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Technology Entrepreneurship Intention among Higher Education Institutions Students: A Literature Review

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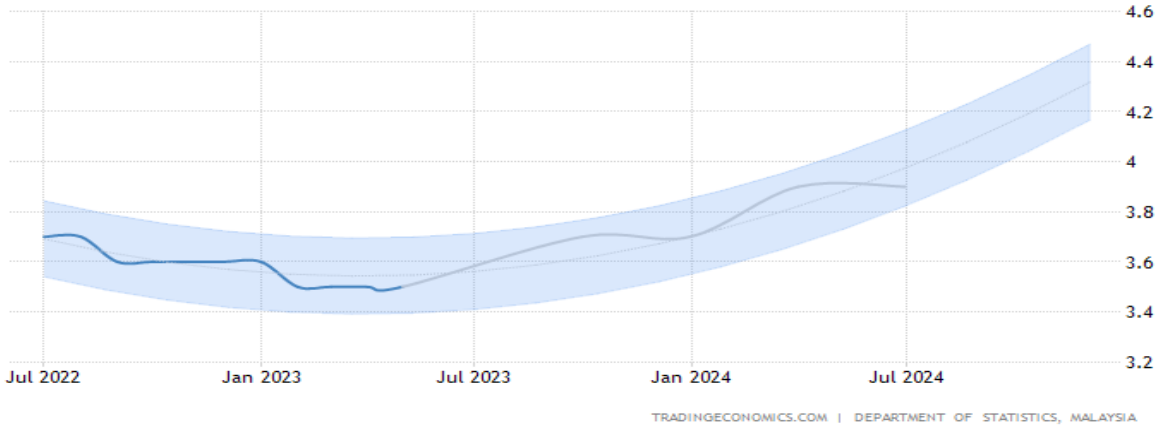
Abstract: Technology entrepreneurship is a new breed of entrepreneurship in a technology context, where it merges technology prowess and entrepreneurial skills. Technology plays a critical role in Industry Revolution 4.0; hence undoubtedly technology entrepreneurship is crucial in business settings as well as for economic developments. The intention to become technopreneurs among students from higher education institutions has become more and more prominent since it can be seen as a valuable way to contribute to the labor market to solve unemployment issues. However, despite data showing that the unemployment rate in Malaysia post-COVID is at a worrying state, studies on technology entrepreneurship intention are still lacking, with few areas being under-researched. This paper attempts to provide a review of existing academic literature on technology entrepreneurship intention among university students, revealing the current state and future direction of technology entrepreneurship intention research. Using a systematic literature review (SLR) method, the research papers were analyzed between the years 2017 and 2023 (7 years) to see the trend in the current years. The result shows that previous studies do not cover the subject comprehensively. Subjective norms were the least studied factor, despite their importance in shaping an individual's behavior and intention. It was also found that none of the papers studied the role of government support and social media towards technology entrepreneurship intention. The identification of these under-researched areas will provide future directions for researchers to empirically study the factors. This paper may also provide future directions for the government in ensuring that more graduates have the intention to pursue technology entrepreneurship which will in turn contribute to the country's economic growth.

Keywords: *Technology entrepreneurship, technology entrepreneurship intention, technopreneurship intention and higher education institutions students.*

1. Introduction

The issue of unemployment is one of the complex issues in developing countries (Saraih et al., 2018). According to a report by the UN's International Labor Organization (ILO), global unemployment is projected to reach 208 million people in 2023, with an unemployment rate of 5.8% (Ventura, 2023). Meanwhile, the Department of Statistics Malaysia (2020) has reported in the middle of the COVID-19 pandemic's severe effects, the unemployment rate increased by 46.10% from the previous year, while the employment rate faced a 0.40% decline. As shown in Figure 1, a forecast made by Trading Economics shows that Malaysia is expected to face an increase in the number of unemployed in the year 2024.

Figure 1: Malaysia Unemployment Rate



Source: Trading Economics.

It is also important to note that unemployment does not only occur among those with lower education levels but is also prevalent among those with higher education levels (Refer to Table 1). This is indicated by the challenges encountered by graduates from higher education institutions in seeking jobs either in the public or private sectors as a result of the volatile economic environment (Deuchar & Dyson, 2020).

Table 1: Education and Gender Profile of Malaysia's Labour Force 2019

Highest education attained		Share of labour force	Labour force participation rate	Unemployment rate
Total	*Overall*	*100%*	*68.7%*	*3.3%*
	No formal education	2.9%	60.2%	2.7%
	Primary	11.9%	70.8%	1.7%
	Secondary	55.6%	68.1%	3.3%
	Tertiary	29.6%	70.0%	3.9%
Male	*Overall*	*100%*	*80.8%*	*3.2%*
	No formal education	2.9%	78.5%	2.9%
	Primary	13.1%	88.7%	1.9%
	Secondary	59.3%	81.8%	3.3%
	Tertiary	24.8%	75.4%	3.5%
Female	*Overall*	*100%*	*55.6%*	*3.4%*
	No formal education	3.0%	44.7%	2.4%
	Primary	10.0%	50.0%	1.4%
	Secondary	49.7%	51.9%	3.2%
	Tertiary	37.2%	65.1%	4.3%

Source: Lee (2020); Department of Statistics (2020).

As shown in Table 1, the overall unemployment rate of Malaysians in the year 2019 was 3.3%. The problem that can be seen is the high number of unemployment among those in the tertiary education group, which is at 3.9%. In this competitive higher education arena, higher educational institutions produce thousands of graduates each year, but not all of them secure appropriate job opportunities. The high level of unemployment among graduates from higher education institutions is associated with the fact that most college graduates prefer to be job seekers rather than job creators (Bod'a & Považanová, 2021; Chakraborty et al., 2021). This simply indicates the graduates' lack of entrepreneurial intention. Failure to enforce appropriate solutions to this problem implies that many college graduates will remain job seekers and will experience long periods of waiting to be recruited, therefore increasing the unemployment rate (Hartono, 2021). According to Shamsudin et al. (2017), one of the most important economic development techniques to foster a nation's economic growth and ensure its competitiveness in the face of escalating globalization trends is entrepreneurship.

Technology, like entrepreneurship, has given this life a new dimension. Technology has made life simultaneously easier and more efficient. With technology, humans can achieve so much and get things done in a very short period. On top of that, technology has played a vital role in businesses as the world is turning into the Industry Revolution 4.0. Technology entrepreneurship involves identifying, developing, and commercializing innovative technological solutions to address market needs or opportunities. Technology entrepreneurship has garnered significant attention on innovation, industry transformation, and social revolution as it is a catalyst for industry revolution that would reshape the global economy post-pandemic. Hoque, Awang & Siddiqui (2017) mentioned in their study that in the age of technological globalization, technology entrepreneurship becomes prominent to make society better as a whole and to have economies that are capable of progressing globally. A technology startup is considered a source of employment since it typically develops new products and services that lead to new demand and highly skilled labor that necessitates the creation of new jobs.

Harrison et al. (2014) studied the effects of innovation on the employment growth of four European countries (France, Germany, the United Kingdom, and Spain), and the results showed that product innovation is positively associated with the employment growth of all sampled countries. This shows that the creation of new products and services developed by technology-based companies can be a key reason to generate effective demand and increasing employment. This is further supported by a number of studies that have shown the positive effect of technology startups on employment growth and performance (Pyka, 2017; Choi et al., 2020). Thus, it is essential to understand the existence of technopreneurs, technology entrepreneurship, and entrepreneurial intentions, particularly among higher education institution students. Technology entrepreneurship intention refers to the willingness and desire of individuals, in this case, higher education institution students, to engage in technology entrepreneurship. It reflects their aspiration to become technology entrepreneurs and pursue entrepreneurial endeavors in the technology sector. The concept of entrepreneurial intention was explained in the theory of planned behavior by Azjen (1991), in which three determinants influence one's intention to do something, namely attitudes, subjective norms, and perceived behavioral control. Generally speaking, entrepreneurial intentions are influenced by internal, external, and contextual factors (Asma, Rosdi, Amri, Adnan, and Samsudin, 2018).

Mohd and Shamsudin (2017) stated that the technology entrepreneurship intention is a personality trait in which individuals embraces their way of thinking by highlighting the possibility of generating new value and advancing their careers. Hence, having the intention to be entrepreneurs may encourage the students (who later become future graduates) to embrace the values needed for their career prospects. Intention is a key factor in pursuing a career as a technopreneur. However, research on entrepreneurial intention toward technology entrepreneurship is still insufficient due to a vast number of entrepreneurial intention studies focusing on traditional entrepreneurship. Consequently, there is a scarcity of research on technology entrepreneurship as a career option among university students, and clarification of factors towards entrepreneurial intention is also lacking (Belmonte and Lira, 2023). A limited number of studies on technology entrepreneurship intention have been conducted; particularly in the context of students from higher education institutions (Refer to Table 2). However, previous studies do not cover the subject comprehensively, leaving a few important variables behind. Therefore, the following objectives were established for this study: i) to identify, evaluate, and interpret current research by previous authors on factors influencing technology entrepreneurship intention among students from higher education institutions; ii) to identify under-researched factors towards technology entrepreneurship intention as a recommendation for future study.

2. Literature Review

Technology is an application of scientific knowledge that has transformed the world today. It has not only made life easier, but it has also expedited it. With technology, work can be completed in a matter of minutes. Entrepreneurship, like technology, has added another dimension to human life. It is impossible to dismiss the fact that most, if not all, forms of employment today stem from some form of entrepreneurship. Both technology and entrepreneurship are the products of the human intellect, and when merged, they form a compound that could be used to benefit society in a great way. Technology entrepreneurship is a new breed of entrepreneurship in a technology context. It is the result of merging technology prowess and entrepreneurial skills. This term has been used by many scholars since 1983 when it was first introduced. Technology entrepreneurship is the practice of recognizing and capitalizing on human resources and business opportunities in the field of technology (Dorf and Byers, 2011).

According to Yordanova (2021), technology entrepreneurship is the establishment of a new firm offering products or services that rely heavily on the application of scientific or technological expertise. Ferreira et al. (2016) stated that technology entrepreneurship is a combination of entrepreneurship and technology-based innovation. This is similar to the definition provided by Beckman, Eisenhardt, Kotha, Meyer and Rajagopalan (2012), where it is defined as a type of entrepreneurship that aims to exploit opportunities related to advances in science and engineering. Technology entrepreneurship is an instrument that facilitates prosperity in individuals, businesses, states, and nations. In the business world, the advent of technology entrepreneurship is regarded as an economic development engine. This is because technological innovation often enhances the quality of life and allows greater convenience, while also opening up new possibilities for

businesses.

Hence, fostering technology entrepreneurship is vital since technology development may promote wealth generation and economic progress (Yordanova, 2021). Entrepreneurial intention is the first and most important phase in the entrepreneurial process (Molino et al., 2018). Without it, no further entrepreneurial actions can be taken. As a result, scholars have paid close attention to entrepreneurial intention to better understand how entrepreneurship emerges and why people become involved in venture creation (Alammari et al., 2019; Saiqal et al., 2019). Intention has been referred to as a state of mind in a way that directs one's attention towards a certain purpose to attain a specified goal (Bird, 1988). It has recently become one of the most popular theoretical frameworks for understanding the influencing factors of entrepreneurial behavior (Liñán and Fayolle, 2015). Mohd and Shamsudin (2017) have defined technology entrepreneurship intention as a psychological feature in which people adopt a way of thinking that emphasizes chances to generate new value and promote their profession, particularly among Malaysian graduates. The concept of intent appears to be fundamentally basic to human decision-making (Al-Jubari et al., 2018; Krueger, 2009). As a result, entrepreneurship is an intentional activity and planned behavior (Al-Jubari et al., 2018; Bird and Jelinek 1988). As such, the study of technology entrepreneurship intention serves an important purpose beyond satisfying intellectual curiosity. A high rate of unemployment among graduates has become one of the main issues in Malaysia (Bahrim et al., 2019).

Instead of waiting to be recruited, graduates are encouraged to create employment by becoming either technopreneurs or entrepreneurs. Technology entrepreneurship is regarded as a way to combat the global prevalence of graduate unemployment (Boldureanu et al., 2020), ensuring that they become technopreneurs. This is mainly due to the ability of technology entrepreneurship intention to develop a state of mind that drives and steers individual behaviors toward the development of innovative technology-based business concepts. Higher education institutions play a crucial role in shaping students' attitudes, skills, and intentions toward technology entrepreneurship. Thus, higher learning institutions and Small and Medium Enterprise (SME) corporations in Malaysia have taken dynamic approaches to encourage students to get involved in technology entrepreneurship or entrepreneurship through different classes, workshops, seminars, and activities. For example, Universiti Teknologi MARA (UiTM) has been offering a Technology Entrepreneurship course to inculcate entrepreneurial skills among Science and Technology cluster students and promote the development of technology-based ventures among students and graduates (Universiti Teknologi MARA, 2023). Through classes and seminars, it is hoped that students will learn and develop the technopreneurial mindset, which helps to identify and exploit technology entrepreneurship-related opportunities. Several researches have been conducted by different authors to understand factors contributing to technology entrepreneurship intention among university or higher education institution graduates.

Hoque, Awang and Siddiqui (2017) determined that technopreneurial self-efficacy (TSE) and technopreneurial learning had positive effects on technopreneurial intention among students who enrolled in business courses in Malaysian universities. This is supported by other studies by Nurhayati et al., (2019), Machmud et al., (2020) and Wardani et al., (2020) that also reported a positive relationship between technopreneurial learning and technopreneurial intention. On the other hand, a study by Utami (2018) indicated that environmental factor has a significant effect on technopreneurial intention, while academic climate has a significant effect on attitude and self-efficacy, hence creating a positive environment and academic climate is important to support technopreneurial intention among undergraduate students. Similarly, in another study by Boller (2018), it was found that technopreneur-related activities significantly affect technopreneurial intention and suggested that educators and policymakers incorporate more technopreneurial-related activities in their fields to develop intention. Other studies have focused on individual factors such as computer self-efficacy, Internet self-efficacy, individual entrepreneurial orientation, technopreneurial self-efficacy, risk-taking propensity, motivation, and others. For example, Koe et al., (2018) found in their study that computer self-efficacy and Internet self-efficacy positively influence technopreneurial intention among university students. Salhieh and A-Abdallat (2022) also found in their study that technopreneur self-efficacy had a positive and significant impact on technopreneurial intentions, suggesting that those who express an interest in launching a new technology-based venture have a strong belief in their abilities to perform the technological and entrepreneurial tasks required, are confident in their ability to obtain the academic technical skills, and have an inner drive to seek what is technologically novel

and unique.

3. Methodology

This section aims to describe the scope of the review and the selection of papers. This study uses a systematic literature review (SLR) method, which is a method used to identify, evaluate, and interpret all research available on a specific research question, topic area, or phenomenon of interest. The paper selection process is divided into three major stages, which are as follows: *Phase I*: Determine the database and keywords to be searched. For this study, the authors used the Google Scholar database to search related studies that had already been published by using the keywords 'technology entrepreneurship intention' or 'technopreneurship intention'. The papers selected are indexed in Scopus, WOS, ERA or MyCite. The scope of fields selected is 'Article Title', 'Abstract', and 'Keywords'. *Phase II*: Paper identification. For this SLR method, we focused on one type of document; an article, that was published in a variety of journals, including journals in the field of entrepreneurship. There were no restrictions put on the journal category when selecting papers. However, this study employs a specific timeline to present a review of current academic literature published between 2017 and 2023. Following the screening process, a total of 17 research papers were chosen for the study. These 17 papers are papers that studied technology entrepreneurship intention specifically among higher education institution students. Papers that studied technology entrepreneurship intention among other groups such as high school students or companies were disregarded. *Phase III*: Analyse and group the variables. The variables in the chosen studies are divided into the following factors: technopreneurial education, individual factors, external factors, and subjective norms.

4. Results and Discussion

The selected research paper has been analyzed by grouping the factors into four (4) factors, which are technopreneurs' education, individual factors, external factors, and subjective norms. Table 2 shows research papers on factors that influence technology entrepreneurship intention that had been published by different authors between 2017 and 2023.

Table 2: Factors that Influence Technology Entrepreneurship

Author/Year	Factors	Variables	Country
(Hoque, Awang, and Siddiqui, 2017)	Technopreneurial education	Technopreneurial learning	Malaysia
	Individual factor	Technopreneurial self-efficacy	
(Utami, 2018)	External factor	Environmental Factor	Indonesia
	Individual factor	Self-efficacy	
	Individual factor	Attitude	
(Koe et al., 2018)	Individual factor	Computer self-efficacy	Malaysia
	Individual factor	Internet self-efficacy	
	Individual factor	Individual entrepreneurial orientation	
(Boller, 2018)	Individual factor	Risk-taking propensity	Philippines
	External factor	Technopreneurial-related activities	
	Individual factor	Technopreneurial self-efficacy	
	Subjective norms	Emotional family support	
(Nurhayati & Machmud, 2019)	Technopreneurial education	Technopreneurial learning	Indonesia
(Yordanova, Filipe and Coelho, 2020)	Technopreneurial education	Entrepreneurship Education	
	Technopreneurial education	University support	
	Technopreneurial education	University research excellence	Bulgaria
(Machmud, et al., 2020)	Technopreneurial education	Technopreneurial learning	Indonesia
	Individual factor	ICT self-efficacy	

(Fathonah, Machmud, and Suwatno , 2020)	Individual factor Individual factor	Student motivation ICT self-efficacy	Indonesia
Wardani, Machmud, and Suwatno (2020)	Technopreneurial education	Technopreneurial learning	Indonesia
Koe (2021)	Individual factor Individual factor Individual factor	Computer capability Internet ability Individual Entrepreneurial Orientation	Malaysia
(Salhieh and Al-Abdallat, 2022)	Individual factor Individual factor Individual factor	Innate innovativeness Technopreneurial self-efficacy Academic self-efficacy	Jordan
(Belmonte et al, 2022)	Individual factor Technopreneurial education	ICT Self Efficacy Technopreneurial learning	Jordan
(Soomro and Shah, 2021)	Technopreneurial education Individual factor Individual factor	Technopreneurial-related activities Technopreneurial self-efficacy Technopreneurial motivation	Pakistan
(Belmonte, Prince and Castro, 2022)	Individual factor Individual factor Individual factor Individual factor Individual factor	Computer capability Internet ability Individual entrepreneurial orientation Entrepreneurial experience Access to Capital	Philippines
(Koe, Nordin and Marmaya, 2022)	Individual factor Individual factor	Computer self-efficacy Internet self-efficacy	Indonesia
(Alamsyahrir & Ie) (2022)	Individual factor Technopreneurial education Subjective norms	Self-efficacy Entrepreneurship education Relation support	Indonesia
(Koe, Abdul Rahim & Mahphoth, 2023)	Individual factor Individual factor External factor Individual factor	Computer self-efficacy Internet self-efficacy Contextual element Individual entrepreneurial orientation	Malaysia

Based on the table, there are 25 variables altogether studied by the authors, which include: 1) technopreneurial learning, 2) technopreneurial self-efficacy, 3) self-efficacy, 4) internet self-efficacy, 5) computer self-efficacy, 6) academic self-efficacy, 7) environmental factor, 8) attitude, 9) individual entrepreneurial orientation, 10) risk taking propensity, 11) technopreneurial related activities, 12) emotional family support, 13) university support, 14) university research excellence, 15) student motivation, 16) innate innovativeness, 17) technopreneurial motivation, 18) computer capability, 19) internet ability, 20) entrepreneurial experience, 21) access to capital, 22) entrepreneurship education, 23) relation support, 24) contextual element, and 25) technopreneurial related activities. We have grouped these 25 variables into four factors, which are technopreneurs' education, individual factors, external factors, and subjective norms. Out of 25 variables, 5 of them are classified under the technopreneurial education factor, which includes technopreneurial learning, entrepreneurship education, university support, university research excellence, and technopreneurial-related activities. Another 15 variables are grouped under individual factors, which include technopreneurial self-efficacy, self-efficacy, internet self-efficacy, computer self-efficacy, academic self-efficacy, attitude, and individual entrepreneurial orientation, risk-taking propensity, student motivation, innate innovativeness, technopreneurial motivation, computer capability, internet ability, entrepreneurial experience, and access to capital.

Finally, the remaining 5 variables are classified under external factors (environmental factors, technopreneurs-related activities, contextual elements) and subjective norms (emotional support, relation support). It is found that most of the studies have focused on exploring how individual factors can influence the formation of technology entrepreneurship intention (with a total of 15 variables). This is followed by technopreneurial education with a total of five variables and environmental factors with three variables. The least studied factor goes to subjective norms with only two variables. Firstly, we can say that there is a lack of studies conducted that relate technology entrepreneurship intention with subjective norms, although subjective norms play a crucial role in shaping one's attitude and behavior. According to Wahyuni et al. (2019), in subjective norms, the support from people around us (family, relatives, close friends) and seeing successful people are very influential in shaping students' entrepreneurship intention. Exposure to successful tech entrepreneurs can inspire and educate students about the possibilities and challenges of starting technology-based ventures.

A supportive ecosystem that encourages innovation, collaboration, and risk-taking can positively influence students' intentions to pursue technology entrepreneurship. Therefore, more studies are needed to understand the influence of subjective norms on technology entrepreneurship intention. Secondly, it is found that government support has not been mentioned in these studies as one of the variables. It is known that to venture into a technological firm, a high amount of capital and proper research and development (R&D) are required. This could be a barrier for graduates to pursue their innovative ideas to create technology-based ventures, knowing that it does not come without high risks. According to Chaudhuri, Agrawal, Chatterjee and Hussain (2022), government support to increase R&D activities is seen as a key for a company to stimulate innovation. Hence, this is where government assistance plays a vital role in ensuring that future graduates have the interest and intention to pursue their technological products or project ideas, hence reducing the unemployment rate of the country. Government assistance may come in the form of financial, training, mentoring programs and more.

Thirdly, it is also found that social media's influence on technology entrepreneurship intention has not been studied in the above studies. In this technological era, social media is widely used especially among the young generation; hence it can easily influence students in making life decisions. Social media use can be defined as the ability to use social media to explore and discover new ideas (idea discovery) and implement those ideas (idea exploitation) (Zhang and Zhu, 2021). According to a study by Ahmed, Rahim, Alabdullah and Thottoli (2019), the findings of the study indicated that entrepreneurial intention was significantly influenced by social media. This is supported by another study by Abdelfattah, Al Halbusi and Al-Brwani (2022) which confirmed that social media use has a significant impact on entrepreneurial intention. Although these studies focused on the influence of social media on entrepreneurship intention in general, the role of social media in influencing technology entrepreneurship intention should not be disregarded. Perhaps relevant authorities and appointed leaders could use social media platforms to disseminate information and engage in interactive communication especially with university students to promote technology entrepreneurship events.

Implication of Study: Minimal studies have been carried out on factors influencing entrepreneurship intention, especially in the context of technology entrepreneurship. This paper provides a review of existing academic literature on technology entrepreneurship intention among university students and analyses the factors that are mostly studied and understudied. It has been identified that social norms are the least studied factor based on the chosen studies. This paper introduced government assistance and social media as possible variables to be studied by future researchers. Previous researchers have studied these two variables regarding traditional entrepreneurship intention, but there are currently no studies on their influence on technology entrepreneurship intention per se. Hence, the identification of these under-researched areas will provide future directions for researchers to have a clear understanding of the concept. This paper may also provide future directions for the government in ensuring that more graduates have the intention to pursue technology entrepreneurship which will in turn contribute to the country's economic growth.

5. Conclusion

This paper is a literature review-based paper that aims to provide a review of existing academic literature on technology entrepreneurship intention among university students. From the chosen studies, we have

grouped the variables into four factors, namely, technopreneurial education, individual factors, external factors, and subjective norms. The analysis has resulted in a few findings. First, it was found that most of the studies focused on individual factors, followed by technopreneurial education and external factors. Subjective norms were the least studied factor, despite their importance in shaping an individual's behavior and intention. Second, it was found that government support has not been mentioned in these studies among the variables, although the importance of government support or assistance in encouraging innovation had been established by other researchers. Third, it was found that social media's influence on technology entrepreneurship intention has not been studied as well. Previous studies have indicated that entrepreneurial intention was significantly influenced by social media; however, there is a lack of research on how this applies to the technology entrepreneurship context. Thus, future research should empirically test the identified factors. This paper provides a classification of factors contributing to technology entrepreneurship intention, allowing researchers and practitioners to gain an understanding of the concept. We are in a position to bridge the gap between previous and future studies by identifying under-researched areas as mentioned above. This paper may also benefit the government to foresee future graduates in terms of career choice in ensuring the growth of new technology-based ventures to help the country's economic growth.

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