

The Fourth Industrial Revolution: Issues and Implications for Career Research and Practice

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Abstract

The accelerating digitization and automation of work, known as the fourth industrial revolution, will have an enormous impact on individuals' career experiences. Yet the academic literature in vocational psychology and careers research has been remarkably silent on this trend so far. This paper summarizes some of the most important issues of the fourth industrial revolution as they pertain to career development. It then critically reviews how current models and frameworks of career development are suitable for addressing these emerging issues. Opportunities for future career development research and practice are outlined.

Keywords: digitization, career development, career choice, career counseling

Introduction

Digitization and automation of work—frequently referred to as the fourth industrial revolution (Schwab, 2016)—is considered by many to be the most important societal and economic trend in the world: one that will fundamentally change the nature of work, business, and society in the coming decades (Arntz, Gregory, & Zierahn, 2016; Brynjolfsson & McAfee, 2014; Ford, 2015; Frey & Osborne, 2013). These changes might lead to the elimination of thousands of jobs and the disappearance or fundamental change of many current occupations. At the same time, new occupations, new industries, and fundamentally new ways of work will likely emerge (Brynjolfsson & McAfee, 2014). It seems clear that digitization and automation might thus be one of the most important issues to shape the future nature of career choices, career development, and career counseling.

Surprisingly, however, the academic literature in vocational psychology, career studies, and career counseling has been largely silent on this major phenomenon, as is the case for the related disciplines of organization and management studies (Barley, Bechky, & Milliken, 2017). Hence, despite clear relevance, the scientific literature lacks a more profound discussion and investigation of the consequences of digitization and automation of work for career development research and practice. It seems particularly important to reflect critically on the extent to which prominent models and frameworks of career development are suitable for addressing the

occurring changes in the world of work and how career counseling practices might be affected by these changes.

To address these issues, I first summarize key elements of the current discussion about the nature and consequences of the digitization and automation of work. Based on this overview, I then address how recent models and perspectives from vocational psychology and career development are suitable for addressing these issues. Finally, I propose directions for future research, as well as implications for practices.

The Fourth Industrial Revolution

The economic and technological changes over the last centuries represent three major industrial revolutions: (1) mechanical production in the late 18th century; (2) mass industrial production in the later 19th century, and (3) personal computers and the internet in the 1960's (Frey & Osborne, 2013). Current changes in the world of work are frequently depicted as the fourth industrial revolution, or industry 4.0 (Schwab, 2016), characterized by key technologies, such as genetics, artificial intelligence, cloud computing, nanotechnology, biotechnology, and 3D printing, among others. In their widely popular book, Brynjolfsson and McAfee (2014) have called this the *second machine age*, and argued that the key difference from previous industrial revolutions is that current technology is no longer aimed at replacing physical labor and supporting humans in doing their work, but rather at replacing cognitive work and human workers altogether. Proponents of this view have stressed that technological progress is advancing with exponential speed and that we are currently just at the beginning of fundamental changes and technological breakthroughs that are yet to occur in the next few decades (Brynjolfsson & McAfee, 2014; Ford, 2015). One very prominent fear emerging from these envisioned changes is that automation and robots will gradually take over much of the work currently performed by humans (Ford, 2015).

Will digitization lead to the disappearance of work? In a widely popularized report, Frey and Osborne (2013) estimated that about 47% of total U.S. employment is at risk of being automated. To arrive at this conclusion, for 70 occupations, the authors estimated whether they were automatable or not, taking into account *bottlenecks to computerization* in terms of tasks that cannot be easily automated with current technology (i.e., perception and manipulation, creative intelligence, social intelligence). They then extrapolated this analysis to other occupations and to the U.S. economy based on numbers from the 2010 Bureau of Labor Statistics. The analysis specifically estimated that a large number of jobs in office and administrative support, sales, service, and production might be automated in the nearer future (i.e., one or two decades).

However, this analysis has been criticized on several grounds. First, jobs consist of many tasks, among which several might not be easily automated (Autor, 2015). Hence, automation usually affects some tasks, but not others, and is unlikely to eliminate entire occupations. Taking such a task-based approach, Arntz et al. (2016) estimated the extent to which specific tasks might be automated and the degree to which individuals in an occupation perform such tasks, based on the International Assessment of Adult Competencies Program. Arntz et al. (2016) estimated that 9% of all individuals in the United States are working in a job that has high potential for automation, with at least 70% of performed tasks being automatable based on current technology. This study also found significant differences between Organisation for Economic Co-operation and Development (OECD) countries, ranging from 12% (Germany and Austria) to 6% (Korea and Estonia) of work at high risk of automation. Across countries, the analyses revealed that workers

with higher educational levels and higher income were less likely to be at risk, whereas the majority of at-risk workers were low-skilled and have low income.

A second major criticism of the high estimates of potential job loss by Frey and Osborne (2013) has been that ever since the first industrial revolution, there have been protests and publicly raised concerns that technological progress will lead to mass unemployment and dehumanized work (Mokyr, Vickers, & Ziebarth, 2015). However, such fears have failed to materialize thus far. One reason for this is that whereas potential job loss due to automation is easy to see, people generally tend to underestimate the potential for new jobs that emerge due to the creation of new occupations and industries (Mokyr et al., 2015). Moreover, labor markets react dynamically to technological progress, and changing demand and supply of workers with different skills determine the extent to which it is economically desirable to automate work.

Hence, effects on productivity, labor demand, and labor earnings due to automation need to be taken into account. For example, automation in an industry can increase productivity, which reduces prices for the offered products, which can increase demand for that product, leading to new labor demand for workers in these industries (Mokyr et al., 2015). Finally, there are a range of ethical, legal, and societal (e.g., social acceptance of robots providing certain services) issues that impact the extent and speed at which technological possibilities are, in fact, realized (Arntz et al., 2016).

In sum, the extent to which digitization and automation will lead to an overall reduction of jobs is hard to estimate and there is no consensus in the literature on the degree to which digitization and automation will affect workforce demands. However, despite some rather pessimistic views (e.g., Ford, 2015), there is a general consensus among labor economists that mass unemployment is unlikely to be a major problem in the next few decades (Arntz et al., 2016; Autor, 2015; Furman, 2016). Nonetheless, there is agreement that we are about to witness major structural changes in the labor market and the way we work. These structural changes specifically pertain to increasing job polarization and people working in non-standard jobs.

Structural changes in the world of work. A major result of technological progress in the U.S. and European labor markets in recent decades was an increasing job polarization (Autor & Dorn, 2013; Goos, Manning, & Salomons, 2009). Job polarization describes the phenomenon where middle-skilled jobs are hollowed out, whereas lower-skilled service jobs and high-skilled jobs increase disproportionately. This is due to the fact that many middle-skilled jobs (e.g., office administration, machine operation) consist of cognitive or manual tasks that can relatively easily be automated with recent technology because they follow precise, predictable procedures. By contrast, low-skilled service jobs (e.g., personal care, cleaning, security) encompass many tasks that are relatively easy to do for humans, but very difficult to automate with current technology. On the other hand, high-skilled jobs (e.g., technicians, educators, managers) frequently involve creative problem solving and complex social interaction that are also harder to automate. One result of this job polarization is that many workers who performed middle-skill jobs have been pushed into lower paid and lower-skilled occupations, whereas the pressure to increase skills through lifelong learning and continued education in order to avoid this fate has grown (Frey & Osborne, 2013). Because the boundaries of which tasks can be automated are expanding rapidly, job polarization is likely also to continue with increased pressure on higher-skilled jobs (Autor, 2015).

A second major trend in employment that emerged in recent decades has been the increase of the *gig economy*, which includes crowdwork and work on-demand via apps (De Stefano, 2016). In crowdwork individuals complete a series of tasks online (e.g., reviewing documents, annotating photos, or entering data) for an infinite number of organizations worldwide, facilitated by a platform (prominent examples include MTurk and Clickworker). Work on-demand via apps involves completing physical tasks, such as transportation, cleaning, or running errands (prominent examples of platforms that offer such work are Uber, care.com, or Taskrabbit). It is difficult to obtain exact estimates of the size of the workforce in these types of work, but research from the OECD has shown that a considerable number of people are engaged in the gig economy, even though their relative numbers remain small (De Stefano, 2016). Based on a survey of more than 8,000 individuals in the United States, United Kingdom, Germany, Sweden, France, and Spain, the McKinsey Global Institute (2016) estimated that about 20–30% of the working age population in the United States and the European Union are engaged in independent work, which they define as exhibiting a high degree of autonomy regarding which assignments to accept; payment by task, assignment, or sales; and a short-term relationship between worker and customer. Interestingly, 56% use independent work only as supplemental income, among whom 29% do so out of financial necessity. Only 14% obtain their primary income from independent work and do so out of necessity. However, only 15% of all independent workers reported using a digital platform for their work. This number is likely to increase in the future, however, due to the benefits that such platforms offer in terms of larger pools of potential clients and provided digital infrastructure and payment services, or search and matching algorithms.

Applying Career Models to the Fourth Industrial Revolution

Clearly, changes in the labor market have major implications for labor protection, public policy, business, and society more generally (De Stefano, 2016). These changes also have important implications for career development and how prominent models and perspectives in career research and practice can address them. Among the most pressing issues for career development that emerge from these are the need to (a) be self-directed and flexible in one's career development; (b) engage in self-directed career management over the entire lifespan; (c) create a sense of meaning and identity in the work role despite nonstandard work arrangements; (d) and secure work that is able to fulfill basic human needs despite the loss of traditional employment relationships. In order to address these issues, the protean and boundaryless career models, social cognitive career theory (SCCT), career construction and life design, and the psychology of working theory (PWT) seem particularly promising. These models and frameworks feature prominently in the international career literature and provide direct linkages to key challenges for career development due to increasing digitization and automation of work.

Protean and boundaryless careers. The protean (Hall, 1996, 2004) and boundaryless (Arthur, 2014; Arthur & Rousseau, 1996) career models are two of the most prominent frameworks to address the emergence of *new careers* that have occurred in the past three decades (Sullivan & Baruch, 2009). Although there are important differences between these two models, both share the assumption that careers are increasingly described by a high degree of personal flexibility and psychological and physical mobility between and within organizations, as well as a self-directed and values-driven approach to career development (Briscoe & Hall, 2006). These core tenants of the protean and boundaryless career models seem to gain even more

importance for an increasingly large number of people in the future. In fact, it seems likely that organizational boundaries and organization-directed careers will continue to diminish in importance at an increasing speed. By contrast, taking responsibility for one's career development and being flexible in terms of working a multitude of jobs and for multiple organizations (even simultaneously) is likely to be a reality for an increasing number of people. The notions of protean and boundaryless careers thus hold continuing and potentially increased importance in a largely digitized and automated economy.

However, it also seems likely that additional features become important that have not yet been explicitly considered in these models. As careers increasingly will no longer consist of a series of jobs done sequentially over the life span for a number of organizations, but rather consist of different tasks and projects that a person completes for different organizations, the notion of a boundaryless career might change. This new form of boundaryless career does not pertain to changing jobs within or between organizations over a career, but rather working simultaneously for multiple employers in multiple projects in a short sequence, or even in parallel. Moreover, although the protean career is traditionally described as a pursuit of freedom and personal growth (Hall, 2004), career development in the future might increasingly not be driven by these values. As job insecurity is likely to become more widespread, and work in a digital economy naturally allows more freedom than traditional careers (e.g., by working remotely, being self-employed), we can expect for many people, the values of stability and income, that are commonly attributed to represent a "traditional" vs. a protean career (Hall, 2004), will increase in importance. By contrast, personal growth might be increasingly pursued in nonwork roles because more people might no longer be able to obtain work that promotes personal development in a meaningful way.

Finally, the protean career model stresses that the person, and not the organization, is in charge of career development. In the future, an increased role might be played by platforms of digital matchmakers (Evans & Schmalensee, 2016) that find matches between job seekers and potential employers, or between existing employees and new job opportunities within the current organization. In such models, neither the person nor the organization is the dominant driver of career development. Rather, both play a critical role by providing data about personal skills or job requirements, respectively, and securing a positive online reputation to find a good match facilitated by such platforms. In sum, whereas the basic notions of protean and boundaryless careers seem increasingly relevant in the future, the expected changes in the world of work might mean that the specific components of what constitutes a protean and boundaryless career might need to be somewhat adjusted to new realities.

Social cognitive career theory. SCCT (Lent & Brown, 2013; Lent, Brown, & Hackett, 1994) seems well suited to explaining career self-management across the lifespan. It can also be applied to understand how and why people might or might not choose to work in new occupations and enter emerging industries, as well as how to assist individuals in such career choices. As suggested by SCCT research (Sheu et al., 2010; Sheu & Bordon, 2017), the extent to which somebody has high self-efficacy expectations regarding the tasks that are required in new jobs and industries as well as the perceived desirability of job characteristics and work outcomes of these new career options (i.e., outcome expectations) will play a major role in determining the extent to which somebody develops an interest in a new occupation or industry field. In addition, supports and barriers from the distal (e.g., cultural, economic) and proximal (e.g., family, work) environment are important for understanding under which conditions people will make actual

career choices for, and ultimately work in, new occupations and industries that might emerge due to digitization and automation.

In addition to addressing the issue of career choices, the more recent expansion of the social cognitive career model to career self-management (Lent & Brown, 2013) seems particularly suited to explaining career development issues in a more digital and automated economy. Given the increased tendency toward self-employment, and the constant need to update one's skills and knowledge to keep up with technological change, career self-management can be expected to play an ever-increasing role.

The social cognitive framework can be a useful guide to explain, investigate, and intervene regarding factors that enable and motivate individuals to actively manage their careers through various self-directed career behaviors. For example, actively building networks across professional and organizational boundaries might become increasingly important for securing continuous employment. Another critical self-directed career behavior in this context is to constantly update one's professional skills. This can occur via formal education and continuing education over the life course. However, it also pertains to updating skills on the job by adapting to and working with ever-changing systems and technologies. This demand for continued learning and skill development places a high burden on people and not everyone will be able or willing to comply. The social cognitive model can offer a useful guide to understanding the conditions that enable and motivate people for self-directed career behaviors, such as networking and upskilling, as well as for designing interventions to assist individuals in this regard. Specifically, as suggested by SCCT and emerging research (Lent, Ezeofor, Morrison, Penn, & Ireland, 2016), strong self-efficacy and positive outcome expectations toward career behaviors, like networking and learning, motivate people to set goals related to such behaviors. Depending on personality, contextual supports, and barriers, such goals are then put into action and result in various career outcomes.

Career construction and life design. The fourth industrial revolution makes constructing a clear sense of professional identity and finding meaning in work increasingly challenging for many people. Career construction theory and practice (CCTP; Savickas, 2013) offers a valuable framework for how counselors can assist people to construct a sense of coherence and purpose across their diverse work experiences. As this approach suggests, helping people to identify life themes, deconstructing and co-constructing identities, and connecting these with past and future work experiences can create a sense of meaning and give direction and purpose to one's work role. Within the corresponding paradigm of life design (Savickas et al., 2009) CCTP stresses the construction of a professional identity from a holistic perspective that takes identities from nonwork domains, such as leisure, family, community, into account. Given that we can expect the work role to be significantly reduced in importance for some people, and digitization and automation are increasingly blurring the boundaries between work and nonwork roles, constructing a holistic sense of identity that encompasses work and nonwork will become increasingly important for many people. Career construction and life design can be used to help people find meaning and a sense of purpose that encompasses their work and other roles.

An important component of CCTP and life design that has received considerable recent research attention is career adaptability (Johnston, in press; Rudolph, Lavigne, & Zacher, 2017). Career adaptability denotes a psychosocial construct that represents an individual's resources for coping with career tasks and that help individuals to implement their identities in a work role (Savickas, 1997; Savickas & Porfeli, 2012). Given the increased dynamics in career development

due to rapid technological change, being able to adapt to changing circumstances and to find ways to secure work that provides a sense of meaning and purpose can be expected to become increasingly important for many people. The notion of career adaptability can thus help in understanding which psychosocial resources people need to successfully deal with the challenges of an increasingly digitized and automated world of work. However, it is important to note that career adaptability resources are only one facet of a broader set of career resources that individuals need to successfully develop a career (Hirschi, 2012). It is important to also consider how human capital resources, social capital resources, and environmental (e.g., organizational, labor market) resources help people to cope and adapt with the merging changes at work.

Psychology of working theory. Changes in the nature of work indicate that increasing numbers of people are or will be without permanent employment by a single employer and work in a series of more independent tasks and projects (Brynjolfsson & McAfee, 2014; De Stefano, 2016). This poses important challenges to how work can fulfill basic human needs in terms of security, survival, social connection, and self-determination. This means that the call to pay more attention to the career experiences of people who are outside of the mainstream of more traditional career paths might become even more important (Blustein, 2006). However, a frequent critique of most career development theories and frameworks is that they were derived for—and are particularly suited to explain—the career choices and career development of relatively highly educated people, mostly men working in white-collar jobs. By contrast, the career experiences of people from low socioeconomic backgrounds and individuals working in lower-qualification or blue-collar jobs have been largely neglected in the contemporary career discourse (Blustein, 2006; Richardson, 1993). Therefore, career research needs to broaden its scope and use theoretical frameworks that can encompass non-typical career patterns. Such frameworks need to be applicable to people without permanent employment, who hold multiple jobs, or have very limited career advancement opportunities. PWT (Blustein, 2006; Duffy, Blustein, Diemer, & Autin, 2016) provides a potentially useful framework to address this issue. That is because it was specifically derived to address the work experiences of marginalized people and individuals from lower socioeconomic backgrounds with limited financial and social capital.

PWT recognizes that work is an essential aspect of life and is critical for mental health because it can fulfill the central human need for competence, relatedness, and autonomy. PWT builds on a broad definition of work that includes caregiving work outside of the marketplace, and that acknowledges work and nonwork are closely intertwined for most people. Moreover, the theory stresses that to understand work experiences, social, political, economic, and historical forces need to be taken into account. Given the continuing polarization of the job market (Autor, 2015), an increasing number of people might be faced with limited career choices and an increased difficulty to secure decent work, defined by physically and interpersonally safe working conditions, hours that allow for free time and adequate rest, organizational values that complement family and social values, adequate compensation, and access to adequate health care (Duffy et al., 2016; International Labor Organization, 2012). Whereas PWT has not been derived by considerations of an increasingly digitized and automated world of work, its approach of focusing on marginalized people, work volition, and decent work provides a valuable starting point to address some key challenges of career development in a digitized and automated economy.

Implications for Research and Practice

Future research directions. Given the profound changes in the world of work that lie ahead, career research should address several key issues. Informed by PWT (Blustein, 2006; Duffy et al., 2016) and the career construction and life design perspectives (Savickas, 2013; Savickas et al., 2009), a first challenge for future research is to examine how people can derive intangible benefits from work (e.g., social connection, sense of purpose, sense of competence) in a digitized economy. For example, the classic notion of a professional identity built around a relatively stable occupation and associated tasks will need to be revised for many people. This will be especially pronounced for people forced to downgrade their work to perform relatively unconnected and mundane tasks due to increasing job polarization. For others, work might no longer occupy the majority of their time, and might only be one of several areas of activity.

Moreover, we can expect an increasing interconnection between work and nonwork. Examining such issues might be informed by the protean career model that stresses a whole-life perspective on career management (DiRenzo, Greenhaus, & Weer, 2015) as well as by career construction and life design approaches that focus on how people can integrate diverse identities into a meaningful personal narrative (Savickas et al., 2009). One aspect in this regard concerns the question of how people can manage the boundaries between work and other life domains when these areas are no longer physically separated due to the increased use of telework (Diaz, Chiaburu, Zimmerman, & Boswell, 2012). A core issue to examine is thus how people form professional identities in relation to nonwork roles, and how they integrate nonwork roles in their career choices and career planning (Greenhaus & Kossek, 2014). Researchers could examine if and how the subjective meaning of work changes under such conditions, and what effects new forms of vocational identities have on career commitment, job satisfaction, and well-being.

Building on the social cognitive model of career self-management (Lent & Brown, 2013) as well as the protean and boundaryless career frameworks (Arthur, 2014; Hall, 2004), a second major issue to address is what career behaviors, attitudes, and potentially new career competencies are needed by individuals to thrive in the new economy. Lent and Brown (2013) have given an overview of adaptive career behaviors that are important in different career periods (e.g., developing work readiness and employability skills in the exploration period during adolescence). Although these behaviors, based on past and current economic conditions, are likely to continue to play an important role in the future, it is also likely that the economic changes will call for additional new behaviors, attitudes, and competencies. For example, it seems increasingly important to be able to secure work from a range of employers by using digital matchmaker platforms. Individuals need to be able to present themselves well on such platforms and build an online reputation of the high quality and reliability of their work. Also, building and updating professional skills constantly and quickly by using digitized sources (e.g., online training programs, online courses, online communities) as well as creating, maintaining, and using digital networks to other workers and potential employers seems increasingly critical. Future research could examine which new career behaviors, attitudes, and competencies are important for success in the new economy, and who is more or less likely to exhibit and develop these under certain conditions.

SCCT (Lent & Brown, 2013; Lent et al., 1994), CCTP (especially its focus on adaptability resources; Savickas & Porfeli, 2012), and PWT (Blustein, 2006; Duffy et al., 2016) can provide useful frameworks to address the issues of which new career tasks emerge that people need to

cope with, and which personal and environmental resources are important for doing so. For example, a key career task for many people is to continuously adapt to—and learn to work with—increasingly fast-changing technology. Though acquiring career relevant experiences and skills has traditionally been positioned to play a major role in one's early career and the exploration phase of one's career (Super, 1990), the ongoing changes in the economy will compel individuals at every career and life stage to upgrade their skills and knowledge. Another emerging career task for many people at all career stages will be to secure and successfully handle multiple jobs from multiple employers at any given time in their career—for example, by providing services or completing tasks and projects via multiple digital platforms. Such work arrangements will be needed to achieve desirable levels of job security and income. One key challenge for career research is thus to identify such key career tasks with which people are increasingly confronted. In addition, research needs to determine how individuals can successfully deal with these tasks. Here, a close examination of how different personal (e.g., knowledge, motivation, traits) and environmental (e.g., social support, organizational support) career resources (Hirschi, 2012; Hirschi, Nagy, Baumeler, Johnston, & Spurk, in press) assist in addressing career challenges seems important.

A final suggestion for future research is to capitalize on new data sources and methodologies that become available due to increasing digitization and that might help to better examine the emerging research questions. For example, social network sites such as LinkedIn offer a wealth of information on educational experiences and job sequences from people around the world that might be analyzed to derive new insights into career patterns, including the sequence of jobs and educational experiences that typically lead to certain positions (for a related example see Biemann, Fasang, & Grunow, 2011). Moreover, organizations are using tools such as *Cornerstone* to collect and manage increasing amounts of digital data on all aspects of employee behavior and performance, including assessment results, completed job assignments, trainings, and work experience. Such data might provide new insights into predictors of career success, well-being at work, and different career trajectories. Researchers can also consider to partner with platforms that offer on-demand work to investigate work experiences of workers in the gig economy by combining data from these platforms with additional survey questions (for an example see Rockmann & Ballinger, in press). Finally, the widespread use of smartphones and smart watches allows researchers to collect real-time data, including picture and audio recordings and physiological measures. Studies capitalizing on such technologies could offer new insights into the daily behaviors and experiences of workers in diverse work arrangements (for a related example see Ilies, Liu, Liu, & Zheng, 2017).

Practice implications. Changes in the world of work offer several opportunities for career counseling practices. Given the increasing speed at which current occupations change, more and more people are confronted with familiarizing themselves with new occupations and industries that might offer new employment opportunities and career prospects. Career professionals can play an increasingly important role in helping people make sense of these changes and obtain, evaluate, and apply career-relevant information for their career decision making and career planning. Moreover, career professionals can assist people in coping with the constant change in their current jobs and staying employable through continued education and learning. Career counselors can help clients to identify learning and training needs, as well as assist them in finding

and successfully completing trainings and education, including capitalizing on the increasing number of online resources in this regard.

To deliver such support, counselors and career centers can also use new ways to reach new groups of clients by developing online assistance. The potential of computer-assisted assessment via the Internet (Tracey, 2010), virtual counseling centers (Horan, 2010), and web-based self-help and interventions (Gati & Asulin-Peretz, 2011) has been recognized for some years. However, in their review of intervention studies conducted within the last 20 years, Whiston, Li, Goodrich Mitts, and Wright (2017) were able to identify only 4 out of 57 interventions that were computer guided. Practitioners should see this as a call to action to more readily develop and integrate online- and computer-assisted career interventions into their practices and to partner with researchers to evaluate the effectiveness of such approaches. Computer-assisted interventions have the potential to reach and engage a much larger and diverse group of people, who might benefit from such services given the challenges of digitization and automation of work, but are not typically reached by more traditional career support (Nota, Santilli, & Soresi, 2016). Digital career support could be offered in the form of online self-assessment, delivering online career information (e.g., through video or virtual reality), or offering video-based online counseling. However, there also is considerable potential to design online career guidance systems that capitalize on the advances in artificial intelligence and the increasing amount of available data on people's careers. Such systems might offer an adaptive evaluation of a person's career concerns guided by tailored, automated interview questions and assessments followed by individualized suggestions for activities to support self-directed career management.

Summary and Conclusion

There is widespread agreement in society, politics, education, and business that digitization and automation will lead to fundamental changes in the way we work over the next few decades (e.g., Brynjolfsson & McAfee, 2014; De Stefano, 2016; Frey & Osborne, 2013). However, the professional career development and vocational psychology literature has not tackled the implications of these changes for the field in a systematic way. To address this issue, this paper provided an overview of some of the major trends that career researchers and practitioners need to be aware of. It then provided an analysis of the extent to which current prominent models and frameworks of career development and career counseling are suited to address the emerging issues. Finally, the paper outlined needs and opportunities for future research and practice. It should be acknowledged that other frameworks and approaches not reviewed herein might also offer valuable insights on the issue of digitization and automation of work. The selection of the presented models and frameworks is thus somewhat subjective and limited by space constraints. Future work could offer additional analyses of other models and frameworks as well as develop new theory regarding how people can successfully develop their careers in the future world of work.

The changes addressed herein do not propose to lead to fundamentally different careers for a majority of people in the next few years. Many researchers have pointed out that despite the popular notion of new careers introduced some decades ago (Dries & Verbruggen, 2012; Hall, 2004), many people still have very traditional career paths (Biemann, Zacher, & Feldman, 2012; Inkson, Gunz, Ganesh, & Roper, 2012) and traditional career attitudes (Gerber, Wittekind, Grote, & Staffelbach, 2009). Similarly, there is sound reason to believe that within the next decade, most

people will still hold rather traditional jobs and that most current issues of career development will remain important. However, just as the notion of new careers outlined some important trends in the world of work that affected career development in the past three decades, the herein outlined issues are likely to lead to changes of at least a similar magnitude in the decades to come. Although these changes will not occur overnight, and might not affect all people equally, it nonetheless remains critical for careers researchers and practitioners to continue to actively engage in the conversation about what increasing digitization and automation of work means for workers and our field, and how research and practice can address these emerging trends.

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