Webology (ISSN: 1735-188X)
Volume 19, Number 3, 2022

Technology Integration In The Workplace: A Global Study

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Abstract— The use of technology in the workplace augments business operations. It imparts effective customer relations and generally improves business performance. This paper aims to describe technology integration in the workplace. Specifically, it presents the prevalence of technology in the workplace regarding internet connectivity and internet satisfaction, digital platforms implemented, and means of communication used. This paper also presents the significant relationships between technology integration and continent, country's income level, company type, company form, and company size. A total of 5,379 responses were analysed from 36 countries. The Marcial-Launer Digital Trust in the Workplace questionnaire was used. Results show that Wi-Fi is the most utilized connection in all continents. Internet satisfaction yields an overall mean of 3.13. Social networking sites are the most utilized digital platform in the world. Continent, income-level, company type, and company size are significantly related to internet satisfaction, utilization of digital platforms, and means of communication. It is concluded that technology integration varies in different parts of the world, affected by many interrelated factors in the country, the workplace, and the employee.

Index Terms—digital transformation, Education 4.0, technology integration, workplace

I. INTRODUCTION

Technology revolutionizes everything. It affects the way people live, works, and communicate. It evolves exponentially from the first to the fourth industrial revolution (4IR). The 4IR is a technological revolution ""merging the physical, digital and biological worlds in ways that create both huge promise and potential peril [1]. The World Economic Forum [1] describes:

> "The speed, breadth and depth of this revolution is forcing us to rethink how countries develop, how organizations create value and even what it means to be human. The Fourth Industrial Revolution is about more than just technology-driven change; it is an opportunity to help everyone, including leaders, policy-makers and people from all income groups and nations, to harness converging technologies in order to create an inclusive, human-centered future."

In short, the 4IR technologies disrupt the workplaces. It relandscapes how we do business and manage organizations. Popular disruptive technologies include the Internet of Things, long-term evolution telecommunications, and other emerging technologies [2]. Web 2.0, social media, and other digital platforms continue to significantly impact economic and societal development [3]. Most importantly, these technologies change how we communicate, interact, and relate with others socially and

professionally. "Technology has influenced communication through improved quality, diminished communicating cost, altered nature and style of communication" [4]. In short, the 4IR technologies "transforms social, economic and political systems, often in unpredictable ways" [5].

Technology integration and adoption in the workplace are challenging. Integration varies by multi-complex variables that continue to challenge many workplaces. Among the key factors that affect technology, integration includes individual level like technology satisfaction and socio-demographics, group-level like team communication, and organizational levels like organizational culture and climate [6]. Likewise, information and social practice affordances must be deliberately considered in the workplaces [7]. Technology integration can also be viewed in three complementary forms: "technical integration between tools, collaborative integration between teams and cultural integration between organizations" [8]. Getting employees on board is also a crucial factor in technology integration in the workplace [9]. Workplaces should understand digital skills' levels, characteristics, and determinants among their workers [10].

This paper describes technology integration in Africa, Asia, Europe, North America, South America, and Oceania. Specifically, it presents the status of technology in the workplace regarding internet connectivity and its satisfaction, digital platforms used, and means of communication. This paper also presents the significant relationships between technology integration and continent, country's income level, company type, company form, and company size. This paper is an additional contribution of knowledge to the landscape of information and technology in the workplace.

II. LITERATURE REVIEW

Internet is “a system architecture that has revolutionized communications and methods of commerce by allowing various computer networks around the world to interconnect” [11]. “It is governed by agencies like the Internet Assigned Numbers Authority (or IANA) that establish universal protocols” [12]. Internet speed and efficiency vary according to connection types: mobile, Wi-Fi, dial-up, broadband, DSL, cable, satellite, ISDN [13]. See table 1 for the description. It is basically differed by Internet Service Provider and by region [13]. Internet utilization varies according to demographics, social status, innovation, and others. See table 2 for the vital Internet statistics, as cited in [14] that has implication in the workplace.

Table 1. Types of Internet Connections [13]

Type of Internet Connection	Description
MOBILE	Many cell phone and smartphone providers offer voice plans with Internet access. Mobile Internet connections provide good speeds and allow you to access the Internet.
WIFI HOTSPOTS	Wi-Fi Hotspots are sites that offer Internet access over a wireless local area network (WLAN) by way of a router that then connects to an Internet service provider. Hotspots utilize Wi-Fi technology, which allows electronic devices to connect to the Internet or exchange data wirelessly through radio waves. Hotspots can be phone-based or free-standing, commercial or free to the public.
DIAL-UP	Dial-up connections require users to link their phone line to a computer in order to access the Internet. This particular type of connection—also referred to as analog—does not permit users to make or receive phone calls through their home phone service while using the Internet. Now more outdated, a dial-up connection used to be among the most common Internet connection type.
BROADBAND	This high-speed Internet connection is provided through either cable or telephone companies. One of the fastest options available, broadband Internet uses multiple data channels to send large quantities of information. The term broadband is shorthand for broad bandwidth. Broadband Internet connections such as DSL and cable are considered high-bandwidth connections. Although many DSL connections can be considered broadband, not all broadband connections are DSL.
DSL	DSL, which stands for Digital Subscriber Line, uses existing 2-wire copper telephone line connected to one's home so service is delivered at the same time as landline telephone service. Customers can still place calls while surfing the Internet.
CABLE	Cable Internet connection is a form of broadband access. Through use of a cable modem, users can access the Internet over cable TV lines. Cable modems can provide extremely fast access to the Internet, making a cable connection a viable option for many.
SATELLITE	In certain areas where broadband connection is not yet offered, a satellite Internet option may be available. Similar to wireless access, satellite connection utilizes a modem.
ISDN	ISDN (Integrated Services Digital Network) allows users to send data, voice and video content over digital telephone lines or standard telephone wires. The installation of an ISDN adapter is required at both ends of the transmission—on the part of the user as well as the Internet access provider.
OTHERS	T-1 lines, T-3 lines, OC (Optical Carrier) and other DSL technologies

The accelerating development of the Internet dramatically revolutionizes the organizational communication process. Email, instant messaging, texting, video calls, analytics, cloud repositories, remote accessibility, social media are among the many platforms used in the workplaces [15] [16] [17]. Understandably, many employees still prefer face-to-face communication, especially those brick-and-mortar types of business [15].

Among the most powerful Internet applications is Web 2.0, a generation of websites that emphasizes interactivity, collaboration, and sharing anytime and anywhere. Web 2.0 has essential characteristics that tremendously affect businesses. These include a unified platform, harness collective intelligence, open and accessible data, end of the software release cycle, lightweight programming models, software above the level of a single device, and rich user experiences [18]. Web 2.0 can be regarded as four interconnected mechanisms: 1) social media, 2) filtering and recommendations, 3) content sharing, and 4) web applications [17].

Studies show that social media is an effective tool in the workplace. Social media is a platform for marketing and advertising [19], employee engagement, company branding, better communication [20], education and training [21], among others. It affects employee productivity [22] and the legal, ethical, and managerial practices in the workplaces [23]. Social media varies in terms of its use and applications. Among these, common in the workplaces, include social networks like Facebook and Twitter, Media sharing networks like YouTube and video portals, social blogging networks, discussion networks [24].

Table 2. Internet Statistics (cited in [14])

Results	Description
4.66 billion active internet users in the world	There are currently about 4.66 billion active internet users in the world out of the 7.83 billion global population. Of which, 92.6% access the world wide web using mobile devices
59.5% global penetration	The estimated global penetration is at 59.5% as compared to internet penetration in the US, which is at 90% as of January 2021
China is the top Internet users	In 2019, China is the top Internet users, followed by US, India, Japan, Brazil, Russia, Germany, Nigeria, United Kingdom, and France.
Asia is on the top of Internet users	In 2020, Asia is on the top of Internet users, followed by Europe, North America, Latin America, Africa, Middle East, and Oceania.
4 hours and 25 minutes per day Internet usage	In 2019, Internet users spend 4 hours and 25 minutes per day.
English is the number one language used online	In 2019, English is the number one language used online (Internet World Stats), which accounts for 25.2% of internet users across the globe. Out of the estimated 97,025,201 people that speak German, 95.1% are Internet users. And the number of Japanese-speaking internet users has grown to a staggering 152% over the last 19 years.
100% of 18-29 years old in the US are internet users	In 2019, 100% of 18-29 years old in the US are internet users. The number of internet users 65+ has seen remarkable growth over the last 19 years. Overall, 90% of the adult US population have access to the internet.
96.98 Mbps is the global average download speed	As of January 2021, the global average download speed for fixed broadband connections is 96.98 Mbps, while the global average upload speed is 51.28 Mbps
Taiwan has the fastest internet connection in the world	In 2019, Taiwan overtook Singapore and now has the fastest internet connection in the world with an average speed of 85.02 Mbps. Yemen on the other hand got the slowest internet speed in the world at 0.38 Mbps.
92.3% of adults in the US use text messaging or instant messaging	92.3% of the US online adult population access the internet to use text messaging or instant messaging
Vietnam, China, Belarus, and Turkmenistan block certain sites or have very limited internet access.	Vietnam, China, Belarus, and Turkmenistan are included in the long list of countries that block certain sites or have very limited internet access.

III. METHODS

This paper is part of the global study on Digital Trust in the Workplace [25]. It was an online survey conducted in 36 countries in Europe, the USA, Latin America, Africa, and Asia that gathered 5,621 respondents from a snowball sampling. The online questionnaire [26] was translated into 14 languages. In this paper, 5,379 responses were included and analyzed.

Specifically, the data sets were extracted from the questions on the technological profile of the respondents. Respondents were asked the type of their Internet connectivity: Wi-fi, wired, prepaid data, and post-paid data plan. The respondents were also asked about their general satisfaction with the Internet based on the 4-point scales, 1 (not at all satisfied) to 4 extremely satisfied. 11 common digital tools and platforms in the workplaces were listed wherein respondents are expected to respond whether the tools were used, moderated, or operated for official transactions in the Workplace. Lastly, the means of communication in this paper are categorized into three: face-to-face, digital, and hybrid. Respondents are asked to evaluate the means of their communication with the different persons or groups of people in the Workplace: workers in higher, lower, and the same ranks, customers, and other stakeholders.

IV. RESULTS

A. Internet Connectivity and Satisfaction in the Workplace

Table 3 shows the ranking of the type of Internet connectivity utilized in the workplace. Wi-Fi is the most utilized connection in all continents, followed by a wired connection. Post-paid is the least implemented kind of connectivity in the workplace. Africa's least used type of connectivity is pre-paid data plan.

When asked their satisfaction regarding their connectivity, it yields an overall mean of 3.13, which implies that they are moderately satisfied with their bandwidth connection.

Data also shows that Wi-Fi connectivity is the least utilized Internet connectivity from low, lower-middle-and high-income countries. Wired connectivity is the least utilized in the lower-middle-income countries. The most used in lower-middle- and high-income countries is post-paid data. Virtual and non-virtual companies have the same connectivity status, with pre-paid data being the most utilized and Wi-Fi being the least utilized. Post-paid data is the most utilized connectivity in large enterprises, small groups of companies, and large companies, while wired is the least. Pre-paid data is the most used in small enterprises and medium-sized companies, while Wi-Fi is the least utilized in these companies.

Table 4 shows the results of the analysis made to ascertain whether or not a significant relationship exists between each of the components included in the respondents' profile and their level of Internet satisfaction. Continent, income level, company type, company form, and company size appeared to be significantly related to the level of satisfaction.

Data shows that Europe ($\bar{x}$ = 3.30) and North America (3.45) are highly satisfied with their Internet. African countries have the lowest level of Internet satisfaction with a mean of 2.64. High-income countries are highly satisfied ($\bar{x}$ = 3.44), low income ($\bar{x}$ = 3.20), lower-middle ($\bar{x}$ = 3.10), and upper-middle ($\bar{x}$ = 2.78). Government companies have better satisfaction ($\bar{x}$ = 3.23) compared with non-government ($\bar{x}$ = 3.16), low and business with one person (3.11), and semi-private & public ($\bar{x}$ = 2.95). Virtual companies have better satisfaction ($\bar{x}$ = 3.25) than non-virtual ($\bar{x}$ = 3.09). Large enterprises are better in their satisfaction ($\bar{x}$ = 3.21) than small enterprise and medium-sized companies ($\bar{x}$ = 3.12), small groups ($\bar{x}$ = 3.09), large groups ($\bar{x}$ = 3.06).

Table 3. Ranking of Internet Connectivity

Internet Connectivity	Africa		Asia		Europe		North America		South America		Oceania		Total	
	f (%)	R	f (%)	R	f (%)	R	f (%)	R	f (%)	R	f (%)	R	f (%)	Rank
Wi-Fi connection	329 (31.57)	1	1870 (34.21)	1	1620 (36.55)	1	265 (40.83)	1	578 (32.31)	1	5 (38.46)	1	4667 (34.85)	1
Wired connection	299 (28.69)	2	1644 (30.07)	2	1474 (33.26)	2	219 (33.74)	2	569 (31.81)	2	3 (23.08)	2.5	4208 (31.42)	2
Pre-paid Data plan	298 (28.60)	3	865 (15.82)	4	434 (9.79)	4	53 (8.17)	4	269 (15.04)	4	3 (23.08)	2.5	1922 (14.35)	4

Post-paid Data plan	116 (11.13)	4	1088 (19.90)	3	904 (20.40)	3	112 (17.26)	3	373 (20.85)	3	2 (15.38)	4	2595 (19.38)	3

Legend: f means frequency, R means Rank

Table 4. Test of Relationship of Internet satisfaction among the groups of respondents

Internet Satisfaction and	**x2**	**df**	**p-value**	**Remarks**
Continent	388.6302929	15	0	significant
Income Level	240.982626	9	0	significant
Type of Company	127.871	12	0	significant
Company Form	34.18026681	3	0	significant
Company Size	97.00766888	12	0	Significant

B. Digital Platforms in the Workplace

Table 5 shows the ranking of digital platforms used in the workplace. The result indicates that other social networking sites are the most utilized digital platform globally, followed by Twitter and video portals. Email using the company domain is the least available platform in the workplace. Interestingly, workplaces use Twitter than Facebook across continents.

Twitter is the most utilized in low income, non-government, semi-private, semi-government, and business with one person. Expectedly, company websites are implemented better in virtual companies than non-virtual ones. Surprisingly, blogs, forums, or inquiry forms are better implemented in non-virtual companies than virtual ones. Twitter is the most utilized platform in small enterprises and large companies.

Table 6 shows the results of the analysis made to ascertain whether or not a significant relationship exists between each of the components in the respondents' profile and integration of digital platforms. Continent, income level, company type, company form, and company size appeared to be significantly related to using digital media.

C. Means of Communication in the Workplace

As seen in Table 7, a hybrid form of communication is the most utilized. The data shows a consistent ranking of utilization across all kinds of employees. Face-to-face with co-workers is most preferred in the workplace (1481, 22.77%). African countries most preferred face-to-face communication with subordinates, while Asian, European, and North Americans preferred face-to-face with co-workers. South Americans preferred face-to-face with their supervisor. In terms of digital means, communication using digital means with clients is most preferred. In African and Asian countries, digital communication with co-workers is the least preferred. Digital communication with subordinates is the least preferred by European and North Americans.

In terms of the hybrid, communication with the clients is most preferred while the least is with co-workers. African and Asian countries prefer hybrid communication with a co-worker the least, while European, North Americans, and South Americans do not prefer communicating hybrid with

subordinates.

Table 8 shows the results of the analysis made to ascertain whether or not a significant relationship exists between each of the components in the respondents' profile and means of communication. Continent, income level, company type, company form, and company size appeared to be significantly related to computer-mediated communications. A hybrid type of communication is affected by continent, income level of the country, and the type of company but not with company form and size. Interestingly, company size does not affect face-to-face or hybrid communication type. It is also worth noting that company form affects the utilization of hybrid means of communication. Still, it does not affect the utilization of face-to-face and digital means of communication.

Table 5. Digital Platforms Used/Moderated/Operated in The Workplace

Digital platforms that are available used/moderated/operated) for official transactions in your workplace	**Africa**		**Asia**		**Europe**		**North America**		**South America**		**Oceania**		**Total**	
	f (%)	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**
1. Blogs, Forum, or Inquiry Form	308 (10.86)	4	1017 (8.68)	5	894 (9.29)	5	157 (10.13)	5	350 (9.01)	5	3 (7.89)	5.5	2729 (9.21)	4
2. Instant messenger (e.g. Skype for Business, Cisco Jabber)	256 (9.03)	5.5	919 (7.85)	7	775 (8.05)	7	111 (7.16)	6	312 (8.04)	7	2 (5.26)	8	2375 (8.01)	7
3. Email using Company Domain	65 (2.29)	9	472 (4.03)	9	186 (1.93)	9	42 (2.71)	9	51 (1.31)	9	2 (5.26)	8	818 (2.76)	9
4. Local Area Network or Intranet	206 (7.26)	8	841 (7.18)	8	521 (5.41)	8	105 (6.77)	7	210 (5.41)	8	3 (7.89)	5.5	1886 (6.36)	8
5. Video Portals	358 (12.62)	2	1320 (11.27)	3	1049 (10.90)	3	196 (12.65)	3	449 (11.56)	3	6 (15.79)	2	3378 (11.40)	3
6. Facebook	256 (9.03)	5.5	950 (8.11)	6	826 (8.58)	6	161 (10.39)	4	375 (9.66)	4	5 (13.16)	4	2573 (8.68)	6

7. Twitter	327 (11.53)	3	1541 (13.16)	1	1305 (13.56)	2	202 (13.03)	2	522 (13.44)	2	6 (15.79)	2	3903 (13.17)	2
8. Social Networking Sites	386 (13.61)	1	1524 (13.01)	2	1424 (14.80)	1	231 (14.90)	1	606 (15.61)	1	6 (15.79)	2	4177 (14.09)	1
9. Website	219 (7.72)	7	1157 (9.88)	4	936 (9.73)	4	81 (5.23)	8	324 (8.34)	6	2 (5.26)	8	2719 (9.17)	5

Table 6. Test of Relationship of Digital Platforms among the groups of respondents

Digital Platforms and	**x^2**	**df**	**p-value**	**Remarks**
Continent	284.981	45	0	Significant
Income Level	358.385	27	0	Significant
Type of Company	233.612	36	0	Significant
Company Form	130.534	9	0	Significant
Company Size	546.065	36	0	Significant

Table 7. Means of Communication in the Workplace

Means of Communication in the Workplace	**Supervisor**		**co-worker**		**subordinates**		**Client**		**Total**	
	f (%)	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**	**f (%)**	**Rank**
Face-to-Face	1388 (27)	2	1481 (28)	2	1444 (29)	2	1244 (25)	2	5557 (27)	2
Digital	503 (10)	3	485 (9)	3	524 (11)	3	963 (19)	3	2475 (12)	3
Hybrid	3261 (63)	1	3243 (62)	1	2982 (60)	1	2779 (56%)	1	12265 (60)	1

Table 8. Test of Relationship of Means of Communication among the groups of respondents

Face-to-face Means of Communication and	**x2**	**df**	**p-value**	**Remarks**
Continent	49.027	20	0	Significant
Income Level	35.19092301	12	0	Significant
Type of Company	31.20390582	16	0	Significant
Company Form	19.234	4	0	Significant
Company Size	23.47000884	16	0.10	Not significant

Digital Means of Communication and	x2	df	p-value	Remarks
Continent	35.878	20	0	Significant
Income Level	70.69395771	12	0	Significant
Type of Company	38.102	16	0	Significant
Company Form	41.19730467	4	0	Significant
Company Size	63.507	16	0	Significant
Hybrid Means of Communication and	**x2**	**df**	**p-value**	**Remarks**
Continent	13.71387067	20	0	Significant
Income Level	7.827	12	0	Significant
Type of Company	10.96889286	16	0	Significant
Company Form	2.379	4	0.67	Not significant
Company Size	10.55489645	16	0.84	Not significant

V. DISCUSSION

The results of this study prove that there is still a digital divide. The developed countries have better connectivity. Needless to say, the developing countries and those with lower innovation indexes have struggled and challenged with access and reliable connectivity. This divide may be driven by economic, educational, geographical imbalances, among others [27]. Because Internet satisfaction is affected by many variables, there is a need to focus on equipping employees with the necessary skills that may affect the countrymen's social, economic, and political lives [28]. In today's knowledge-based economy, the Internet is a necessity. Internet usage "improves professional practice, personal development, and quality of working life" [29]. The study [30] asserts that "Internet technologies enhance job satisfaction by improving access to data and information, creating new activities and opportunities, and facilitating communication and social interactions."

The result also suggests varying digital transformation levels, initiatives, and approaches. The result may imply that some countries are in the digitization stage, some are digitalization stage, and some are in the actualization of the digital transformation [31]. Digital transformation "triggers in business processes, as well as organizational implications" [32]. Moreover, it "provides possibilities for efficiency gains and customer intimacy" [33].

The result also suggests a level of digital resiliency at the workplace, especially in those countries with challenging Internet connectivity and the unavailability of digital platforms. "Digital resilience refers to having the ability to adjust positively when facing online adversity" [34]. The results imply that employees are equipped with the minimum knowledge and skills to work autonomously and self-organize using the hybrid form of information sharing [35]. It has been said that "workers with high resilience have better outcomes in difficult work environments" [36]. Similarly, a study showed a "linear relationship between work environments, resilience and sustainable futures" [37].

VI. CONCLUSION AND RECOMMENDATIONS

Technology integration in the workplace is varied, which is affected by the company’s location and company profile. The use of social networking sites is prevalent in the workplace. Hybrid means of communication are predominantly used in any type, form, and size of companies.

Workplaces must strategically invest in improving their bandwidth connectivity. While many digital

platforms are integrated into business operations, workplaces must develop an IT policy and standard operating procedures on all the used media. This policy should include implementing guidelines on the communication protocol in the organization. Most importantly, the human resource must emphasize IT training and education. Companies must establish "specific organizational structures and bears consequences for the metrics used to calibrate performance" to take advantage of institutional and societal digital transformation [31], [32]. Organizations "need to transform strategically – to build new networks and value chains" [38].

Further, the government must strengthen its effort to prioritize the IT budget. The government must develop partnerships and collaborative alliances [39] and foster indigenous rural innovation systems [40]. Comprehensive and competitive IT strategy must be in-placed to mitigate the digital divide [41]. There must be a collective effort to alleviate the digital divide that will focus not only on accessibility but also on digital readiness and skills [28]. Digital leadership must be given emphasis by any officials and leaders.

Moreover, it is recommended to expand the survey with the integration of 4th industrial revolution technologies emphasizing the hardware and networking, software and information systems, and data and information. It is also worth studying how these technologies impact businesses. Likewise, a study to examine the diffusion and acceptance of these technologies in the workplace is also recommended.

ACKNOWLEDGEMENT

We want to thank the participants during the 5th Management Service Congress on November 24-26, 2021 for their comments and suggestions on the original version of this paper. Likewise, we also appreciate the inputs of Dionisia Marie Cadavez during the conceptualization stage of the paper. This research is part of a larger study "Digital Trust and Teamwork" which is funded by the European Regional Development Fund, facilitated by Ostfalia University of Applied Sciences.

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