^2 value	Null hypothesis

Accounting	0.15	0.7009	0.0004	Accepted. Means no significant difference between the years.
Office	0.59	0.4425	0.0015	Accepted
Process	2.25	0.1341	0.006	Accepted
Webtop	0.46	0.4973	0.001	Accepted
Web conferencing	0.14	0.706	0.0002	Accepted

Table 3b: MANOVA test with only post-COVID observations from 2021 and 2022

These tests show that pre-COVID data (before 2020), COVID (2020), and post-COVID data (after 2020) are statistically different.

4.2 Testing for bias

As self-reported data implies a potential for common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), we conducted two statistical analyses to identify its extent. First, we used Harman's single factor test, designed to find whether a large fraction of the variance is explained by just one factor, and find that it yields a proportion of 0.31 relative to a recommended value of not more than 0.50. Second, we follow the Common Latent Factor method, where the squared value of the common coefficient should be lower than 0.5. In the collected data, this value was 0.26. Further, as the structural model is not simple enough for users to find on their own, the incidence of common method bias should be low.

4.3 Testing for validity:

Convergent and discriminant validity may be assessed by the level of agreement in the responses to different survey items by the respondents (Phillips & Bagozzi, 1986). Convergent validity can assess if the individual scale items are related. The results from the confirmatory factor analysis results were used to assess validity (Bagozzi, 1980). For all factor loadings, the t values exceeded the critical value of 3.29 at $p < 0.01$. This shows the measures have convergent validity (Anderson & Gerbing, 1988).

Discriminant validity relates to the degree of correlation between instruments that measure different constructs. As the study has six constructs, the $\chi 2$ test can predict discriminant validity (Anderson, Gerbing, & Hunter, 1987). The $\chi 2$ from the confirmatory factor analysis of the unconstrained model was recorded. Constrained models had the highest covariance across a pair of independent and dependent factors constrained to 1. The difference in $\chi 2$ values between the constrained and unconstrained model was found to be more than 10.9 in each category, pre-COVID and post-COVID. With a degree of freedom 1, and $p < 0.001$, it indicates the survey items demonstrate discriminant validity and the model is better off with the two constructs viewed as distinct factors.

4.4 Model Estimation and Goodness of Fit:

Table 3 reports an absolute index (Standardized Root Mean Square Residual SRMR), a parsimony index (Comparative Fit Index CFI), and an incremental index (Root Mean Square Error of Approximation RMSEA) to provide information about the goodness of fit for the structural equation model. The large number of observations used (2,899) could result in a bias in the indices. Therefore, these indices are reported along with those for each of the constituent five categories of web service that vary in size from 208 to 395 observations. The $\chi 2$ values for the theoretical model are Satorra-Bentler (1988) scaled at $p < 0.0001$. Each category has a $\chi 2$/df greater than 1 and less than 5 (Chin, Gopal, & Salisbury, 1997; Salisbury, Chin, Gopal, & Newsted, 2002), as verified visually. The CFI is above the ideal value of 0.94 for every web service, except one where it is 0.936, suggesting that the CFI's meet the criterion. For SRMR, two are below the ideal value of 0.055 and the others are adequate (below 0.08). The RMSEA values are ideal except for one that is an adequate level of 0.0605.

Web service Category	Sample size	Theoretical model		Measurement model (CFA) on		Comparis		Prob	Bentler CFI	SRMR	RMSEA	90% cl	90% cl
	N	$\chi 2$	df	$\chi 2$	df	$\Delta\chi^2$	Δdf					lower	upper
PRE-COVID													
Accounting	214	233	162	205	149	28.9	13	<.005	0.9407	0.0686	0.0455	0.0318	0.058
Office	208	283	155	266	149	17.0	6	<.01	0.9364	0.0781	0.0605	0.0487	0.072
Process	266	258	155	244	149	14.9	6	<.01	0.9569	0.0709	0.0478	0.0367	0.0584
Webtop	307	247	161	246	149	1	12	<.01	0.9754	0.0601	0.0421	0.0314	0.0522
Web conferencing	215	245	159	240	149	5.1	10	<.01	0.9616	0.0672	0.0489	0.0358	0.0611
POST-COVID													
Accounting	320	368	155	356	149	12.8	6	<.01	0.9545	0.0735	0.0525	0.0433	0.0616
Office	212	269	155	247	149	22.5	6	<.005	0.9587	0.0529	0.043	0.0299	0.0547
Process	377	328	155	319	149	8.2	6	<.01	0.9587	0.0693	0.0528	0.0446	0.0609
Webtop	385	274	155	270	149	3.9	6	<.01	0.9707	0.0514	0.0423	0.0334	0.0509
Web conferencing	395	314	155	302	149	12.2	6	<.01	0.9566	0.0651	0.0471	0.0388	0.0552

Table 2: Goodness of fit

The confirmatory factor analysis (CFA) conducted for each web service showed that the same factors are statistically relevant and important for the adoption of each web service. The structural equation modeling for all categories combined shows that the measurement model (CFA) is good: all selected factors are statistically relevant. But the $\Delta\chi 2$ between

the measurement model and the best possible theoretical model was too high, meaning there is a need to analyze each category separately. Consistent with this, the structural equation models for each web service did show significant differences for each web service category. The factor loadings for each web service had |t| values greater than the critical value of 1.96.

5. Discussion of results

Comparing figure 1 with figures 2a to 2e, we see that most hypotheses hold across web services and across the pandemic, with significant differences. All hypotheses hold for all five web services, except for H4 that did not hold for the Accounting web services. Meaning, External collaboration was not a significant factor for adoption of Accounting web services. Typically, the Accounting department does not go for any direct collaboration with external parties such as customers or suppliers, and so it makes sense that this factor was found to be not significant. However, the functional departments it is contact with, the sales and the purchasing, do go for extensive external collaboration and the Accounting web service is helpful in that respect and so the factor is important.

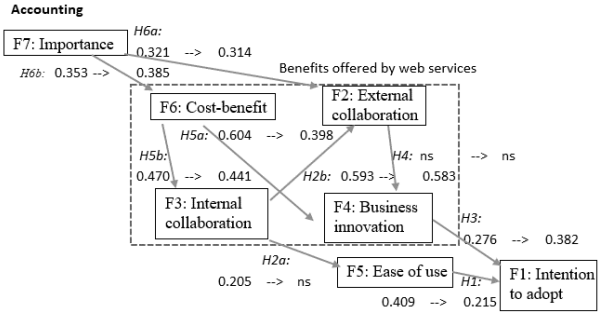

Figure 2a. For web services category: Accounting

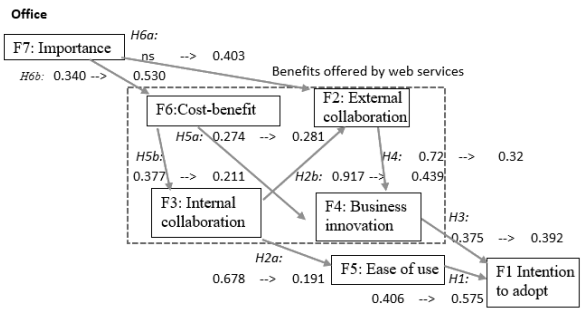

Figure 2b. For web services category: Office

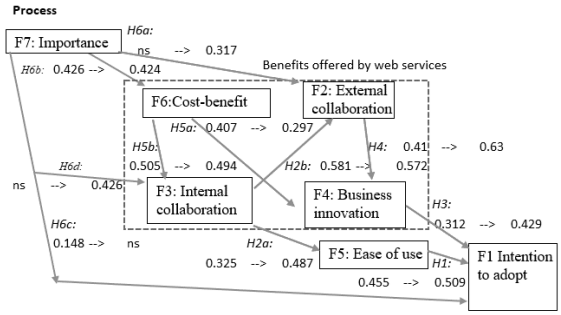

Figure 2c. For web services category: Process

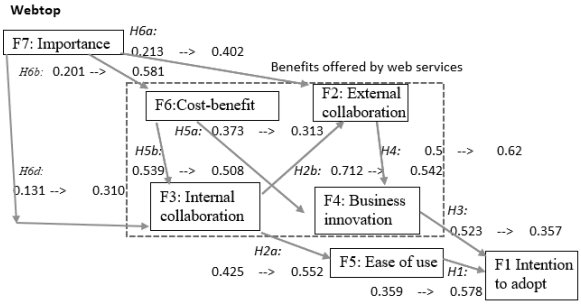

Figure 2d. For web services category: Webtop

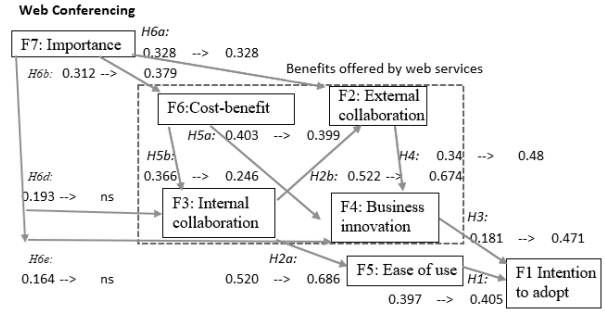

Figure 2c. For web services category: Web conferencing

Although all six of the motivational factors are found to be significant across all five web service categories, each one has the model configured differently with additional paths and/or missing paths. This indicates a commonality of factors but not a commonality of the model among web service categories. Thus, the model in Figure 1 serves as a baseline that can be refined for each web service. While Accounting and Office web services followed the predicated paths, the process, webtop, and web conferencing services make way for additional paths originating in the 'Importance' factor. These paths are the weakest among all other paths in the pre-COVID time. When the averages of the indicators for the Importance factor for Webtop was compared with

other web services, it showed that the users probably did not find it as useful.

Effect of COVID: The analyses showed that pre-pandemic data (before 2020) and post-pandemic data (after 2020) are statistically different. Does the adoption model still hold? Did the adoption model invert or was there a radical change in the model? The results (figures 2a to 2e) suggest that the factors mostly remain the same, while the models and the path coefficients have significant variations. The pandemic did not break the model or make it unrecognizably different. Looking at the coefficients across web services, it appears that internal collaboration strongly drives external collaboration (H2b) and the pandemic did not affect this influence. The cost benefit had a strong influence before the pandemic, while Importance and Business Innovation had a stronger influence after the pandemic. The pandemic certainly increased the perceived importance of web services. Almost every path originating in the importance factor reported an increase in its coefficient. Business Innovation also increased as business had to find new ways to effectively do the existing work and information systems helped significantly. The ease-of-use factor also had a greater influence post pandemic, probably because the pandemic mode created higher facility with information systems in general, leading to an improved perception of ease-of-use and its influence on adoption. Interestingly, the extent of variation across web service categories are more extensive than those due to the pandemic.

The comparison of pre-COVID and post-COVID data sets show that only a life-altering event, such as COVID, can permanently alter user perception. There was no statistically significant difference within the pre-COVID data over multiple years, or within the post-COVID data over multiple years. This suggests that unless faced with a life-altering event of historic proportions, user perceptions may not shift. It also shows that even while the situation has come back to normal, the user perceptions have not.

6. Limitations and future research

To more clearly convey the contribution made by the findings of this study, it is also useful to note its limitations. First, the study offers a baseline framework to model the factors that influence the adoption of web services. As noted with some examples above, specific web services, would need adaptations in this model and the current study examines only a handful of web services and categories. A larger set of web services can lead to a better understanding. Second, the study only examines some of the factors that influence adoption. Features such as reliability, security, and flexibility (Benlian, Koufaris, & Hess, 2011) are not seen as important by the new generation as should be expected from those who have not fully experienced the effects of systems failure, data loss, and market shifts. These and similar factors can be incorporated in subsequent, more advanced adoption models.

Another limitation of the study is its examination of the effects of the pandemic. With heightened user awareness, knowledge, and usage of web services during and after COVID, the perceived importance levels have seen a significant increase. After comparing the mean values, it is clear that the average value for every indicator is higher post-pandemic compared to pre-pandemic. The MANOVA for the process category suggests a possibility that within a few years, all values may revert to pre-pandemic levels. Only time will tell if they do. And if they do, an interesting avenue for further research is to map the year-wise fading of the impact of the pandemic. It would also be interesting to note if certain categories, possibly Office, do not revert to pre-pandemic levels, probably because the work style today is permanently altered with remote work becoming an established norm and an alternative that businesses wish to keep in case of similar exigencies. These effects cannot be understood completely through structural equations.

The demographics and psychographics of the study subjects can affect the abstraction and application of the results. The study primarily examines perceptions of Millennials and Gen Z, just before they embark on their business careers. The perceptions could change with the work environment and with changes in job and responsibilities. The study does not represent other generations and a study across all generations of business professionals may lead to a better understanding of user perceptions.

With these limitations, this study provides useful directions and expectations about how life-altering events may impact user perceptions and adoption of technology. The impact is substantial and significant. The study also suggests an almost unshakeable commonality of factors across web service categories, while each category sports a different model.

7. References

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