

2021

Understanding the career dynamics of IT professionals in digital transformation times: a systematic review of career anchors studies

Catherine Cabot
Université du Québec en Outaouais

Stéphane Gagnon
Université du Québec en Outaouais

Follow this and additional works at: <https://aisel.aisnet.org/ijispm>

Recommended Citation

Cabot, Catherine and Gagnon, Stéphane (2021) "Understanding the career dynamics of IT professionals in digital transformation times: a systematic review of career anchors studies," *International Journal of Information Systems and Project Management*. Vol. 9 : No. 2 , Article 4.
Available at: <https://aisel.aisnet.org/ijispm/vol9/iss2/4>

This material is brought to you by AIS Electronic Library (AISeL). It has been accepted for inclusion in International Journal of Information Systems and Project Management by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.



Understanding the career dynamics of IT professionals in digital transformation times: a systematic review of career anchors studies

Catherine Cabot

Université du Québec en Outaouais
Gatineau, Québec
Canada
cath.cabot@gmail.com

Stéphane Gagnon

Université du Québec en Outaouais
Gatineau, Québec
Canada
stephane.gagnon@uqo.ca

Abstract:

The concept of career anchors has long been a reference model to guide Human Resources Management (HRM) practices within the information technology (IT) discipline. However, as the digital transformation phenomenon grows increasingly disruptive, the misalignment of human resources is becoming more apparent as IT professionals are faced with mixed job demands requiring multidisciplinary skillsets. Along with the lack of workforce diversity and high turnover rates, these HRM challenges are impacting career dynamics and talent management practices. A systematic literature review of 20 empirical studies reveals three broad themes: debunking the dual-ladder construct of traditionally opposing technical and management career paths, fostering a diverse workforce through a variety of demographic profiles, and understanding the response strategies of IT professionals. While career anchors proved to be a useful model, it falls short in the context of the current structural changes of professional career choices and talent requirements, which requires a more diverse and dynamic model. This finding leads to a new research agenda emphasizing the study of Business Technology Management (BTM). This new concept refers to an emerging transdisciplinary profession, uniting Project Management (PM), Information Systems (IS) and IT competencies within a common body of knowledge for leading digital transformation projects.

Keywords:

career dynamics; information technology (IT); career anchors; human resources management (HRM); business technology management (BTM), digital transformation.

DOI: 10.12821/ijispm090203

Manuscript received: 14 December 2020

Manuscript accepted: 20 March 2021

Copyright © 2021, SciKA. General permission to republish in print or electronic forms, but not for profit, all or part of this material is granted, provided that the International Journal of Information Systems and Project Management copyright notice is given and that reference made to the publication, to its date of issue, and to the fact that reprinting privileges were granted by permission of SciKA - Association for Promotion and Dissemination of Scientific Knowledge.

1. Introduction

“Although the importance of project management is nowadays widely acknowledged and the evolution and importance of project-based organizations has received quite some attention in theory and practice the role and the motivation of the individual project manager is still under-researched” [1].

More than ever, research efforts are required to understand the motivations of project managers as Information Technology (IT) professionals are increasingly called up to fulfill project management (PM) roles across various organizations. Combined with the importance of project-based organizations, their roles have also greatly evolved due to the intensity of the digital transformation phenomenon. Ultimately, this has created a misalignment of human resources that is causing a talent shortage. Project success requires IT executives and hiring managers to revisit their Human Resources Management (HRM) practices and adjust them in the context of these new complex roles, ensuring more effective recruitment, retention, and talent management strategies.

The widespread digital transformation phenomenon has caused major disruptions requiring important structural changes to organizations including the need for professionals to assume new roles outside of their traditional functions [2]. Professionals with a non-IT background are faced with managing IT projects and conversely, IT professionals are expected to assist with the realization of these new IT projects [2]. This requires individuals to be proficient in multiple knowledge areas traditionally considered separate disciplines. Furthermore, digital transformation has caused organizations to shorten the lifecycle of those roles, driving professionals to change the way they think about the timeframe of their careers.

In response to digital transformation, Business Technology Management (BTM) was introduced in 2009 by the IT Association of Canada (ITAC) as a way of redefining the traditional career perspectives within technology-focused disciplines. BTM merges various business, project management and technical skills supported by core references to lead digital transformation projects within all types of organizations [3, 4]. This initiative has grown into a global community of professionals who master a broad range of integrated skillsets required by digital transformations [5].

BTM embodies a brand, a concept and a profession [5]. As a brand, BTM is a registered trademark in over 100 countries including Canada and the United States. Moreover, several Canadian academic institutions now offer a BTM program to bridge the business and IT learning curricula. As a concept, BTM promotes digital leadership from the highest strategic level of the organization to address the digital transformation [5]. As a profession, BTM includes practitioners with hybrid skillsets encompassing business, technology, and management. Since BTM blurs the traditional career boundaries of IT professionals, it has the potential to establish career paths across multiple specializations to address the talent shortage crisis. To accomplish this, research focused on career dynamics is required to shed light on the motivations of professionals that could fit within the BTM umbrella.

Accordingly, this literature review will assess to what extent existing studies of IT professionals and their career dynamics can provide insights into how HRM practices can evolve to address the misalignment of human resources in the IT discipline. The career anchors framework is the primary focus of this review as it is a widely studied model. Thus, the literature reviewed in this article focuses on the career orientations of IT professionals through the lens of the career anchors framework. The results of this study will validate the BTM initiative in the context of the digital transformation.

This article is divided into four main sections. The first section explains the misalignment of human resources in the IT profession, which include the evolution of roles in the IT sector, the lack of workforce diversity and high turnover rates. The second section provides an overview of Schein’s career anchors. The third section is the heart of this article as it presents the literature review of 20 empirical studies under the umbrella of three broad themes: debunking the dual-ladder construct, fostering a diverse workforce through demographic profiles, and understanding the response strategies of IT professionals. The fourth section discusses BTM as a promising framework to model the diverse and dynamic career paths of IT professionals. The article concludes with suggestions for new research and highlights the limitations of the study.

2. The misalignment of human resources in the IT discipline

Based on the current literature, HRM challenges have emerged that appear to be causing a misalignment of human resources in the IT discipline such as the evolving roles in the IT sector, the lack of workforce diversity and high turnover rates. As these HRM challenges negatively impact recruitment, retention and talent management, individuals may find themselves in the wrong job based on their skillsets while the ideal candidates may be overlooked.

The main challenge affecting HRM is the evolution of roles in the IT discipline that have created a gap between the skills that professionals have and those that they require to undertake multidisciplinary roles. Typically, IT professionals either specialize in a technical field throughout their career or branch out into a managerial path in later career stages; indicating a potential shift in their underlying career motivations [6, 7]. However, today's professionals are increasingly faced with mixed job demands that require a blend of technical and managerial skills [7]. One reason for this evolution is the increase in project-based organizations that requires IT professionals to develop managerial skills early on to direct projects while retaining the skills to perform technical duties [1, 7].

The widespread use of digital technologies to improve organizations, industries and societies is also causing roles to evolve as IT professionals are becoming increasingly involved in digital transformation projects [2]. In fact, the digital transformation phenomenon is often cited in the literature as inducing disruptive changes to the organization, including human resources [2, 8, 9]. Digital transformation has caused various job roles to evolve according to need for new types of knowledge and skills [9]. For the non-IT professional, this means that they may have to learn new technical skills. For the IT professional, this means that they may have to understand the business strategy as was highlighted in a case study from the oil and gas industry by Kohli and Johnson [10] where Chief Information Officers and IT managers learned that they must first gain insight into the business strategy before implementing digital solutions. Therefore, a combination of skills is necessary for the IT professional to successfully take on the multidisciplinary roles available to them along their career path. Yet, it is unclear whether these evolving job demands align with the underlying motivations of the individual.

Another HRM concern is the lack of diversity in the IT workforce. While the benefits of a diverse workforce are well-known, the career dynamics of individuals with identity-based differences are not well understood. The IT sector is perceived to be a high-pressure environment where it is difficult to keep up with specialized technical skills for long periods of time [6]. This commitment conflicts with the work-life balance of older workers who prefer to spend more time with their families [6]. The desire for a healthier work-life balance may explain why some individuals transition from a specialized field to more generic management positions later in their career. Ultimately, there exists an age bias in a workforce that deals with new technologies and innovative firms, which is predominant in the IT sector [11]. To retain a progressively ageing workforce that contributes to its diversity, employers need to pay attention to the changes that may occur in the underlying motivators of individuals.

Likewise, gender equality is an ongoing problem as women represent only 26% of the IT workforce in developed countries and are reportedly earning \$20K less than men [12, 13]. Pay disparity as well as discrimination and lack of advancement opportunities are some of the reasons that women choose to leave the IT sector [12]. Women face different work-life balance issues than men since most women are still primarily responsible for childcare and household duties [14]. The significant underrepresentation of women is detrimental to the diversity of the IT sector.

Furthermore, with the growing popularity of crowdsourcing platforms, consultant opportunities and startup companies, there is a shift away from the traditional career progression that is leading to higher turnover rates within the IT sector [15, 16]. In fact, LinkedIn reports that the IT sector has the highest talent turnover rate across all sectors with a turnover rate of 13.2% [17]. Several factors are thought to act as the driving force behind the high turnover rate including high demand, rising compensation and the project-focused nature of the work [7].

These issues act as career barriers from both an organizational and individual perspective, creating a misalignment of human resources within the field. From an organizational perspective, companies may struggle to recruit and retain individuals with the skills required for the job. Conversely, from an individual perspective, the jobs that are available may not match what the individual wants if it does not fulfill their career motivations and values.

3. The career anchors framework

The concept of career anchors provides a compelling framework for understanding the career dynamics of IT professionals because it provides “valuable insight into employee motivation and career development” [18]. Although the concept emerged almost half a decade ago, the career anchors model is still relevant for today’s working professionals [19]. In particular, the career anchors model is widely applied in the current literature to gain insight into the underlying motivations of IT professionals; thus, it is a good model for this study.

Career anchors emerged from a longitudinal research study carried out by Edgar Schein in the 1960s and 1970s [20]. A sample of 44 male alumni from the Sloan School of Management was interviewed as students in 1961-1963 and then re-interviewed post-graduation in 1973-1974 to answer questions related to career attitude. Schein initially identified five common themes from these interviews to explain what individuals want from their careers, which he coined as career anchors [21]. Through follow-on studies, Schein eventually adapted his career anchors model to include eight career anchors that explain the underlying motivations of individuals with regards to their careers. The following describes Schein’s career anchors:

- General managerial competence (GM): The individual who values management activities and roles.
- Technical functional competence (TF): The individual who values the ability to refine their technical skills.
- Entrepreneurial creativity (EC): The individual who values entrepreneurship and creativity.
- Autonomy/independence (AU): This anchor is closely linked with EC and describes the individual who values the freedom of defining their own work in their own way.
- Security/stability (SE): The individual who values certainty or tenure in their job.
- Service/dedication to a cause (SV): The individual who values work that they believe contributes value to the larger society.
- Pure challenge (CH): The individual who values challenges and overcoming obstacles.
- Lifestyle (LS): The individual who values a healthy work-life balance that meets the needs of their professional careers and personal lives.

Schein’s subsequent work at the end of the twentieth century predicts that the evolution of the labour market will cause shifts in the content and structure of career anchors [19]. As technology is rapidly evolving, Schein predicts that technical experts will continue to be in demand. At the same time, general managerial competence will also continue to be in high demand, especially at the lower more technical levels where greater coordination will be required: “Team managers, project managers, and program managers will have to have general management and leadership skills above and beyond their technical understanding of the tasks at hand” [19]. This precisely describes the blend of technical and managerial skills that are required by IT professionals today.

The existing literature offers several criticisms of Schein’s careers anchors framework. Feldman and Bolino [22] and Chapman and Brown [23] critique Schein’s notion that individuals have only one career anchor. Rather, they argue that multiple career anchors can exist to satisfy multiple career goals. The results of the study by Chapman and Brown [23] revealed that 86% of respondents had more than one career anchor. Yet, while Schein believes that there is only one dominant career anchor defining a career path, he acknowledges that individuals can be anchored in several areas [21]. Another concern with career anchors is that the individual needs to possess the introspective ability to understand their strengths and weaknesses in order to properly identify their career anchors [22]. Moreover, the availability of jobs as well as personal constraints can severely limit the ability of an individual to make career decisions that are compatible with their career anchors [22]. However, the latter two criticisms were not tested empirically by the authors.

There are also variations of Schein’s career anchors model in the literature. One variation that is widely applied in empirical studies is derived from Thomas DeLong, who identifies two additional career anchors: identity and variety [24]. The identity anchor represents the sense of belonging to a specific organization. The variety anchor represents a

preference for a wide range of challenges, which can be likened to Schein's pure challenge anchor. Moreover, DeLong separates security and stability into two distinct career anchors where the former refers to geographic security and the latter refers to organizational stability.

4. Methodology

4.1 Research Method

A systematic literature review was undertaken to collate existing empirical studies on the career dynamics of IT professionals through the lens of the career anchors framework to provide insights into how HRM practices can evolve to address the misalignment of human resources in the IT discipline. This type of review is useful for synthesizing accumulated knowledge within the IT discipline in a rigorous and standardized manner [25]. Moreover, it supports the pragmatic approach underpinning this research, which is a practical problem-solving philosophy where "what people believe to be true is what they find to be useful" [26]. With pragmatism, the researcher is not forced to choose research methods that are deeply tied with the traditionally opposing views of positivism or constructivism.

4.2 Selection of articles

The records included in this literature review had to be published in peer-reviewed academic journals, which means that books and conference proceedings were excluded as neither necessarily go through a rigorous peer-review process. In fact, peer analysis was the primary criteria for validating the quality of the article. Moreover, to be included in the review, the following selection criteria were applied: 1. article must apply the career anchors framework or a wellknown variant of the framework; 2. article must focus on the IT profession or any other related profession including but not limited to management information systems (MIS), the information systems (IS) and software/computer engineering and; 3. article must provide empirical results. Only articles published after 1974 were considered as this is when the career anchors framework emerged in the literature.

This article used the four-step method preferred reporting items for systematic reviews and meta-analyses (PRISMA): 1-Identification; 2. Screening; 3. Eligibility; 4. Inclusion. Figure 1 depicts the flowchart of the literature search, which corresponds to the four steps of the PRISMA method.

Identification: The following search phrase was used in the Scopus database: "information technology professional" OR "information systems professional" OR "project management professional" AND "human resources" AND "career dynamics". The keywords were picked to allow for the broadest possible search results to identify frameworks for understanding career dynamics other than Schein's concept of career anchors that may be widely applied in the research.

Screening: Screened 53 records. Eight records were excluded as they were either books or conference proceedings.

Eligibility: 45 articles were assessed for eligibility. 33 articles were excluded: five articles did not provide empirical results; 17 articles were focused on non-IT professions; and 11 articles did not apply the career anchors framework. Moreover, of the latter 11 articles that did not apply the career anchors framework, there was no other prevalent framework that emerged for understanding career dynamics; thus, confirming that the career anchors framework is the most widely used framework.

Inclusion: 12 articles were initially included in the review. Subsequently, a manual scan was conducted of the references included in the 12 articles and an additional eight relevant articles criteria were identified that met the selection criteria. As such, a total of 20 articles were included in the review.

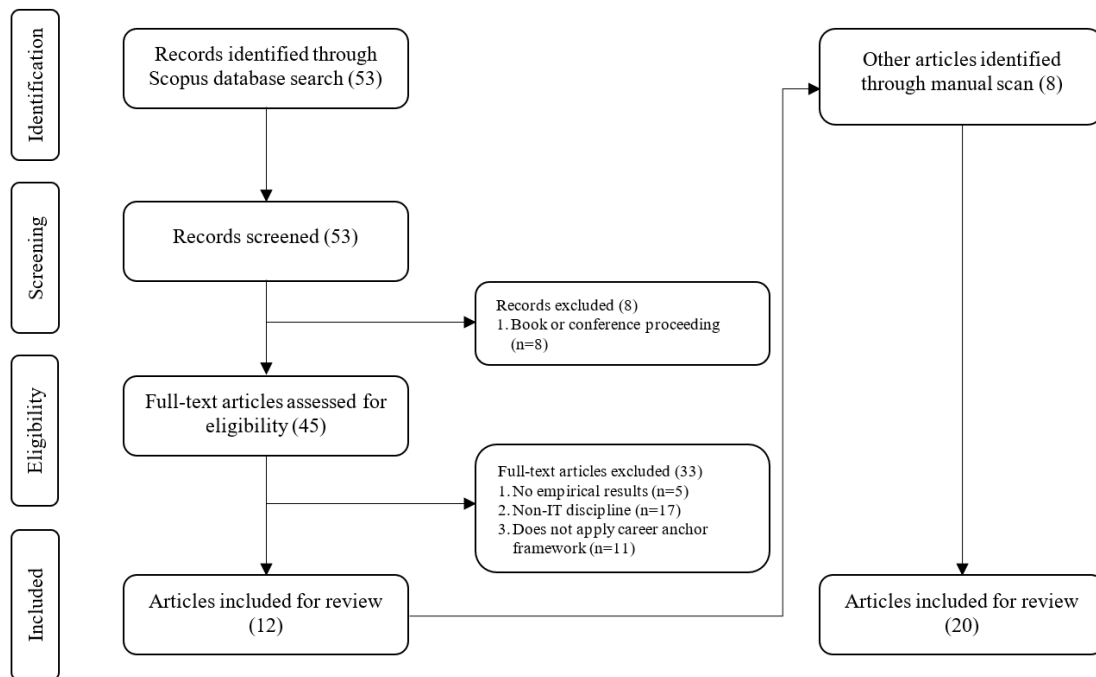


Figure 1: Flowchart of the literature search according to the four steps of the PRISMA method

5. Insights from the career anchors framework

Based on the literature review, three broad themes emerged from the literature that correspond to the HRM challenges at the core of this article: 1. debunking the dual-ladder construct; 2. fostering a diverse workforce through demographic profiles and; 3. understanding the response strategies of IT professionals. As several articles corresponded to more than one theme, the articles were matched with what was perceived to be the overarching theme intended by the author(s). Table 1 represents the 20 articles along with descriptive characteristics of the studies including year, country, participants, sample size (n) and the corresponding theme. The following describes the themes in more detail:

1. **Debunking the dual-ladder construct:** This theme represents five articles that are useful for guiding HRM practices that address the evolving roles of IT professionals. The studies challenge the traditionally opposing management or technical career paths. Moreover, they challenge the notion that the dominant career orientations are necessarily management or technical competencies due to the evidence that a wide range of career orientations exist.
2. **Fostering a diverse workforce through demographic profiles:** The bulk of the articles falls within the umbrella of this theme. A total of 11 articles shed light on the career dynamics of individuals with identity-based differences. The studies use the career anchors framework to build profiles of individuals with various demographic backgrounds, which may be useful for addressing the lack of diversity within the IT workforce. The articles are further divided into four sub-themes that represent these demographic backgrounds: students and entry-level personnel, senior personnel, gender roles and cultural diversity.
3. **Understanding the response strategies of IT professionals:** This theme encompasses the remaining four articles that use the career anchors framework to investigate three common response strategies of IT professionals when making decisions about their career: 1. retention is where an individual chooses to remain within the same organization; 2. turnover is where an individual will leave an organization and find a job elsewhere within their current field; and 3. turnaway involves experiencing a job change outside of one's current field.

Table 1: 20 Empirical studies of career anchors categorized by themes

Author(s)	Journal	Year	Country	Participants	n	Debunking dual-ladder	Demographic Profiles			Response Strategies			
							Entry-level	Senior	Gender	Cultural	Retention	Turnover	Turnaway
Arnold, Coombs et Gubler (2019)	International Journal of Human Resource Management	2019	Europe (Switzerland/UK/Germany)	IT Professionals	1629						x		
C. L. H. Chang (2010)	International Journal of Information Management	2010	Taiwan	MIS Professionals	353				x				
C. L. H. Chang, Shen et Wu (2020)	Journal of Global Information Management	2020	China/Taiwan/India/UAE/US	IT and IS Professionals	859				x				
C. L. H. Chang, Chen, Klein et Jiang (2011)	European Journal of Information Systems	2011	Taiwan	IS Professionals	10								x
C. L. H. Chang, Jiang, Klein et Chen (2012)	Information and Management	2012	Taiwan	IT Professionals	10							x	
I. C. Chang, Hwang, Liu et Siang (2007)	Journal of Computer Information Systems	2007	Taiwan	IS Students	145		x						
Crepau, Crook, Goslar et McMurtrey (1992)	Journal of Management Information Systems	1992	United States	IS Professionals	321	x							
George et Joji (2011)	IUP Journal of Organizational Behaviour	2011	India	IT Professionals	236							x	
Huang (2008)	International Journal of Business and Systems Research	2002/2006	Taiwan	IS Professionals	106/150						x		
Hsu, Chen, Jiang et Klein (2003)	Data Base for Advances in Information Systems	2003	United States	IS Professionals	153			x					
Igbara, Greenhaus et Parasuraman (1991)	Information Technology & People	1991	United States	MIS Professionals	464	x							
Igbara, Meredith et Smith (1995)	Journal of Strategic Information Systems	1995	South Africa	IS Professionals	112							x	
Jiang et al. (2020)	IEEE Transactions on Engineering Management	2020	United States	IT Professionals	164	x							
Jiang et Klein (1999)	Journal of Management Information Systems	1999	United States	Entry-level IS Professionals	101		x						
Jiang, Klein et Balloun (2001)	Information and Management	2001	United States	Entry-level IS Professionals	101					x			
Jiang, Motwani et Pick (1996)	Journal of Computer Information Systems	1996	United States	IS Students	135					x			
Quesenberry et Trauth (2012)	Information Systems Journal	2012	United States	Women IT Professionals	210							x	
Ramakrishna et Potosky (2001)	Journal of Computer Information Systems	2001	United States	IS Professionals	163	x							
Ramakrishna et Potosky (2003)	Human Resource Development Quarterly	2003	United States	IS Professionals	163	x							
Wong, Fiedler et Liu (2007)	Issues in Information Systems	2007	United States	IS Students	106					x			

5.1 Debunking the traditional dual-ladder construct

At one time, technical and management positions were traditionally considered opposing career paths as one would typically hold purely technical or management positions throughout their career or switch from a technical path to a management path in later stages of their career. In either case, this dual-ladder construct considered technical and management roles to be mutually exclusive. The dual-ladder construct was also reflected in career orientations, where professionals were thought to be primarily oriented by technical or managerial preferences. Using the career anchors framework, Igbaria et al. [27], Crepeau et al. [28] and Ramakrishna and Potosky [29], [30] debunk the commonly accepted notion of the dual-ladder construct as they reveal a wide-range of career orientations that shape the career path of individuals. Moreover, with the increase in mixed job demands, Jiang et al. [7] challenge the theoretical perception that the technical and management career anchors are contradictory.

Studies from the early 1990s started to pay attention to the diverse career anchors that influence the career decisions of IT professionals. Igbaria et al. [27] conducted a study among 464 MIS professionals from various demographic backgrounds to examine their career orientations in relation to work experiences and job attitudes. While almost half of the population surveyed valued managerial and technical career orientations, the other half valued different career orientations such as autonomy and lifestyle integration. Likewise, around the same timeframe, Crepeau et al. [28] surveyed 321 IS personnel in a variety of industries confirming the wide variety of career anchors. The study also revealed stability as a dominant career anchor of IS personnel in addition to the management and technical anchors, reflecting a preference for job security, a stable income and retirement benefits.

A decade later, a significant shift occurs in the career anchors of IS professionals. Whereas previous studies included managerial and technical competence among the dominant career anchors, the study conducted by Ramakrishna and Potosky [29] found that only 8% of respondents with the same demographic characteristics as those in Igbaria et al. [27] valued these competencies. Instead, the findings suggest that IS professionals prefer to have geographic security and organizational stability, reflecting their preference to stay in the same geographic location and within the same firm.

Ramakrishna and Potosky [30] introduce the notion of composite career anchors, where individuals have multiple dominant career anchors. The authors examine the career anchors of 163 IS professionals to reveal that almost half of the participants maintained composite career anchors. These findings contradict Schein's career anchors framework where only a single dominant career anchor is thought to exist.

Finally, Jiang et al. [7] posit that IT professionals are now faced with mixed job demands where they must apply a blend of technical and management skills in the same position. The authors sampled 164 IT professionals in the United States (US) to determine the ideal blend of management and technical orientations that would lead to the highest job satisfaction. The results reveal that professionals prefer a moderate blend of technical and management demands. Job satisfaction is lowered when the demand is disproportionate; that is, when the blend of competencies is too low or too high.

Overall, these studies show that the career anchors framework is an effective model for challenging the traditionally opposing career paths within the IT profession and ultimately debunking the dual-ladder construct. However, while these findings are useful for understanding a collective shift in career orientations, the career anchors model falls short in providing a comprehensive understanding of an individual's career orientations as it neglects the complexity of composite career anchors and the dynamic aspect of career orientations brought on by the digital transformation. This also serves to validate the main criticism of the careers anchors model that was raised by Feldman and Bolino [22] and Chapman and Brown [23] in Section 3.

The findings of these studies are summarized in Table 2.

Table 2: Findings of the studies under the theme “debunking the traditional dual-ladder construct”

Author(s)	Findings
Igbaria et al. [27]	IT professionals hold a wide range of career anchors beyond technical and managerial competence.
Crepeau et al. [28]	
Ramakrishna and Potosky [29]	
Ramakrishna and Potosky [30]	IT professionals can hold more than one career anchor (composite career anchors).
Jiang et al. [7]	IT professionals prefer a proportionate blend of technical and management demands in their jobs.

5.2 Fostering a diverse workforce through demographic profiles

Students and entry-level personnel

Students and entry-level personnel represent IT professionals at the beginning of their career path and with many years left to fulfill their career aspirations. Chang et al. [31] propose that there exists a relationship between the career anchors of students and their job preferences. The findings revealed three leading career anchors among the 145 Taiwanese IS students that were surveyed: job security, lifestyle, and service. The findings also revealed varying preferences among different groups of students: undergraduate students value technical competence, graduate students prefer managerial competence and students undertaking a master of business administration (MBA) value lifestyle and job security. The preference for job security can be explained by the low unemployment rate in Taiwan and the value of lifestyle corresponds to the importance of family and social relationships in the Taiwanese culture.

Alternatively, Wong et al. [32] examine what motivates business students to major in IS. The results show that students believe the IS career path is unlikely to fulfill their needs when compared to the four other majors available to them: finance, accounting, marketing, and management. Marketing and management were perceived as majors more likely to achieve competency in general management, service to a cause and pure challenge. Moreover, marketing was thought most likely to lead to independence, maintaining a selected lifestyle and entrepreneurial creativity while management was considered most likely to lead to job security and stability.

Jiang et al. [33], Jiang and Klein [34] and Jiang et al. [35] focus on the career anchors of the entry-level professional and their relationship with job satisfaction. Like the studies that served to debunk the dual-ladder concept, these studies confirm that entry-level professionals also identify with many career orientations. In fact, Jiang et al. [33] found that 50% of their respondents ranked job security as their dominant anchor, which corresponds with the findings of the other studies by Crepeau et al. [28] and Ramakrishna and Potosky [30].

Another study by Jiang and Klein [34] uses a variation of Schein’s career anchors construct to reveal that variety and service are significantly related to the career satisfaction of entry-level professionals. This reflects the individual’s desire for a variety of job assignments and challenges as well as the opportunity for commitment to an important cause. Likewise, Jiang et al. [35] found variety to be a dominant career anchor among professionals at the entry-level stage.

Given the results of these current studies, students and entry-level personnel seem to value a variety of career anchors. The findings of the study by Wong et al. [32] offer meaningful insight to support BTM as a promising transdisciplinary academic program and profession because BTM intersects multiple disciplines including finance, accounting, marketing, management, which are areas at the core of the digital transformation roles within non-IT business units.

Senior Personnel

Unlike students and entry-level personnel, senior personnel represent individuals who find themselves towards the end of their career. Hsu et al. [36] examine the career satisfaction of senior personnel who are in the later stages of their career, which include Stage 3 (mentor) where one starts to lead junior employees and Stage 4 (sponsors) where one starts to become a leader within the organization. Limiting their research in the context of the technical and managerial

career anchors, the authors sampled 153 senior IS personnel in Stage 3 or Stage 4 of their careers and mainly between the ages of 51 and 60. The findings show that senior personnel in Stage 4 of their career tend to express a higher career satisfaction than those in Stage 3. Moreover, individuals who value management competency are most satisfied in Stage 3 as they begin to embrace their role as a formal manager or supervisor.

While the articles focused on entry-level and senior-level personnel represent a large portion of the systematic literature review results, it is surprising that no articles focused on mid-level professionals. This highlights a neglected research area in the context of career anchors studies. It may be worthwhile topic for future studies, which could serve to better understand how to retain these types of individuals.

Gender roles

Quesenberry and Trauth [37] investigate the career anchors of women within the IT workforce. Their study was conducted in two phases: a qualitative and a quantitative phase. First, the qualitative phase analyzed the interviews of an existing study conducted between 2002 and 2006 that surveyed 92 women in the US IT workforce. The goal of this phase was to better understand the relationship between female retention and occupational interventions. The quantitative phase consisted of administering a survey to another 210 women within the IT workforce between 2006 and 2007 to collect additional information that was used to shed light on career anchor variations of women and how they impact career satisfaction and turnover intentions.

The findings show that all the career anchors were present among the women participants in both phases of the study. The overall leading career anchor was lifestyle, which was identified by 28% of all the women in the study. This shows that many women value a healthy work-life balance that allows them to manage both their careers and their family. Accordingly, they value flexible work programs such as job-sharing, part-time work and virtual work arrangements.

Quesenberry and Trauth [37] note that “understanding why a woman is aligned with a particular career anchor is based on more than simply knowing her biological sex; it appears to be based on a variety of constructs including life experiences, talents and preferences” (p.469). This also includes cultural context, which is an important factor for women in IT as different types of cultural pressures may influence their career orientations.

Cultural factors

Igbaria et al. [38] published a study in 1995 to examine the career orientations of IS personnel from the perspective of a developing country. The study surveyed 112 IS professionals in South Africa to show that sense of service was the most valued career anchor.

Huang [39] conducted a longitudinal study to compare the career anchors of Taiwanese IS professionals from those of US IS professionals in 2002 and 2006. The findings revealed cultural differences where autonomy, creativity, identity, and managerial competency ranked higher in Taiwan than the US. Likewise, the study by Chang [40] in 2010 investigates the influence of the Taiwanese culture in the context of career anchors and turnover intentions. Chang [40] surveyed 353 MIS professionals in Taiwan to reveal lifestyle as the highest frequency career anchor to affect turnover. This corresponds with the sense of collectivism and the importance of family in Taiwan.

Chang et al. [41] published a study in 2020 that sheds light on how social connections affect career orientations by comparing the career anchors of IT professionals rooted in five different cultures: China, Taiwan, India, United Arab Emirates (UAE) and the US. The findings show that IT professionals value different anchors depending on their cultural identity where service is most valued in China, technical competence is most valued in Taiwan, creativity and challenge is most valued in India, learning is most valued in the UAE and lifestyle and variety are most valued in the US.

These studies show that individuals from different countries value different career anchors; confirming that cultural context influences the career orientations of IT professionals. Since cultural factors are closely intertwined with gender roles, it should be assumed that together they have a strong impact on career choices. The digital transformation phenomenon has created new roles where professionals from diverse backgrounds may find that they are a better fit than the traditional IT roles. The findings of these studies are summarized in Table 3 below.

Table 3: Findings of the studies under the theme "Fostering a diverse workforce through demographic profiles"

Author(s)	Findings
Chang et al. [31]	Job security, lifestyle, and service are the leading career anchors among IS students.
Wong et al. [32]	Students believe the IS career path is unlikely to fulfill their needs compared to other career paths.
Jiang et al. [33]	
Jiang and Klein [34]	Entry-level IT professionals identify with many career orientations.
Jiang et al. [35]	
Hsu et al. [36]	Senior personnel in later stages of their career tend to express a higher career satisfaction than those in earlier stages, especially those who value managerial competence.
Quesenberry and Trauth [37]	Women identify with a variety of career anchors as their motivations are based on a variety of constructs.
Igbaria et al. [38]	
Huang [39]	Individuals from different countries value different career anchors, which confirms that cultural context influences the career orientations of IT professionals
Chang [40]	
Chang et al. [41]	

5.3 Understanding the response strategies of IT professionals

Retention

Retention involves a career path where the individual remains within the same organization. Arnold et al. [42] study the link between career anchors and preferences for organizational career management (OCM) practices, which help to strengthen an individual's internal employability and desire to remain within the organization. The authors surveyed 1629 IT professionals from several countries in Europe and found that the link was most evident for the managerial competence and job security career anchors. Specifically, individuals who valued managerial competence most were less interested in on-the-job learning opportunities and technical skills training. In contrast, individuals who valued job security most were interested in opportunities for advancement within the company. Given the findings of this study, organizations will have to tailor their OCM practices in consideration of emerging complex digital transformation roles to maximize retention rates. They will need to be better prepared to offer learning opportunities that will appeal to the underlying motivations of IT professionals to fulfill jobs that require a mix of technical and managerial skills.

Turnover

Turnover is commonly associated with the lack of job satisfaction where an individual will leave an organization and find a job elsewhere within the IT sector. George and Joji [43] studied the link between career anchors and turnover intentions of IT professionals to better inform organizations. The authors surveyed 236 IT professionals in India to reveal that those who value job security and technical functional competence were less likely to leave an organization. Alternatively, those who value entrepreneurial creativity and general management competencies were more likely to leave the organization.

Chang et al. [44] shed light on alternative reasons for turnover intentions when career anchors are satisfied. The authors interviewed 10 IT professionals in Taiwan to reveal external factors that may disrupt the relationship between career anchors and job satisfaction such as perceived job alternatives, working relationships with coworkers and social identity.

Given the new roles and opportunities offered by the digital transformation phenomenon, turnover has the potential to translate into retention as individuals will no longer need to leave an organization to satisfy underlying career orientations such as entrepreneurial creativity and general management competencies, which were once thought to

conflict with a career path within the same organization. In fact, the evolution of roles in the IT discipline may be more supportive of the complex relationship between career anchors as described by Chapman and Brown [23] when compared to the traditional roles.

Turnaway

Turnaway involves a drastic change to the career path as an individual chooses to leave the IT profession for an entirely different profession or enters the IT profession from a different profession. Chang et al. [45] examine the career changes of 10 IS employees in Taiwan who experienced at least one job change to shed light on how career anchors can change throughout different career stages. From the participants' responses, the authors identify four patterns that are helpful for managing the IS profession: 1. IS personnel will value managerial competence more in later career stages; 2. IS personnel will consistently value technical competence throughout their career stages; 3. IS personnel will consistently value job security throughout their career stages and will value geographic security more in later career stages and; 4. IS personnel will value autonomy less in their early career stages.

The effects of digital transformation on turnaway are like those of turnover where the diversity of roles has the potential for IT professionals to satisfy a wide range of career orientations across all career stages without leaving the discipline. Moreover, the BTM framework unites resources from multiple disciplines to support the IT professional across these diverse roles. The findings of these studies are summarized in Table 4 below.

Table 4: Findings of the studies under the theme "Understanding the response strategies of IT professionals"

Author(s)	Findings
Arnold et al. [42]	Individuals who value managerial competence are less interested in on-the-job learning opportunities and technical skills training. Individuals who value job security most are interested in opportunities for advancement within the company.
George and Joji [43]	Those who value job security and technical functional competence are less likely to leave an organization. Those who value entrepreneurial creativity and general management competencies are more likely to leave the organization.
Chang et al. [44]	External factors that may disrupt the relationship between career anchors and job satisfaction such as perceived job alternatives, working relationships with coworkers and social identity.
Chang et al. [45]	<ol style="list-style-type: none"> 1. IS personnel value managerial competence more in later career stages. 2. IS personnel will consistently value technical competence throughout their career stages. 3. IS personnel will consistently value job security throughout their career stages and will value geographic security more in later career stages. 4. IS personnel will value autonomy less in their early career stages.

6. Discussion

The findings of the systematic literature review present challenges in modelling the career paths of IT professionals, which may be overcome with the BTM framework. The dual-ladder construct is losing relevance as IT positions are growing increasingly complex; blending management and technical competencies that go beyond the traditional boundaries of the IT discipline. This can also be observed in the career orientations of IT professionals who value a wide range of career anchors beyond management and technical competencies. Figure 2 depicts the six professional roles integrated within the BTM Body of Knowledge; representing a more accurate reflection of the roles of IT professionals today.

As for students and entry-level professionals, the importance of transdisciplinary competencies also points to the need for academic curricula redesign, structured around core digital transformation roles within non-IT business units. The same perspective is reflected for senior professionals where their contribution can be leveraged to ensure an effective transition between traditional IT roles and more diverse digital leadership roles, where senior personnel is often hired. Another set of factors, such as gender and culture, have a strong impact on career choices. Thus, professionals of various demographic backgrounds may find a better fit within the new digital transformation roles and identities in

comparison to the more traditional IT roles. Finally, the traditional response strategies of professionals including retention, turnover and turnaway, have the potential to be redefined in the context of new roles and opportunities offered by the digital transformation phenomenon and the corresponding BTM framework.

Positions with Business Focus		Positions with Technology Focus	
IT Function Management <ul style="list-style-type: none"> Chief Digital/Information Officer (CDIO) and Governance Business Architect and Digital Transformation Manager Enterprise Risk and Compliance Manager 	90/10	50/50	IT Asset Management <ul style="list-style-type: none"> Chief Data Officer and Chief Data Scientist Enterprise Architect and IT Integration Program Manager Business Intelligence and Process Automation Manager
IT Project Management <ul style="list-style-type: none"> Project Manager and Digital Product Manager Business Process and Rules Architect Business Analyst and Requirement Analyst 	80/20	40/60	IT Development Management <ul style="list-style-type: none"> Engineering Team Manager and DevOps Manager Systems Architect and Data Architect Testing Manager and Quality Assurance Manager
IT Service Management <ul style="list-style-type: none"> Data Center Manager and Service Manager Cybersecurity Manager and Business Continuity Manager Technical Support Manager and User Experience Manager 	70/30	30/70	IT Application Management <ul style="list-style-type: none"> ERP Module Manager and Systems Maintenance Manager E-Commerce Manager and E-Marketing Manager E-Content Manager and Intellectual Property Manager

Figure 2: BTM Positions and Ratio (%) of Skills Requirement in Business and Technology [5]

These findings confirm that digital transformation has impacted IT career choices to a greater extent than is acknowledged by existing models such as career anchors. The adoption of enterprise-wide digital technologies requires multidisciplinary skills suited to lead more complex IT projects. And if the past few years are any indication, the next decade is likely to be more disruptive than the last. This is most evident in areas experiencing rapid technological change, especially artificial intelligence, cloud component engineering and born-digital service innovation such as disruptive FinTech.

The conceptual BTM framework provides an opportunity to integrate all relevant IT and digital-related knowledge and practice areas so that any professional may assess their individual and team-related competencies as well as their potential for success in new and high-risk career choices. BTM may inspire OCM and talent management practices that will provide IT and digital-related roles the conditions necessary to continuously renew oneself and perform in ever-evolving and challenging new roles.

Digital roles that involve more leadership and innovative competencies, with highly focused and self-taught technological expertise, are increasingly more appealing to IT professionals from all walks of life, including those without higher education degrees. The fact that both business and technology professionals are eligible for these higher ranking positions will no doubt cause further disruption in the OCM and talent management strategies targeting the IT professional groups. Hence, BTM can serve as a unifying conceptual framework for all IT and digital roles and underlying disciplines, providing an opportunity to facilitate the rapid transition of various professionals interested in diversifying their careers.

Disruptive technological transformations have significant consequences on IT jobs, career paths and OCM and talent management strategies. First, professionals must be proactive and invest more time than usual in keeping up to date with rapidly evolving and emerging technologies. Second, career paths are no longer linear as they must be built around various digital platforms and for shorter periods than what was previously expected. Third, while traditional IT roles such as analysts, programmers and data centre engineers remain important, they are slowly giving way to increasingly digital-related roles requiring multidisciplinary skills.

7. Conclusion and future work

This literature review examined 20 career anchors studies to provide insights into how HRM practices can evolve to address the misalignment of human resources in the IT discipline. Three broad themes emerged from the literature: 1. debunking the dual-ladder construct; 2. fostering a diverse workforce through demographic profiles and; 3. understanding the response strategies of IT professionals. While career anchors proved to be an effective model to analyze the career choices of previous generations of IT professionals, a more diverse and dynamic model may be required to understand the opportunities and challenges presented by the increasingly disruptive digital transformation.

New research is required to develop IT career models that account for the disruptive digital transformation and its structural impact on professionals and their jobs. While this study showed BTM as a promising framework for understanding the career dynamics of IT professionals faced with mixed job demands, further research is required to validate the underlying motivations of these individuals. Future studies should focus on collecting empirical data that can identify the types of professionals that fit under the BTM umbrella.

The main limitations of this study relate to the search method for the systematic literature review. First, the keywords selected to carry out the search had a significant influence on the types of articles that were uncovered. Including keywords such as "career anchors" may have narrowed the results. Yet, this would not have allowed us to validate the widespread use of the career anchors framework in understanding the career dynamics of IT professionals. Moreover, excluding keywords such as "human resources" may have provided broader search results. Second, the search for articles was carried out using the Scopus database. Other databases may have yielded different results. A combination of databases would have been useful to enrich the results of the review.

References

- [1] K. Hölzle, "Designing and implementing a career path for project managers," *International Journal of Project Management*, vol. 28, no. 8, pp. 779-786, 2010.
- [2] G. Vial, "Understanding digital transformation: A review and a research agenda," *The Journal of Strategic Information Systems*, vol. 28, no. 2, pp. 118-144, 2019.
- [3] S. Gagnon, "Business Technology Management as Transdisciplinary IS-IT Competence Framework," presented at the ICIS 2020 Making Digital Inclusive: Blending the Local and the Global, Manuscript submitted for conference, December 13-16, 2020, 1896.
- [4] ITAC Talent, "Business Technology Management National Occupational Standards," ed. Mississauga, ON: The Information Technology Association of Canada (ITAC), 2016.
- [5] S. Gagnon, "Business Technology Management (BTM) Body of Knowledge (BOK)," v.0.1 ed. BTM Forum, 2019.
- [6] L. Brooke, "Prolonging the careers of older information technology workers: continuity, exit or retirement transitions?," *Ageing & Society*, vol. 29, pp. 237-256, 2009.
- [7] J. J. Jiang, W. W. Huang, G. Klein, and J. C.-A. Tsai, "The Career Satisfaction of IT Professionals With Mixed Job Demands," *IEEE Transactions on Engineering Management*, vol. 67, no. 1, pp. 30-41, 2020.
- [8] P. Parviainen, M. Tihinen, J. Kaariainen, and S. Teppola, "Tackling the digitalization challenge: how to benefit from digitalization in practice," *International Journal of Information Systems and Project Management*, vol. 5, no. 1, pp. 63-77, 2017.
- [9] E. Henriette, M. Feki, and I. Boughzala, "The Shape of Digital Transformation: A Systematic Literature Review," in *Mediterranean Conference on Information Systems (MCIS)*, 2015: Association for Information Systems Electronic Library (AISEL).
- [10] R. Kohli and S. Johnson, "Digital Transformation in Latecomer Industries: CIO and CEO Leadership Lessons from Encana Oil & Gas (USA) Inc.," *MIS Quarterly Executive*, vol. 10, no. 4, pp. 141-156, 2011.
- [11] P. Aubert and E. Caroli, "New technologies, workplace organisation and the age structure of the workforce: Firm-level evidence," *Economic Journal*, vol. 116, no. 509, pp. F73-93, 2005.

- [12] D. J. Armstrong, C. K. Riemenschneider, and L. G. Giddens, "The advancement and persistence of women in the information technology profession: An extension of Ahuja's gendered theory of IT career stages," *Information Systems Journal*, vol. 28, no. 6, pp. 1082-1124, 2018.
- [13] K. Kyte. "23 Canadian women currently making big moves in the tech scene." <https://dailyhive.com/vancouver/canadian-women-in-tech-march-2019> (accessed 20 June, 2020).
- [14] G. Valenduc *et al.*, *Widening Women's Work in Information and Communication Technology*. Brussels, Belgium: European Commission, 2004.
- [15] M. Maneesatitya and W. Fongsuwan, "Structural equation model of variables affecting turnover intentions on Bangkok's information technology career professionals," *Research Journal of Business Management*, vol. 8, no. 4, pp. 453-463, 2014.
- [16] R. Vandhana and K. R. Sowmya, "Relationship between Job Satisfaction and Employee Turnover in IT Organizations," *International Journal on Global Business Management & Research*, vol. 4, no. 1, pp. 62-69, 2015.
- [17] M. Booz. "The 3 Industries Have the Highest Talent Turnover Rates." <https://business.linkedin.com/talent-solutions/blog/trends-and-research/2018/the-3-industries-with-the-highest-turnover-rates> (accessed 17 June, 2020).
- [18] W. B. Barclay, J. R. Chapman, and B. L. Brown, "Underlying Factor Structure of Schein's Career Anchor Model," *Journal of Career Assessment*, vol. 21, no. 3, pp. 430-451, 2013.
- [19] E. H. Schein, "Career anchors revisited: Implications for career development in the 21st century," *Academy of Management Perspectives*, vol. 10, no. 4, pp. 80-88, 1996.
- [20] E. H. Schein and J. Van Maanen, "Career anchors and job/role planning: Tools for career and talent management," *Organizational Dynamics*, vol. 45, no. 3, pp. 165-173, 2016.
- [21] E. H. Schein, "Career Anchors and Career Paths: A Panel Study of Management School Graduates," Sloan School of Management, M.I.T., Technical Report 1, 1974.
- [22] D. C. Feldman and M. C. Bolino, "Careers within careers: Reconceptualizing the nature of career anchors and their consequences," *Human Resource Management Review*, vol. 6, no. 2, pp. 89-112, 1996.
- [23] J. R. Chapman and B. L. Brown, "An empirical study of the career anchors that govern career decisions," *Personnel Review*, vol. 43, no. 5, pp. 717-740, 2014.
- [24] T. J. DeLong, "Reexamining the career anchor model," *Personnel*, vol. 59, no. 3, pp. 60-61, 1982.
- [25] M. Templier and G. Pare, "A Framework for Guiding and Evaluating Literature Reviews," *Communications of the Association for Information Systems*, vol. 37, no. 6, pp. 112-137, 2015.
- [26] M. Farjoun, C. Ansell, and A. Boin, "Pragmatism in Organization Studies: Meeting the Challenges of a Dynamic and Complex World," *Organization Science*, vol. 26, no. 6, pp. 1787-1804, 2015.
- [27] M. Igbaria, J. H. Greenhaus, and S. Parasuraman, "Career Orientations of MIS Employees: An Empirical Analysis," *MIS Quarterly*, vol. 15, no. 2, 1991.
- [28] R. G. Crepeau, C. W. Crook, M. Goslar, D., and M. E. McMurtrey, "Career anchors of information systems personnel," *Journal of Management Information Systems*, vol. 9, no. 2, pp. 145-160, 1992.
- [29] H. Ramakrishna and D. Potosky, "Structural shifts in career anchors of information systems personnel: A preliminary empirical analysis," *Journal of Computer Information Systems*, vol. 42, no. 2, pp. 83-89, 2001.
- [30] H. Ramakrishna and D. Potosky, "Conceptualization and Exploration of Composite Career Anchors: An Analysis of Information Systems Personnel," *Human Resource Development Quarterly*, vol. 14, no. 2, pp. 199-214, 2003.
- [31] I. C. Chang, H. G. Hwang, C. F. Liu, and S. H. Siang, "A study of career anchors and job characteristic preferences of IS students," *Journal of Computer Information Systems*, vol. 47, no. 3, pp. 24-33, 2007.
- [32] R. M. Wong, A. M. Fiedler, and C.-H. Liu, "Exploring the motivation of students in choosing information systems as their major," *Issues in Information Systems*, vol. VIII, no. 1, pp. 198-203, 2007.
- [33] J. J. Jiang, J. Motwani, and R. A. Pick, "Managing entry-level IS professionals: Using career orientation constructs," *Journal of Computer Information Systems*, vol. 36, no. 3, pp. 105-110, 1996.
- [34] J. J. Jiang and G. Klein, "Supervisor Support and Career Anchor Impact on the Career Satisfaction of the Entry-Level Information Systems Professional," *Journal of Management Information Systems*, vol. 16, no. 3, pp. 219-240, 1999.
- [35] J. J. Jiang, G. Klein, and J. L. Balloun, "The joint impact of internal and external career anchors on entry-level IS career satisfaction," *Information and Management*, vol. 39, no. 1, pp. 31-39, 2001.

- [36] M. K. Hsu, H. G. Chen, J. J. Jiang, and G. Klein, "Career Satisfaction for Managerial and Technical Anchored IS Personnel in Later Career Stages," *Data Base for Advances in Information Systems*, vol. 34, no. 4, pp. 64-72, 2003.
- [37] J. L. Quesenberry and E. M. Trauth, "The (dis)placement of women in the IT workforce: an investigation of individual career values and organisational interventions," *Information Systems Journal*, vol. 22, no. 6, pp. 457-473, 2012.
- [38] M. Igbaria, G. Meredith, and D. C. Smith, "Career orientations of information systems employees in South Africa," *Journal of Strategic Information Systems*, vol. 4, no. 4, pp. 319-340, 1995.
- [39] C. F. Huang, "A longitudinal and comparative study for career orientations dynamics of information systems professionals," *International Journal of Business and Systems Research*, vol. 2, no. 1, pp. 52-66, 2008.
- [40] C. L. H. Chang, "The study of the turnover of MIS professionals - The Gap between Taiwanese and US societies," *International Journal of Information Management*, vol. 30, no. 4, pp. 301-314, 2010.
- [41] C. L. H. Chang, K. N. Shen, and S. Wu, "Career anchors of IT/IS personnel: A cross-culture research based on the guanxi culture theory," *Journal of Global Information Management*, vol. 28, no. 4, pp. 160-190, 2020.
- [42] J. Arnold, C. Coombs, R., and M. Gubler, "Career anchors and preferences for organizational career management: a study of information technology professionals in three European countries," *The International Journal of Human Resource Management*, vol. 30, no. 22, pp. 3190-3222, 2019.
- [43] A. P. George and A. N. Joji, "Turnover Intentions: Perspectives of IT Professionals in Kerala," *IUP Journal of Organizational Behavior*, vol. 10, no. 1, pp. 18-41, 2011.
- [44] C. L.-H. Chang, J. J. Jiang, G. Klein, and H.-G. Chen, "Career anchors and disturbances in job turnover decisions - A case study of IT professionals in Taiwan," *Information & Management*, vol. 49, no. 6, pp. 309-319, 2012.
- [45] C. L.-H. Chang, V. Chen, G. Klein, and J. J. Jiang, "Information system personnel career anchor changes leading to career changes," *European Journal of Information Systems*, vol. 20, no. 1, pp. 103-117, 2011.

Biographical notes



Catherine Cabot

Catherine Cabot is a student in the Doctor of Business Administration program specializing in project management at the Université du Québec en Outaouais (UQO). She is also an Aerospace Engineering (AERE) Officer currently serving in the Royal Canadian Air Force (RCAF) and has over a decade of experience managing aerospace and software projects in close collaboration with defense contractors.



Stéphane Gagnon

Stéphane Gagnon is Associate Professor of Business Technology Management (BTM) with the Department of Administrative Sciences at the University of Quebec in Outaouais (UQO). He obtained in 2001 a Ph.D. in Business Administration from the University of Quebec at Montreal (UQAM), specializing in Technology Management and Strategy. His research is focused on analytics and intelligent systems for project and risk management as well as process optimization. He has published on such applications in financial services, cybersecurity, and healthcare.