

Poster

TITLE

Twenty Years of Technology at SIOP: Are I/O Psychologists Lagging?

SHORTENED TITLE

SIOP Technology Trends

ABSTRACT

We examine the timeliness of technology research at SIOP conferences since 1998. Findings indicate that, on average, I/O psychologists study technology milestones 6.55 years after they occur. Preliminary results also suggest that I/O psychologists have responded to technology milestones more quickly in recent years. Our study provides the SIOP community with diagnostic information to inform future research and conferences.

PRESS PARAGRAPH

The Society of Industrial Organizational Psychology (SIOP) annual conference is the largest annual gathering of I/O psychologists. Despite the prevalence of technology topics found on SIOP's annual *Top Ten Workplace Trends* lists, no existing studies investigate how well I/O psychologists keep up with technological advancements as they occur. This study uses archival data based on 21 years' worth of SIOP programs to study how quickly I/O psychologists respond to technological milestones. We find that although I/O psychologists appear to be responding to milestones more quickly in recent years, they still wait over six years on average to investigate

them at SIOP conferences. Based on these results, we recommend that the SIOP community better communicates the need for timely technology research among its members.

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Twenty Years of Technology at SIOP: Are I/O Psychologists Lagging?

The introduction of new technologies into the workplace can have a profound influence on employee behavior and performance (Alder, 2001; Jaspersen, Carter, & Zmud, 2005; Stanton & Barnes-Farrell, 1996). In turn, new technologies also influence the employee behaviors and organizational content industrial/organizational (I/O) psychologists are interested in studying (Craiger, 1997). For example, local area networks (LAN) and client server networks that allow for computer supported collaborative work began to proliferate workplaces in the mid 1980's (Mowery & Simcoe, 2002). The wide use of these technologies likely contributed to the increase in scholarly enthusiasm regarding work teams and work groups that took place in the 1990's (Craiger, 1997). Indeed, a JSTOR search of psychology, business, and management journal

articles published from 1990-1999 using the search terms “work groups” or “work teams” yields twice as many results as the same search criteria for articles published from 1980-1989.

However, Landers and Behrend (2018) recently argued that I/O psychologists have a tendency to be slow to conduct studies of technological advancements in the workplace, often preferring to first spend time building complex theoretical models and specific hypotheses. Landers and Behrend argue that while this hypothetico-deductive method is sound science in many contexts, in the case of technology, it is possible that it is leading to a significant lag between when a technological advancement is introduced into the workplace, and when I/O psychologists are studying the technology. Given Moore’s Law, which describes the trend of technology to become twice as powerful every 18 to 24 months (Schaller, 1997), I/O psychologists must be proactive in their research on workplace technologies. If there is indeed a significant lag between the introduction of new technologies into the workplace and when I/O psychologists are collecting data and proliferating research about those technologies, it is likely that our technology research is not reflecting the experiences of the employees who saw the technology’s introduction. The expectation for I/O psychologists studying technology is certainly not to be future tellers, nor is it to abandon theory altogether. However, to understand the dynamic and evolving effects of technology, I/O psychologists need to discuss and collect data about technology innovations as they are introduced into workplaces as opposed to years after.

The Society of Industrial Organizational Psychology (SIOP) annual conference represents the largest annual gathering of I/O psychologists, and the content of each year’s program represents the I/O psychology topics, trends, and research that is predominating the field at a given point in time. Therefore, the year that a work-related technological innovation first appears on a SIOP program should fairly accurately represent when that innovation has

entered the I/O psychology discourse. Examining the difference between when technological innovations are created or popularized (i.e., “technological milestones”), and when they appear on a SIOP program can thus provide quantitative evidence of whether I/O psychologists, as Landers and Behrend (2018) argue, are truly lagging when it comes to timely technology research.

The purpose of the current study is twofold. First, this study uses SIOP conference programs dating back to 1998 to examine the average lag between technological milestones and when I/O psychologists begin discussing those technologies. Second, the current study aims to explore whether I/O as a field is moving in the right direction when it comes to producing timely technology research (i.e., the lag between technological milestones and first mention at SIOP is decreasing over time), the wrong direction (i.e., the lag between technological milestones and first mention at SIOP is increasing over time), or remaining static. These goals give rise to our two research questions:

Research Question 1: What is the average difference in years between technological milestones and when those technologies appear on a SIOP annual conference program?

Research Question 2: Has the difference (in years) between technological milestones and when the technologies appear on a SIOP annual conference program increased, decreased, or remained relatively stable over time?

Method

Procedure and Measures

We used archival data analysis techniques to investigate the timeliness of technology research within SIOP by first generating two separate timelines. The first, the History of Technology (HoT) timeline, represents a compilation of five separate timelines of technology:

the *Technology Timeline* from datesandevents.org (Technology Timeline), the *Technology Through the Years* timeline from King University (Technology Through the Years), the *Timeline of Computer History* from the Computer History Museum, (Welcome | Timeline), the *Where the Future Becomes Now* timeline from DARPA (History and Timeline), and the *Hobbes' Internet Timeline 25* by Robert Hobbes' Zakon (Hobbes' Internet Timeline). Additions to the HoT timeline were made on a case-by-case basis when workplace technologies were not mentioned in the five primary sources; in these cases, peer-reviewed articles found on Google Scholar were used to identify the year for which a specific workplace technology was first introduced. The final HoT timeline included over 1,500 data points related to technological milestones from 2400 BCE to present day.

The second timeline, the SIOP timeline, includes a comprehensive list of technology-related submissions over the last 21 SIOP conferences. The researchers manually reviewed all public SIOP Annual Conference programs available on SIOP's website, which included 21 programs between 1998 and 2018. Researchers reviewed each program for any posters, symposia, panel discussions, or other submissions that related to technology concepts. Symposia, practitioner forums, and other special events containing multiple papers about technology were further sorted; any non-technology related submissions within multi-paper events were omitted from the SIOP timeline.

Any submission whose technology relevance was under question was highlighted within the timeline and reviewed by two researchers; cases in which both reviewers agreed that a submission lacked relevance were removed. The researchers then determined which submissions were also identified within SIOP conference programs as being related to technology. Physical copies of conference programs were reviewed to ensure accuracy in SIOP's online programs.

The submissions listed online for 2001 were incorrect, with the online version listing only one item tagged for technology, while the physical copy listed 76 items. Additionally, a rare few items marked as technologically relevant within the SIOP programs were not included within the SIOP timeline because the researchers did not agree that these items were relevant. All remaining submissions were reviewed for inclusion in the final SIOP timeline, which included 2066 technology submissions from 1998 to 2018.

We identified 53 technology milestones since 1998 with work-related implications from the HoT timeline (see Table 1 and Table 2). Of these, 42 had been studied at least once at a SIOP conference. To identify the first SIOP submission for a given milestone, the researchers searched the SIOP timeline for keyword variations of the milestone. For example, for the popularization of wearable devices, we included keyword searches for “wearable,” “tracker,” “smartwatch,” “Fitbit,” and “Apple Watch” to find the earliest SIOP submission discussing the milestone.

Analysis and Results

Our first research question was tested by calculating a difference between the year in which a technology was invented or popularized and the year that it was first mentioned in a SIOP submission. We then calculated a grand average of these differences, finding that I/O psychologists research technological milestones 6.55 years after they occur.

Our second research question was tested by dividing the 42 usable technological milestones into three equal intervals. These intervals contained an equal number of milestones spread across 1998-2000, 2001-2005, and 2006-2018. We then calculated average lags for each interval. In 1998-2000, there was an average lag of 8.00 years. This average lag decreased to 7.00 years in 2001-2005, and it decreased again to 4.71 years in 2006-2018.

Discussion

Summary of Findings

We found that SIOP members discuss technological milestones an average of 6.55 years after they have occurred, and this lag appears to decrease over time. On average, SIOP members were slower to study the first third of the technological milestones (i.e., those occurring in 1998-2000) than they were with more recent technological milestones (i.e., those occurring in 2001-2005 and 2006-2018). However, we also identified 11 work-related technological milestones that have never been covered at SIOP conferences (see Table 2). Nine of these unstudied topics occurred during the final third interval of our data, meaning that a lag of 4.71 years for the 2006-2018 interval underestimates the actual timeliness of I/O psychologists' research. To illustrate, assume that I/O psychologists investigated all of the unstudied topics at the 2019 conference. If this were the case, the new average lag for technological milestones occurring between 2006 and 2019 would be 5.82 years. While it appears that I/O psychologists are moving in the right direction by producing more timely technology research, a sizable lag still exists for most major technological milestones.

We further analyzed SIOP programs to understand why I/O psychologists are slow to react to many technological milestones. In particular, we note a need to improve the dissemination of technology research among SIOP attendees. SIOP contributors are asked to select from 34 I/O topic areas while describing their submissions, yet a large proportion of technology related submissions were not tagged in conference programs. Of the 2066 submissions we classified as related to technology, only 462 were formally tagged in SIOP programs. Although many untagged SIOP submissions place greater emphasis on the other 33 topic areas (e.g., assessment, teams, leadership), technology undoubtedly influences the

researchers' inferences and methodological decisions for the studies we manually tagged. For example, Yoerger's (2018) recent poster was tagged under counterproductive work behaviors (CWBs), even though he investigated CWBs in the context of technology misuse in meetings. Additionally, Field (2018) presented a poster tagged under research methods, despite his focus on the suitability Amazon's MTurk for aptitude test development. Neither of these posters were tagged as related to technology.

Implications

These findings provide current SIOP members with diagnostic information to inform future conferences. First, SIOP's technology researchers will benefit from an improved categorization of their research in conference programs. The annual SIOP conference provides I/O psychologists with an opportunity to share their latest knowledge with one another, but technology researchers lack a convenient means for finding many studies of interest to them. Workplace technology does not exist in a vacuum; it influences and is influenced by a number of organizational variables (Orlikowski, 1992). Similarly, I/O psychologists should not study technology in isolation, but rather its existence within modern teams, organizations, and economies. A more integrated, comprehensive categorization of technology research within SIOP can better equip those studying technology to generate meaningful theories about its existence in the modern workplace.

Our results also provide I/O psychologists with a metric to estimate the timeliness of their research on major technological milestones. While a notable lag in research exists for many technology events throughout history, we identified several cases where I/O psychologists pioneered technology research. For example, in the early 1990's I/Os recognized that the nature of work was quickly changing, raising questions about how to prepare new entrants to the

workforce and how to expand current employees' skillsets (Peterson et al., 2001). To address these questions, I/O psychologists developed the Occupational Information Network (O*NET), the first online database of job description taxonomies. That same year, the first SIOP submission related to O*NET was presented, titled *Job Clustering Using the O*NET* (Kubisiak, 1998). Now with over twenty years' worth of O*NET research, the general public benefits from the powerful database.

Similarly, I/O psychologists have also generated timely research on technologies that they themselves did not create. One example of this concerns I/O psychologists' coverage of video technology used in interviews; in the late 1990s, one submission investigated the effects of videoconference software on interview outcomes (Chapman, 1998). Such live video programs were not widely used by organizations until the creation of Skype and HireVue in 2003 and 2004, respectively (Jacobs & Probell, 2007). In recognizing the potential for early videoconference software to change the ways that employers communicate with applicants, I/O psychologists anticipated its effects before it was adopted in modern workplaces.

Still, our results highlight several cases where I/O psychologists have been reactive, rather than proactive, in studying technology. In the past 21 years of technology research at SIOP, we identified 35 cases where I/O psychologists conducted research on a technology milestone one or more years after its occurrence. For cases involving tangible technological inventions, Moore's Law predicts that the devices' processing powers will improve exponentially each year. To illustrate, Fitbit, Inc. developed its first wearable fitness tracker in 2009, and in subsequent years, the devices acquired interactive interfaces, web-based applications, and GPS capabilities. In our review of SIOP submissions, the first study to investigate wearable devices, *Sense Making of Wearable Sensors* (Tonidandel, 2014), was

submitted five years after Fitbit's introduction. Given the rapid processing power increases of wearable devices between 2009 and 2014, each Fitbit model likely influenced employee behavior in different ways. Especially with regard to digital inventions that employees can incorporate in their workplaces, I/O psychologists must generate timely research.

In addition to inventions, broad technology concepts also show relevance for the field of I/O psychology. The timeliness of research on these concepts varies across topics. For example, I/O psychologists often label a technology-related phenomenon after observing its occurrence in work settings. The concept of e-matching, for example, was studied at SIOP during the same year it was coined (Boyce, Jackson, & Neal, 2007). On other occasions, I/O psychologists have been slow to study technology concepts that were popular in other disciplines. For example, in 2005 Roger Mougallas coined the phrase "big data" to describe extremely large sets of the data that are nearly impossible for computer programs to analyze (Ularu, Puican, Apostu, & Velicanu, 2012). Although the concept of big data was widely studied in technology fields in the mid-to-late 2000s (e.g., Cohen, Dolan, Dunlap, Hellerstein, & Welton, 2009) it was not investigated as a unitary concept at SIOP until 2014 with a panel discussion titled, *Big Data: From Hype to Practical Realities* (Levine, 2014). Such delays demonstrate that despite I/O psychologists' duty to conduct and share timely research, they are often slow to conduct research on technology concepts that have organizational implications.

This study also provides the SIOP community with data that complements its existing publications. Since 2014, SIOP has surveyed its members in order to create an annual *Top Ten Workplace Trends* list that predicts which workplace needs organizations should address in the coming year. In every list, technology-related topics occupy at least three of the ten trends. For example, the 2014 list included six technology topics: telework, social media, integration of

technology, gamification, mobile assessment, and big data (Munson, 2013). With the exception of big data, all technology trends included in SIOP's *Top Ten* lists have been investigated years prior at annual SIOP conferences. This demonstrates that while I/O psychologists often anticipate the most influential technological milestones, they occasionally react to major trends after they have entered the workplace. Indeed, since the first "big data" submission at the 2014 conference, it has been a topic of over 70 conference submissions. As SIOP continues to hold annual conferences, I/O psychologists should use *Top Ten* lists as a benchmark to ensure adequate coverage of influential workplace technologies.

Limitations

We identify three limitations of the present study. First, although 21 years' worth of research encompasses several major technological milestones, SIOP conferences date another 12 years before 1998. Our HoT timeline includes hundreds of data points related to technological milestones prior to 1998, but we were unable to estimate these SIOP lags without access to earlier programs.

Additionally, the researchers chose to overcome errors associated with automatic keyword searches by manually searching existing technology timelines and SIOP conference programs. As such, the 2066 identified SIOP submissions do not represent an absolute classification of relevant studies. Similarly, the 53 data points generated from existing technology timelines and empirical research may reflect the biases of the researchers. To minimize the influence of human error and bias on our analyses, we involved multiple researchers at each stage while creating the HoT and SIOP timelines.

Finally, the study is limited by a hindsight bias of technologies developed in the late 1990s and early 2000s. Data points for the first half of the HoT timeline were easily accessible,

but more recent data points required additional research. We identified several recent technological milestones that show potential to be used within organizations, but we cannot predict with certainty their influence on the nature of work. With limited data points to calculate lags in recent years, our estimates for 2006-2018 are skewed. Still, a lack of SIOP submissions on recent technological milestones further supports our finding that I/O psychologists are delayed in conducting technology research.

Future Research

This study is the first to investigate the timeliness of technology research among SIOP members. Future research should study how I/O psychologists compare to professionals from other fields (e.g., management scholars at the Academy of Management conferences) in conducting technology research. Additionally, research is needed to investigate how the unstudied topics outlined in Table 2 (e.g., autonomous vehicles, virtual assistants) influence the current nature of work.

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Table 1.

Technological Milestones, First SIOP Submissions, and Average Lags

TECHNOLOGY MILESTONE	FIRST SIOP SUBMISSION	TECH YEAR	SIOP YEAR	LAG (IN YEARS)	
Open source software used	Using Interactive Multimedia Software on the Web for I-O Applications	1998	1998	0	
Automated essay scoring used	AUTOMATED TEXT ANALYSIS IN I-O PSYCHOLOGY: RESEARCH TO PRACTICE	1998	2004	6	
O*NET created	Job Clustering Using the O*NET	1998	1998	0	
"E-Recruitment" coined	E-RECRUITMENT AND THE BENEFITS OF ORGANIZATIONAL WEB APPEAL	1999	2004	5	
Emojis created	Identifying a Set of Emoji Anchors for Interest Measurement	1999	2017	18	
Crowdsourcing used	The Viability of Crowdsourcing	1999	2011	12	
File sharing program created	Transferring Voice Files Over Internet and	1999	2001	2	

(Napster)	Testing Database				
Mobile phones and smartphones created	HR IN THE PALM OF YOUR HAND: SCIENCE AND PRACTICE	1999	2004	5	
"Internet of Things" coined	Will Technology Make Assessment Obsolete?	1999	2017	18	
Texting introduced to US	213-13 Backchannel Communication: Can Text Messaging Improve Traditional Classroom Learning?	2000	2015	15	
GPS made available to public	Private Eyes Are Watching You: Reactions to Location-Sensing Technologies	2000	2010	10	
Cyberloafing coined	Impact of Cyberloafing on Affect, Work Depletion, Facilitation, and Engagement	2000	2009	9	
Beta version of R created	Getting Started With R: Examples and Lessons Learned	2000	2014	4	

				1998-2000 Average Lag:	8.00
"Deep learning" coined	Can Technology Like Deep Learning Eliminate Adverse Impact Forever?	2000	2016	16	
Data science established (new discipline)	The Promise and Perils of Big Data in I-O Psychology	2001	2014	13	
"E-HRM" coined	Individual Level Effects on the e- HRM and Strategy Relationship	2001	2012	11	
Wiki / Wikipedia created	Teaching and Learning and Wiki: Oh My!	2001	2007	6	
Blogging popularized	New SIOP Web Initiative: Enhancing Member Communication via Blog-Based Technologies				
		2002	2009	7	
Unproctored internet testing used	SHOULD WE USE THE UNPROCTORED INTERNET TO	2002	2002	0	

	COLLECT APPLICANT DATA?				
Fully autonomous robots	Robots in the Workplace: What Lies Ahead?	2002	2005	3	
Videoconferencing popularized (Skype)	The Influence of Videoconference Technology and Interview Structure on the Recruiting Function of the Employment Interview	2003	1998	0	
LinkedIn created	Do You Tweet? Social Media and the Implications for I-O Psychology	2003	2010	7	
Wi-Fi used (first home and small office router)	Information Technology Trends and I-O: The World at Your Handheld	2003	2004	1	
Virtual worlds created (World of Warcraft)	Exploring Workplace Relevant Correlates of World of Warcraft Achievements	2004	2011	7	

Other social media created (average of Facebook and Twitter)	Do You Tweet? Social Media and the Implications for I-O Psychology	2005	2010	5	
"Big Data" coined	Big Data: From Hype to Practical Realities	2005	2014	9	
Natural language classifiers used	Natural Language Classifiers and Sentiment Analysis for Open-ended Survey Responses	2005	2016	11	
MTurk created	Lessons Learned From Using MTurk to Pilot New Items	2005	2014	9	
				2000-2005 Average Lag:	7.00
"Cyber incivility" coined	Reactions to Interpersonal and Cyber-Incivility: The Role of Perceived Injustice	2006	2009	3	
Cloud based services created	Cloud Computing: Dynamic Influences on User Acceptance	2006	2009	3	
Hashtags used	#HireMe: Examining	2007	2016	9	

	the Validity of SNS Applicant Evaluation				
"E-matching" coined	A Case for E-Matching	2007	2007	0	
"Cybervetting" coined	Cybervetting: A Common Antecedents Model	2008	2014	6	
Sociometric badges created	Theme Track: Technology Meets Application	2008	2014	6	
Commercial augmented reality applications created	Applying Augmented Reality in Training – A Brief History and Future Insight	2008	2017	9	
"Gig economy" popularized	Technology Trends Leading HR Practice: Key Opportunities for Research?	2009	2017	8	
Open source databases created (Mongo DB)	Tools for Big Data: MongoDB, Hadoop, and Python	2009	2015	6	
Wearables popularized (Fitbit Classic)	Theme Track: Technology Meets Application	2009	2014	5	
Tablets popularized (first iPad)	A Validation Study of Tablet Use in a	2010	2012	2	

	Medical Setting				
"Telepressure" coined	Telepressure and College Student Employment: Costs of Staying Connected	2010	2016	6	
"Gamification" popularized	Gamification: A New Approach to Serious Games in Training	2010	2013	3	
Virtual reality headsets popularized (Oculus Rift, HTC Vive)	Are Head-Mounted Virtual Reality Systems Useful for Training and Education?	2015	2001	0	
				2015-2018 Average Lag	4.71
				1998-2018 Average Lag:	6.55

Table 2

Technological Milestones Unstudied at 1998-2018 SIOP Conferences

TECHNOLOGY MILESTONE	FIRST SIOP SUBMISSION	TECH YEAR	SIOP YEAR	LAG (IN YEARS)
Autonomous vehicle created	--	2004	--	--
“Coworking” popularized	--	2005	--	--
Non-military drone used	--	2006	--	--
Work messengers popularized (Slack created)	--	2009	--	--
Commercial 3D printer created	--	2009	--	--
Crowdsourced funding (Kickstarter created)	--	2009	--	--
Bitcoin created	--	2009	--	--
Google Glass created	--	2012	--	--
Virtual assistants created (average of Siri, Google Assistant,	--	2014	--	--

Alexa, and Cortana years created)				
Microchip RFIDs used	--	2017	--	--
Google Dataset Search created	--	2018	--	--