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Faculty of Economics and Business Administration, Department of Business
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SUMMARY OF A DISSERTATION

**TECHNOLOGY ENTREPRENEURSHIP AMONG BULGARIAN
STEM STUDENTS: THE ROLE OF UNIVERSITY**

In fulfillment of the requirements for obtaining the degree of "Doctor of
Sciences" in 3.7 Administration and management

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Introduction

It has been recognized that entrepreneurship might play a significant role in employment, growth of value-added and productivity and innovation (Van Praag and Versloot, 2007). In the global economy, entrepreneurship and technology are considered as two important engines for economic growth and sustainability and their combination may create value for firms and may increase the wealth of nations and regions (McPhee and Bailetti, 2012; Bailetti, 2012). Therefore, increasing interest by academics and policy makers is devoted to technology entrepreneurship for its significant contribution to economic progress (Mosey et al., 2017). Technology entrepreneurship is a specific type of entrepreneurship with distinctive characteristics stemming from the combination of different concepts: entrepreneurship, technology and innovation (Petti 2009; Bailetti 2012; Nacu and Avasilcai 2014).

Students are important source of entrepreneurs in the knowledge society (Veciana, 1998, cited in Veciana et al., 2005), while universities are seen as “natural incubators” of entrepreneurs (Etzkowitz, 2003:112). Kraaijenbrink, Groen, and Bos (2010:110) stress that “universities can play an important role in stimulating entrepreneurship”. The provision of entrepreneurship education at university level is an important factor for stimulating and preparing future entrepreneurs. However, universities need to operate more entrepreneurially and to create favourable conditions for entrepreneurship among students and academics (Kirby, 2006). Universities are considered as an ideal setting for research on technology entrepreneurship involving different levels of analysis (Mosey, 2016; Mosey et al., 2017).

I. Dissertation Overview

Research relevance and significance

Technology entrepreneurship is a relatively unexplored scientific field which presents various new research opportunities (Shane and Venkataraman, 2003). Since the first symposium on technology entrepreneurship at Purdue University (USA) in 1970 (Bailetti, 2012), technology entrepreneurship is receiving increasing attention among academics, policy makers, entrepreneurs, managers, investors, etc. Even though the academic research in the field of technology entrepreneurship has progressed rapidly in terms of volume, breadth and diversity during the past decades (Ratinho et al., 2015; Bailetti, 2012), the research on technology entrepreneurship has not contributed substantially to other scientific fields such as economics, entrepreneurship, and management (Bailetti, 2012). As a relatively underresearched topic, technology entrepreneurship is seen as a promising area for entrepreneurship research and practice (McPhee and Bailetti, 2012).

Several research gaps have been identified in the literature on technology entrepreneurship. Shane and Venkataraman (2003) call for more research into the context for technology entrepreneurship, the process of new technology venture creation and the drivers and reasons people create new technology ventures. Zhang et al. (2008) note the lack of studies combining individual and corporate technology entrepreneurship. Mosey et al. (2017) call for more research exploring the role of entrepreneurship education and university support measures for the generation of talent and the experience of individuals in relation to technology entrepreneurship. Mosey (2016) argues that the university is an ideal setting for research into technology entrepreneurship spanning different levels of analysis.

Recent studies reviewing technology entrepreneurship research (Bailetti, 2012; Ferreira et al., 2015; Mosey, 2016; Mosey et al., 2017; Ratinho et al., 2015; Spiegel and Marxt, 2011) demonstrate that it is focused

mainly on themes related to the creation, functioning and development of new and existing, small and large technology firms and the institutional factors, governmental policies and support mechanisms and environmental features that influence them. This literature contributes little to understanding the determinants of technopreneurial behaviour mainly because they are identified retrospectively usually several years after the technology business has been established. In addition, such studies cannot show whether identified determinants are a cause or an effect of new technology venture formation (Vesper, 1990). However, for understanding technopreneurial behaviour it is more important to investigate pre-venture characteristics and processes of potential technology entrepreneurs and to identify their antecedents. Research on potential technology entrepreneurs prior to technology venture formation may provide useful insights about the conditioning factors for entrepreneurial behaviour. Shane and Venkataraman (2003) emphasize the need of greater research attention on the context in which technology entrepreneurs operate when trying to explain technology entrepreneurship.

There has been significant research focusing on entrepreneurial intentions in the last decades (Liñán and Fayolle 2015). The premise of this literature is that entrepreneurial intentions provide an understanding of entrepreneurial behaviour without witnessing it (Krueger and Alan 1993), and models of intentions and their antecedents are a useful framework for studying entrepreneurial behaviour (Krueger et al. 2000). However, several authors highlight that the link between entrepreneurial intentions and behaviour might not be so straightforward. Krueger (2009) argue that there is no guarantee that a person's intentions for starting a business will be implemented. Krueger et al. (2000) stress that even when intentionality is present, the timing of the creation of the new venture might be relatively unplanned and even sudden. Shook et al. (2003, p. 383) argue that "it may be a relatively long or short time after intent develops before a new venture

opportunity is even identified". Schlaegel and Koenig (2014) conclude that entrepreneurial intentions explain only 37% of the variance in actual entrepreneurial behaviour. It was acknowledged that the entrepreneurial intention-behaviour link needs further investigation (Fayolle and Liñán 2014).

The formulation of specific plans in the form of implementation intentions facilitates goal attainment over and above goal intentions alone (Gollwitzer, 1999). Students who form specific plans about where, when and how entrepreneurial behaviour will be performed have greater inclination to act on their intentions (Fayolle and Liñán, 2014). Although a large body of literature examines determinants of entrepreneurial intentions (Bae et al., 2014; Zhao et al., 2010), there is a lack of understanding about what factors lead to the formation of entrepreneurial implementation intentions. Fayolle and Liñán (2014) recommend the application of implementation intention theory (Gollwitzer, 1999) in research on the link between entrepreneurial intentions and behaviour. Armstrong (2014) demonstrate the power of simple planning in a study in which students who engaged in planning activities are more likely to view entrepreneurial behaviour as feasible and exhibit higher intentions to engage in entrepreneurial behaviour. The factors which contribute to the transformation of goal intentions into implementation intentions have not been researched yet not only particularly in the field of technology entrepreneurship but also in the field of entrepreneurship in general.

Despite the significant political and academic attention to issues related to the triple helix of business, higher education and government as well as entrepreneurship and entrepreneurial universities, little research about the role of the university in developing entrepreneurship has been published (Davey et al., 2016). The research combining individual-level and organizational-level factors to explain student and graduate entrepreneurship is scarce (Walter, Parboteeah and Walter, 2013). Kraaijenbrink, Groen, and

Bos (2010) argue that universities can have a broader role in stimulating student entrepreneurship. Universities in Bulgaria exhibit narrow understanding of the concept of innovative and entrepreneurial university (OECD, 2014). Entrepreneurship promotion is not a strategic goal for Bulgarian higher education institutions and they have rarely links with the entrepreneurial ecosystem in the country (OECD, 2014). Bulgarian universities can play important role in stimulating students' start-ups during their studies or after graduation. However, there is a lack of understanding to what extent Bulgarian universities provide entrepreneurship support to their students.

Many students worldwide are in the process of starting their own business (i.e., nascent entrepreneurs) or are already owning and managing their own business (i.e., active entrepreneurs) (Sieger et al. 2018). However, most research into university entrepreneurship considers only data about spinoffs by faculty and staff and excludes data about new firm formation by students and graduates (Åstebro et al. 2012; Wright et al. 2019). Grimaldi et al. (2011) stress that student entrepreneurship had not received enough attention in the literature. Several recent studies call for more research into the role of the university in fostering student entrepreneurship (Wright et al. 2017; Alves et al. 2019; Wright et al. 2019), especially for STEM students.

Van der Zwan and Thurik (2017) recommend the adoption of process approach to entrepreneurship research. They argue that the research that investigates different entrepreneurial stages can reveal why entrepreneurial potential is hampered and how it can be fostered. The research viewing entrepreneurship as a single phase can lead to incomplete understanding of entrepreneurial potential of individuals (van der Zwan and Thurik, 2017). The authors stress that a process perspective on entrepreneurship could shed light on differences between the various stages of the entrepreneurial process. Johnson et al. (2006) argue that despite the common definition of entrepreneurship as the act of new venture creation, the entrepreneurial

process cannot be studied accurately using conventional data on new firms from public records. They identify two biases related to this approach. The “survival” bias refers to the omission of aspiring entrepreneurs, who fail in creating new firms. The “hindsight” bias reflects the incorrect reporting of information about the inception of the business due to memory loss or re-interpretation of facts with a time lag. Donaldson (2019) argue that future research should consider the entrepreneurial process form entrepreneurial intentions to actual entrepreneurial behaviour.

Although the topics of entrepreneurship and small business management (e.g. Davidkov, 2006; Vladimirov et al., 2014; Davidkov and Yordanova, 2016; Vladimirov et al., 2017; Davidkov and Yordanova, 2015; Kanazireva, 2018, 2019; Todorov et al., 2011; Davidkov and Yordanova, 2011; Vladimirov, 2015; Pivoda et al., 2011; Lau et al., 2012) and the topics of innovation and technology management (Vladimirov, 2016; Yalamov, 2021; Angelov, 2021; Georgieva and Yalamov, 2020; Lewandowska and Golebiowski, 2014) have received significant research attention, there is a lack of understanding about the role of university for technology entrepreneurship in Bulgaria.

Object and Subject of Study

The object of the study is technopreneurial attitudes, intentions and behaviour of Bulgarian STEM students. Previous research identified positive entrepreneurial attitudes (new venture feasibility and new venture desirability), entrepreneurial goal intentions, entrepreneurial implementation intentions, nascent entrepreneurship/ intrapreneurship; active entrepreneurship/ intrapreneurship as key stages of technopreneurial process (Delanoë-Gueguen and Fayolle, 2019; Shapero, 1982).

The subject of the research is the influence of university factors on technopreneurial attitudes, intentions and behaviour of Bulgarian STEM students.

Research Objective and Tasks

Giving the research gaps identified in the literature on technology entrepreneurship, the research objective of this study is to identify university factors that influence technopreneurial attitudes, intentions and behaviour of Bulgarian STEM students. To achieve this objective we perform the following research tasks:

- Review and critical analysis of concepts, theories, and research approaches adopted in the existing scientific literature on the role of university for entrepreneurship among students.
- Review and critical analysis of existing empirical studies about the role of university for entrepreneurship among students to identify university factors having positive effects on entrepreneurship among students.
- Creation of a conceptual model of the university factors influencing technopreneurial attitudes, intentions, and behaviour of STEM students.
- Empirical investigation of university factors affecting technopreneurial attitudes, intentions, and behaviour of Bulgarian STEM students.
- Formulation of practical implications of the empirical finding for policymakers, academics, and university managers.

Research Thesis and Hypotheses

The main thesis of the presented study is that university factors influence technopreneurial attitudes, intentions and behaviour of Bulgarian STEM students. The working hypotheses of the study are:

Hypothesis 1. Academics' attitudes towards entrepreneurship positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 2. Participation in entrepreneurship education positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 3. Concept development support positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 4. University research excellence positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 5. Industry ties positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 6. Academics' attitudes towards entrepreneurship positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 7. Participation in entrepreneurship education positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 8. Concept development support provided by the university positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 9. University research excellence positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 10. Industry ties positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 11. Academics' attitudes towards entrepreneurship positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 12. Participation in entrepreneurship education positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 13. Concept development support provided by the university positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 14. University research excellence positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 15. Industry ties positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 16. Participation in entrepreneurship education positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Hypothesis 17. Concept development support provided by the university positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Hypothesis 18. University research excellence positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Hypothesis 19. Industry ties positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Hypothesis 20. Participation in entrepreneurship education positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

Hypothesis 21. Business development support provided by the university positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

Hypothesis 22. University research excellence positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

Hypothesis 23. Industry ties positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

Scope of Study

This study investigates the role of university for technology entrepreneurship among Bulgarian STEM students. The study focuses on the following stages of the technopreneurial process (Delanoë-Gueguen and Fayolle, 2019; Shapero, 1982): 1/ positive technopreneurial attitudes (high technology new venture feasibility and high technology new venture desirability); 2/ technopreneurial goal intentions; 3/ technopreneurial implementation intentions; 4/ nascent technology entrepreneurship/ intrapreneurship; 5/ technology entrepreneurship/ intrapreneurship.

Only STEM students enrolled in Bulgarian universities are included in the study. Students enrolled in the study fields of social sciences, humanities, medicine, national security and military science were excluded from the survey.

Methodology

The dissertation uses a wide range of scientific methods to perform the research tasks and achieve the research objective. Systemic approach, comparative approach, interdisciplinary approach, methods of analysis and synthesis, inductive and deductive methods are used within the literature review and the development of the conceptual models of the study.

To test the proposed hypotheses, a cross-sectional survey among STEM students in Bulgarian universities was conducted. Regression analysis is used to estimate the influence of university factors on technopreneurial attitudes, intentions and behaviour of STEM students.

Data Sources

The main sources of data used in this study are:

- a pilot study conducted among 15 students (8 males and 7 females) to pre-test the initial version of the questionnaire of the study;
- a cross-sectional survey among STEM students in Bulgarian universities to investigate the influence of university factors on technopreneurial attitudes, intentions and behaviour of STEM students;
- secondary data about the entrepreneurial activity and the context for entrepreneurship in Bulgaria from the Global Entrepreneurship Monitor, World Bank, European Commission, Eurostat, etc.

Utility and Novelty of Results

This research on the role of university for technology entrepreneurship among STEM students provides valuable insights about technopreneurial process and its university determinants. The presented conceptual framework

of the role of university for technology entrepreneurship among STEM students can help to unleash technopreneurial potential and to encourage the advancement through the stages of technopreneurial process. The results of the study can government bodies, responsible for policies and strategies for entrepreneurship development in Bulgaria as well as Bulgarian universities, which offer educational programs in STEM fields to devise and implement policies and measures to support both early stages and advanced stages of technopreneurial process among STEM students. The novelty of the results is as follows:

- Resolution of a scientific problem by creation of four conceptual models of factors related to the university which affect technopreneurial attitudes, intentions and behaviour of STEM students.
- Creation of an instrument for investigation of technopreneurial attitudes, intentions and behaviour of STEM students.
- The study reveals the differential effects of various university factors on the different stages of the technopreneurial process in which Bulgarian STEM students are involved.
- Identification of factors which may affect the successful transformation of:
 - STEM students' technopreneurial attitudes into technopreneurial goal intentions;
 - STEM students' technopreneurial goal intentions into technopreneurial implementation intentions;
 - STEM students' technopreneurial implementation intentions into nascent technopreneurial behaviour.

Study Limitations

Several limitations of the study should be acknowledged in order to be able to interpret correctly the research result obtained in the dissertation:

- The proposed conceptual models of the study do not include all factors related to the university which can influence technopreneurial attitudes, intentions and behaviour of STEM students.
- The use of a convenient sample of Bulgarian STEM students does not allow for generalization of the findings.
- There may be errors, cognitive biases and omissions in the data due to the self-reported nature of the study.
- The sample is comprised only of Bulgarian STEM students and, therefore, the findings may not be applicable to other countries and contexts.
- Differences in the content and teaching methods adopted in the entrepreneurship courses in which the respondent participated are not considered.
- The study uses perceptual measures of concept development support and business development support provided by the university.
- Due to the cross-sectional design of the research causal relationships cannot be deduced.
- The use of cross-sectional data does not allow to control for unobservable fixed effects that may affect both the dependent and the independent variables.

Approbation of the dissertation research results

The results of the dissertation are approbated as follows: (a) scientific publications on the studied topics – 1 book chapter, 7 scientific articles published abroad; (b) 6 presented and published research papers in

proceedings from national and international scientific conferences; (B) participation in international research conferences with scientific papers which are not published including: (1) RENT XXXI – Research in Entrepreneurship and Small Business, Lund University, Sweden, (15) 16-17 November 2017; (2) RENT 2018 - Research in Entrepreneurship and Small Business, Toledo, Spain, (14) 15-16 November 2018; (3) RENT XXXIV – Research in Entrepreneurship and Small Business, online, (18) 19-20 November 2020.

II. Structure of the Dissertation

The dissertation is structured in four chapters, introduction, conclusions, references, and two appendices. The dissertation volume is 342 pages including 261 pages main text, 50 pages references, and 31 pages appendices.

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III. Summary of the Content of the Dissertation

In the introduction of the dissertation the research relevance and significance are justified, and the research objective, research tasks, the subject and the object of the study are defined. The introduction describes the research thesis and hypotheses, the scope of the study, the research methodology, data sources, the utility and novelty of results, and the study limitations.

CHAPTER 1: THEORETICAL FRAMEWORK

The first chapter of the dissertation presents the theoretical framework of the study. The chapter is structured in four sections. In the section **1.1. Entrepreneurship as a Process** the existing definitions of entrepreneurship in the literature are discussed and critical assessment of different approaches in entrepreneurship research is made. The advantages of conceptualizing entrepreneurship as a process are outlined. The existing process models of entrepreneurship are reviewed and critically analyzed.

The process approach to entrepreneurship posits that entrepreneurship is a process rather than a single event (Moroz and Hindle, 2012; Hindle, 2010). Entrepreneurial process plays a central role in describing the phenomenon of new venture creation (Gartner, 1985). Eckhardt and Shane (2003) argue that studying the process of entrepreneurship is one of the most important directions for future entrepreneurship research. Entrepreneurial process encompasses “all the functions, activities and actions associated with perceiving of opportunities and the creation of organization to pursue them” (Bygrave and Hofer, 1992:14). It was acknowledged that the characteristics of entrepreneurial process determine the survival of the new venture (Brush et al., 2008).

Van der Zwan and Thurik (2017:26) stress that “research considering entrepreneurship as a single state may provide an incomplete picture of the entrepreneurial potential hidden within individuals”. They identify several advantages of the application of the process approach to entrepreneurship. According to Van der Zwan and Thurik (2017), the process approach could help to clarify the reasons for successful transformation of start-up attempts into an actual business. It allows for measuring the ease or difficulty of moving through the stages of the entrepreneurial process..

The section argues that intention models are useful for understanding pre-venture processes in entrepreneurship. It was recognized by researchers

in entrepreneurship that new venture formation is a planned behaviour, an intentional act which requires planning how the perceived opportunity will be exploited (Bird, 1988, Katz and Gartner, 1988, Krueger et al., 2000, Krueger and Carsrud, 1993, Krueger, 1993, Kolvereid, 1997). The emphasis on intentions is especially valuable when investigating phenomena that are rare, hard to observe and involving unpredictable time lags such as entrepreneurship (MacMillan and Katz, 1992). In this case, entrepreneurial intentions provide understanding about entrepreneurial behaviour without witnessing that behaviour (Krueger and Carsrud, 1993).

Our review of the proposed models in the literature on entrepreneurial intentions supports Peterman and Kennedy's (2003:130) statement that the dominant models "are largely homologous in that they all focus on the pre-entrepreneurial event and integrate attitude and behaviour theory (Ajzen, 1991), and self-efficacy and social learning theory (Bandura, 1986)". Another common characteristic of these models is that they assume that exogenous factors contribute to the link between attitudes and behaviour (Peterman and Kennedy, 2003). Schlaegel and Koenig (2014) demonstrate that desirability is the most immediate determinant of entrepreneurial intentions, while the constructs from the Ajzen's (1991) theory of planned behaviour affect entrepreneurial intentions through perceived desirability. In this section, a special attention is drawn to the Rubicon model of entrepreneurial action phases. In this section a special attention is devoted to the Rubicon model of entrepreneurial action phases (Delanoë-Gueguen и Fayolle, 2019) and the results of previous empirical research supporting this theoretical model.

The section **1.2. Technology Entrepreneurship: Scope and Distinctiveness** outlines the nature and distinctive characteristics of technology entrepreneurship. Technology entrepreneurship is a distinct research line at the nexus of Entrepreneurship and the Management of Technology and Innovation (Spiegel and Marxt, 2011; Hsu, 2008; Mosey et

al., 2017). Bailetti (2012) highlights the lack of generally accepted definition of technology entrepreneurship. Burgelman et al. (2004:3) emphasize that technology entrepreneurship “can involve one individual (*individual* entrepreneurship) or the combined activities of multiple participants in an organization (*corporate* entrepreneurship)”. Phan and Foo (2004:2) outline the following levels of analysis:

- Individual level: scientists/entrepreneurs, venture capitalists, and other individuals that contribute to technology entrepreneurship;
- Organizational level: technological teams, structures, processes, and interorganizational linkages influencing value creation;
- Systems level: players in the ecology of value creation (governing factors, industry standards, and the economics of geographical locations).

The proposed definitions of technology entrepreneurship state explicitly various outcomes including value creation (Bailetti, 2012; Petti and Zhang, 2011), value capture (Bailetti, 2012), enhancing the quality of life (Mirchev and Dicheva, 2013), satisfaction of newly originated needs (Mirchev and Dicheva, 2013), creation of new resource combinations (Burgelman et al., 2004), creation of new technology-based firms (Gans and Stern, 2003; Antoncic and Prodan, 2008; Colovic and Lamotte, 2015), creation of (new/innovative) products, services or processes (Spiegel and Marxt, 2011; Pathak et al., 2013).

The section highlights diverse distinctive characteristics of technology entrepreneurship discussed in the literature: innovation-based nature (Hsu, 2008), “strong intellectual links to technology management” (Shane and Venkataraman, 2003:183), the application of technology entrepreneurship to firms with different size and age (Bailetti, 2012:10), the interdependence between technology entrepreneurship and the resource-based view of sustainable competitive advantage (Bailetti, 2012:10), etc.

The section **1.3. The Institutional Setting and Entrepreneurship** describes the effects of formal and informal institutions on entrepreneurship. The nature and characteristics of the new institutional theory are outlined. It was acknowledged that this theory is the most appropriate conceptual framework for examining the impact of the environment on entrepreneurship (Veciana, 1999) and for researching entrepreneurship in Central and Eastern Europe (Welter et al., 2003). The dynamics of entrepreneurship depends on institutional environment (Acs et al., 2008). In contrast to non-entrepreneurs, entrepreneurs exhibit entrepreneurial alertness to profit opportunities (Kirzner, 1973). However, the existence of profits is conditioned by the institutional arrangements (Sautet, 2005; Boettke and Coyne, 2009). Gnyawali и Fogel (1994) posit that the emergence of new organizations is affected by the legal and institutional framework as well as barriers constraining entrepreneurial efforts. Various formal and informal institutional factors which significantly influence entrepreneurship and specifically technology entrepreneurship in various contexts are identified. In section **1.3.1. Universities' Institutional Settings and Entrepreneurship** the interrelation between universities' institutional settings and entrepreneurship among the members of university is examined. The theoretical model of Kirby et al. (2011) which describes formal and informal institutional factors related to the university facilitating entrepreneurial activity is presented.

In section **1.4. Entrepreneurial University** the nature and elements of the entrepreneurial university. Drawing upon various definitions of this concept proposed in the literature several aspects of the entrepreneurial university are identified: characteristics of entrepreneurial universities, types of entrepreneurial activities in the university setting, actors performing entrepreneurial activities, types of support mechanisms for entrepreneurship adopted by the entrepreneurial university, and the interaction between the entrepreneurial university and its environment. Entrepreneurial activities

within universities may include: spin-out and start-up of new ventures (Kirby, 2006; Zhou and Peng, 2008); fund-generating activities (Etzkowitz, 1983:214; Jacob, Lundqvist, Hellsmark, 2003:1555); commercialization activities (Jacob, Lundqvist, Hellsmark, 2003:1555); generation of technology advances (Rothaermel, Agung and Jiang, 2007:707); innovation in how the university goes to business (Clark, 1998:4). Entrepreneurial activities within universities may be undertaken by various actors including faculty, students, employees (Röpke, 1998:2; Etzkowitz, 2003:112; Jacob, Lundqvist, Hellsmark, 2003:1555), and the university itself (Clark, 1998:4; Röpke, 1998:2).

Entrepreneurial activities within entrepreneurial universities are supported by various support mechanisms, structures, and intermediaries such as technology transfer offices and the creation of incubators or science parks (Rothaermel, Agung and Jiang, 2007:707). In addition to direct mechanisms for supporting the transfer of technology from academia to industry there are also indirect mechanisms supporting entrepreneurial activities via entrepreneurship education (Guenther and Wagner, 2008:400). This section describes the diverse ways in which the entrepreneurial university interacts with its environment and participates in shaping and changing it (Guenther и Wagner, 2008; Rothaermel, Agung и Jiang, 2007; Pawłowski, 2001; Röpke, 1998; Zhou и Peng; 2008). Different theoretical models of the entrepreneurial university are presented and key elements of the entrepreneurial university are identified. Taking into account the research objective of the dissertation, a special attention is paid on the model of Guerrero and Urbano (2012:47), because it comprehensively considers formal factors, informal factors and other internal factors which influence positively entrepreneurial activity at the university.

CHAPTER 2. LITERATURE REVIEW, CONCEPTUAL MODEL AND HYPOTHESES

The second chapter of the dissertation presents a literature review of the determinants of entrepreneurial attitudes, intentions and behaviour, the conceptual models and the hypotheses of the study. The chapter contains three sections.

In section **2.1. Individual Determinants of Entrepreneurial Attitudes, Intentions and Behaviour** based on a literature review of empirical studies in different contexts the following individual determinants of entrepreneurial attitudes, intentions and behaviour:

- Demographic characteristics: gender and age;
- Attitudes: entrepreneurial attitudes includes in the Entrepreneurial Event Model (Shapero, 1982) and the Theory of Planned Behaviour (Ajzen, 1991) as well as other attitudes;
- Psychological traits: risk propensity, locus of control, need of achievement;
- Human capital: general and specific human capital, breadth of human capital;
- Social capital and role models.

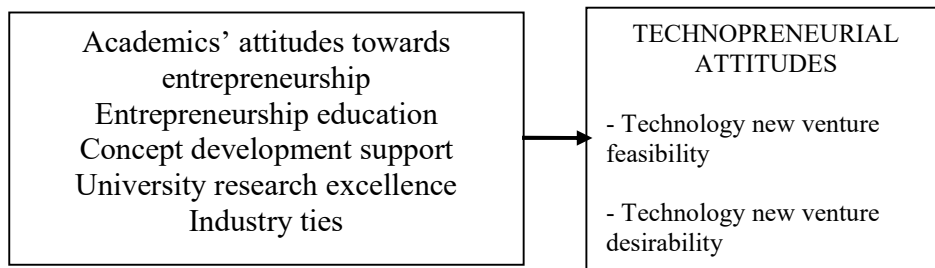
In section **2.2. University Determinants of Entrepreneurial Attitudes, Intentions and Behaviour** numerous empirical studies of the influence of entrepreneurship education on entrepreneurial attitudes, intentions and behaviour in different contexts are analyzed. There is little research on role of entrepreneurship education for entrepreneurial attitudes, intentions and behaviour in Central and Eastern Europe as well as little empirical evidence about the adequacy of entrepreneurship education for a particular target audience (Fayolle, 2013; Byrne et al., 2014). Other factors related to the university identified in the literature as determinants of entrepreneurial attitudes, intentions and behaviour include:

- university support for entrepreneurship;
- university research excellence;

- academics' attitudes towards entrepreneurship
- positive entrepreneurial role models at the university;
- university–industry links.

In section **2.3. Conceptual models and hypotheses** drawing upon the theoretical framework and the literature review four conceptual models of the study which present factors related to the university influencing the following stages of the technopreneurial process (Figures 18 - 21): 1/ positive technopreneurial attitudes (high technology new venture feasibility and high technology new venture desirability); 2/ technopreneurial goal intentions; 3/ technopreneurial implementation intentions; 4/ nascent technology entrepreneurship/ intrapreneurship.

Figure 18: University determinants of technopreneurial attitudes among STEM students.



Source: Own elaboration based on Kirby et al. (2011), Guerrero and Urbano (2012), Delanoë-Gueguen and Fayolle (2019) and Shapero (1982).

This study aims at testing the following hypotheses:

Hypothesis 1. Academics' attitudes towards entrepreneurship positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 2. Participation in entrepreneurship education positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 3. Concept development support positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 4. University research excellence positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 5. Industry ties positively influence the likelihood of high desirability of technology entrepreneurship among STEM students.

Hypothesis 6. Academics' attitudes towards entrepreneurship positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

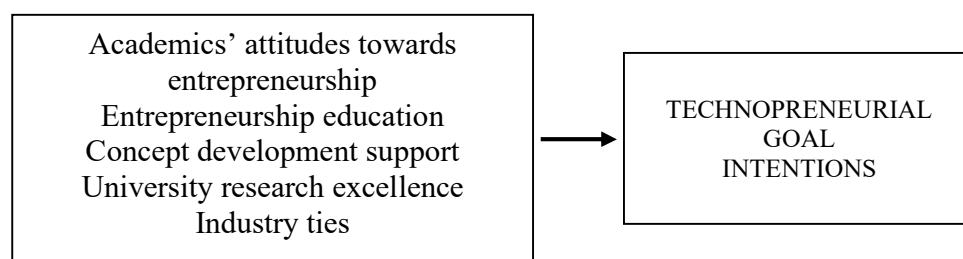
Hypothesis 7. Participation in entrepreneurship education positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 8. Concept development support provided by the university positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 9. University research excellence positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Hypothesis 10. Industry ties positively influence the likelihood of high feasibility of technology entrepreneurship among STEM students.

Figure 19: University determinants of technopreneurial goal intentions among STEM students.



Source: Own elaboration based on Kirby et al. (2011), Guerrero and Urbano (2012), Delanoë-Gueguen and Fayolle (2019) and Shapero (1982).

Hypothesis 11. Academics' attitudes towards entrepreneurship positively influence the likelihood of technopreneurial goal intentions among STEM students.

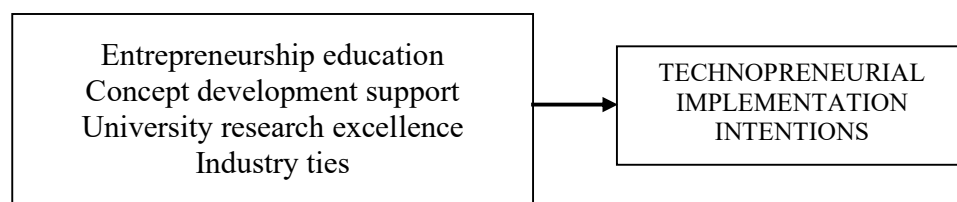
Hypothesis 12. Participation in entrepreneurship education positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 13. Concept development support provided by the university positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 14. University research excellence positively influence the likelihood of technopreneurial goal intentions among STEM students.

Hypothesis 15. Industry ties positively influence the likelihood of technopreneurial goal intentions among STEM students.

Figure 20: University determinants of technopreneurial implementation intentions among STEM students.



Source: Own elaboration based on Kirby et al. (2011), Guerrero and Urbano (2012), Delanoë-Gueguen and Fayolle (2019) and Shapero (1982).

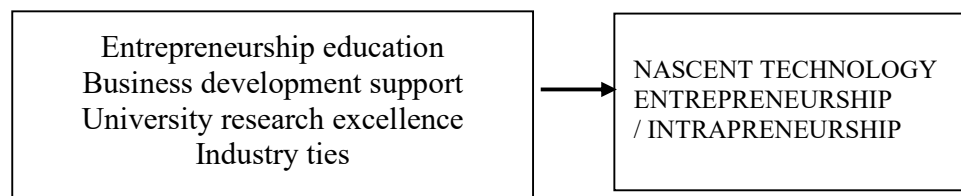
Hypothesis 16. Participation in entrepreneurship education positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Hypothesis 17. Concept development support provided by the university positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Hypothesis 18. University research excellence positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Hypothesis 19. Industry ties positively influence the likelihood of technopreneurial implementation intentions among STEM students.

Figure 21: University determinants of nascent technology entrepreneurship or intrapreneurship among STEM students.



Source: Own elaboration based on Kirby et al. (2011), Guerrero and Urbano (2012), Delanoë-Gueguen and Fayolle (2019) and Shapero (1982).

Hypothesis 20. Participation in entrepreneurship education positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

Hypothesis 21. Business development support provided by the university positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

Hypothesis 22. University research excellence positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

Hypothesis 23. Industry ties positively influences the likelihood of nascent technology entrepreneurship or intrapreneurship among STEM students.

ГЛАВА 3: МЕТОДОЛОГИЯ НА ИЗСЛЕДВАНЕТО

Section **3.1 The Context of the Research** contains analyses of the environment for entrepreneurship in Bulgaria, entrepreneurial activity, and entrepreneurship education and entrepreneurial transformation of Bulgarian universities. The environment for entrepreneurship plays important role for understanding this phenomenon providing opportunities and setting boundaries for individual actions (Welter, 2011). The environment for entrepreneurship comprises “a combination of factors that play a role in the development of entrepreneurship” including overall economic, sociocultural, political and other factors that influence willingness and ability for entrepreneurship as well as support programs that facilitate the entrepreneurial process (Gnyawali and Fogel, 1994). Data from various national and international demonstrate that the environment for entrepreneurship in Bulgaria is less favourable than other member states of the European Union. The entrepreneurial activity in Bulgaria is characterized by low early-stage entrepreneurial activity, low share of opportunity-driven entrepreneurship, low self-employment rate, as well as low economic impact. Despite the steady development of entrepreneurship education in Bulgaria, the National Expert Survey within the GEM study indicates scores below the EU average with regard to entrepreneurship education at basic school and at post-secondary level in the period 2015-2018. A conclusion is reached that Bulgarian universities should play a greater role in providing

entrepreneurship education. It was acknowledged that entrepreneurship education “may possibly thrive best when it is part of an “entrepreneurial university” that is also strong in commercializing research and that is managed in an entrepreneurial manner” (Lilischkis et al., 2015). It was acknowledged that entrepreneurship education “may possibly thrive best when it is part of an “entrepreneurial university” that is also strong in commercialising research and that is managed in an entrepreneurial manner” (Lilischkis et al., 2015). The problems and barriers to the transformation of Bulgarian universities into entrepreneurial universities are analysed.

Section **3.2. Data collection** presents the methods for data collection and the characteristics of the sample. This study utilizes a database about technology entrepreneurship among Bulgarian STEM students. Technology entrepreneurship is defined as the creation of a new business whose products or services depend largely on the application of scientific or technological knowledge (Allen 1992). The database was collected using a cross-sectional survey among 1061 STEM students in Bulgarian universities. STEM students were selected for the empirical analysis because they exhibit the potential to start technology ventures (Souitaris et al., 2007). The survey was administered to students in STEM majors in 15 Bulgarian universities in Sofia and other Bulgarian towns in 2015 and 2016. With the approval and cooperation of rectors, deans, department heads and lecturers in 15 Bulgarian universities, a questionnaire (Appendix 1) was distributed during class sessions. Students were informed that the participation in the survey was voluntary and questionnaires were only for research purposes. Therefore, the sample is not statistically representative of the population of Bulgarian STEM students. The sample is based on convenient sampling and therefore it is not statistically representative of the population of Bulgarian STEM students. In this section the characteristics of the sample and the structure of the sample with respect to the stages of technopreneurial process are presented (Table 9).

Table 9: Structure of the sample with respect to the stages of technopreneurial process.

Stage of the technopreneurial process	Number	%
<i>Technopreneurial attitudes</i>		
STEM students reporting high technology new venture desirability	572	53.9%
STEM students reporting high technology new venture feasibility	190	17.9%
<i>Technopreneurial intentions</i>		
STEM students exhibiting technopreneurial goal intentions	299	28.2%
STEM students exhibiting technopreneurial implementation intentions	149	14.0%
<i>Nascent technology entrepreneurship and intrapreneurship</i>		
STEM students involved in nascent technology entrepreneurship	27	2.5%
STEM students involved in nascent technology intrapreneurship	24	2.3%
<i>Active technology entrepreneurship and intrapreneurship</i>		
STEM students who are active technology entrepreneurs	29	2.7%
STEM students who are active technology intrapreneurs	26	2.4%

Section **3.2. Variables** contains information about dependent, independent, and control variables in the study.

Section **3.3. Data analysis** presents the methods for data analysis. Taking into account the objectives of this study and the properties of the data, we apply a binary logistic regression for data analysis to test the proposed hypotheses (Greene, 1997).

CHAPTER 4: EMPIRICAL FINDINGS

In section **4.1. Descriptive statistics** presents the characteristics, career motives, and perceptions of concept development support and business development support provided by the university of STEM students who exhibit high technology new venture desirability, high technology new venture feasibility, technopreneurial goal intentions, technopreneurial implementation intentions, or are involved in nascent technology entrepreneurship or nascent technology intrapreneurship. The diverse barriers perceived by STEM students involved nascent technology intrapreneurship and their start-up activities are described.

Section **4.2. University Determinants of Technopreneurial Attitudes among Bulgarian STEM Students** presents the empirical findings about university determinants of high technology new venture desirability and high technology new venture feasibility in a subsample of 879 STEM who are not nascent entrepreneurs/ intrapreneurs (in a process of starting a business) or active entrepreneurs/ intrapreneurs (have already started a business). Academics' attitudes towards entrepreneurship, concept development support, and university research excellence influence positively the odds of high technology new venture desirability, while entrepreneurship education and industry ties have no statistically significant effects on this variable.

Concept development support and industry ties influence positively the odds of high technology new venture feasibility, while university research excellence has a negative effect on this variable. Academics' attitudes towards entrepreneurship and entrepreneurship education have no effect on the odds of high technology new venture feasibility. Hypotheses 1, 3, 4, 8 and 10 are supported, while hypotheses 2, 5, 6, 7, and 9 are rejected. A discussion of the empirical findings is presented in this section.

Section **4.3. University Determinants of Technopreneurial Intentions among Bulgarian STEM students** presents the empirical findings about university determinants of technopreneurial goal intentions and technopreneurial implementation intentions. In a subsample of 879 STEM students who are not nascent entrepreneurs/ intrapreneurs (in a process of starting a business) or active entrepreneurs/ intrapreneurs (have already started a business) the likelihood of technopreneurial goal intentions is positively affected by the concept development support, university research excellence, and entrepreneurship education, while academics' attitudes towards entrepreneurship and industry ties do not affect significantly this variable. Only concept development support has significant positive effect on the odds of technopreneurial implementation intentions among STEM students in a subsample of 299 STEM students with technopreneurial goal intentions. University research excellence negatively affects this variable, while entrepreneurship education and industry ties have no effect on it. Hypotheses 12, 13, 14 and 17 are supported, while hypotheses 11, 15, 16, 18, and 19 are rejected. A discussion of the empirical findings is presented in this section.

In section **4.4. University Determinants of Nascent Technology Entrepreneurship and Intrapreneurship among Bulgarian STEM Students** factors related to the university which influence the likelihood of nascent technology entrepreneurship and intrapreneurship in a subsample of 200 STEM students, who report technopreneurial implementation intentions

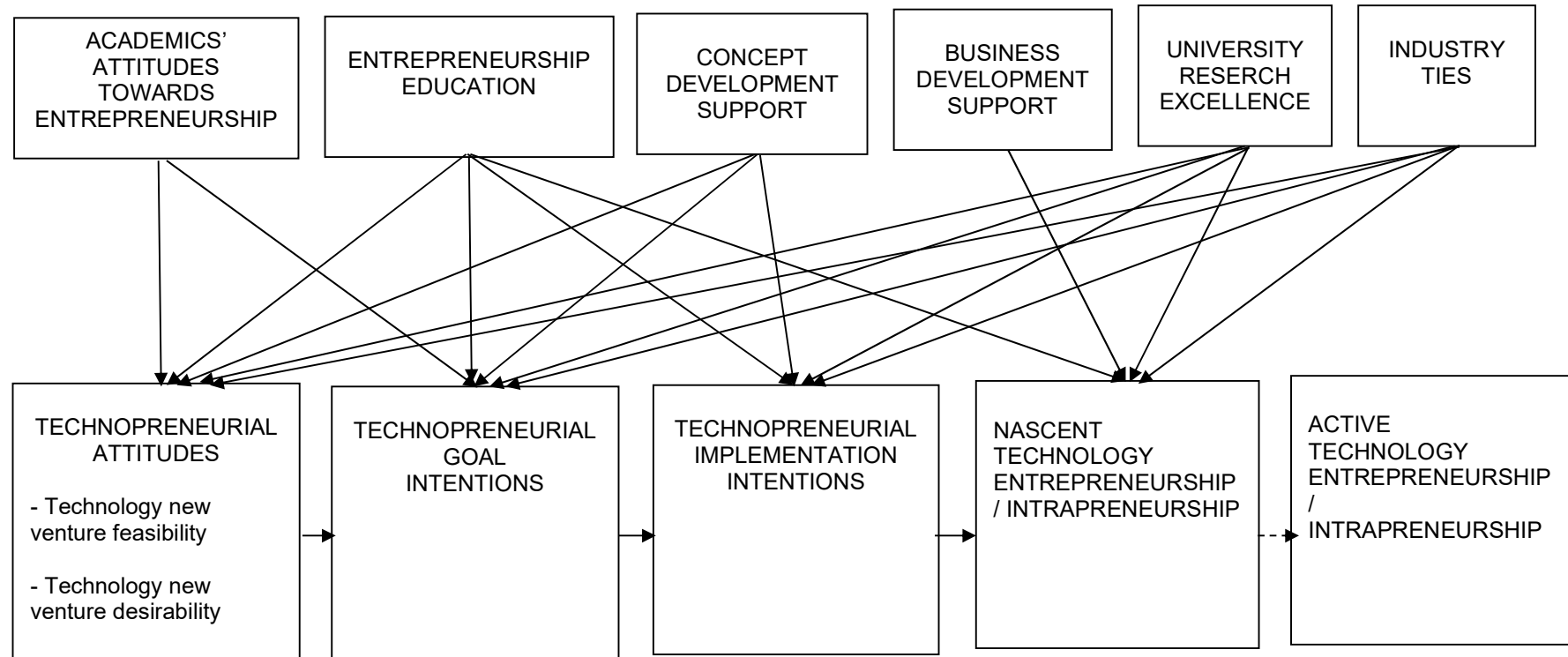
or are involved in nascent technology entrepreneurship and intrapreneurship are identified. Only university research excellence positively impacts the likelihood of nascent technology entrepreneurship and intrapreneurship. Entrepreneurship education and industry ties have no effect on this variable, while business development support has a statistically significant negative effect on it. A special attention is devoted to a scientific discussion of these results.

Section **4.5. The Role of University for Active Technology Entrepreneurship and Intrapreneurship among STEM Students** presents empirical findings about the significant role of the university for the development of active technology entrepreneurship and intrapreneurship among the studied STEM students.

Section **Conclusions** contains a summary of the results and a conceptual framework of the role of university for technology entrepreneurship among STEM students (Figure 22). The limitations of the study, main contributions, directions for future research and practical implications are discussed in this section.

The dissertation contains two appendices. Appendix 1 contains the questionnaire of the study. Appendix 2 contains tables which visualize the content in section 4.1. The lists of tables and figures and references are included in the dissertation.

Figure 22: Conceptual framework of the role of university for technology entrepreneurship among STEM students.



Source: Own elaboration based on Kirby et al. (2011), Guerrero and Urbano (2012), Delanoë-Gueguen and Fayolle (2019) and Shapero (1982).

IV. Scientific and Applied Contributions

The contributions of the doctoral dissertation can be classified in two groups: scientific and applied scientific. The scientific contributions include the following:

- Definitions of concepts, theoretical approaches, and models in the field of entrepreneurship are systematized and critically analyzed.
- A conceptual model of the university factors affecting technopreneurial attitudes, intentions and behaviour of STEM students is developed.
- The proposed conceptual model contributes to better understanding of technopreneurial process by highlighting the role of technopreneurial implementation intentions as a missing link between technopreneurial goal intentions and technopreneurial behaviour.
- An analytical tool for investigating technopreneurial attitudes intentions, and behaviour of STEM students is developed.

The applied scientific contributions are as follows:

- New knowledge about technology entrepreneurship among Bulgarian STEM students and the role of university factors for technopreneurial attitudes, intentions, and behaviour of Bulgarian STEM students is generated.
- The results of the dissertation can help to design and implementing policies and support measures for stimulating technology entrepreneurship among Bulgarian STEM students.
- The findings of the dissertation can be used to improve the content and teaching methods used in entrepreneurship education for STEM students in Bulgarian universities.

V. Publications Related to the Topic of the Dissertation

Book chapter

1. Yordanova, D. (2019). Transformation of Bulgarian Universities into Entrepreneurial Universities: Barriers, Facilitators and Best Practices, *Business Administration: Theory and Practice in Bulgaria II* (pp.53-66), Publisher: St. Kliment Ohridski University Press.

Articles indexed in Scopus and/ or Web of Science

2. Yordanova, D. (2021). Nascent Technology Entrepreneurship among Bulgarian STEM Students. *Administrative Sciences*, 11(4), 121. (Special Issue "Fostering Student Entrepreneurship: Nascent and Active Entrepreneurs in Universities"), (Web of Science, Scopus).
3. Yordanova, D., Filipe, J. A., & Pacheco Coelho, M. (2020). Technopreneurial intentions among Bulgarian STEM students: the role of university. *Sustainability*, 12(16), 6455. (Special issue "Innovation Ecosystems: A Sustainability Perspective"), (Web of Science, Scopus).
4. Yordanova, D., & Filipe, J. A. (2019). Towards entrepreneurial universities: Barriers, facilitators, and best practices in Bulgarian and Portuguese universities. *International Journal of Economics and Business Administration*, 7(4), 213–227. <https://doi.org/10.35808/ijeba/340> (Scopus).

Articles indexed in other databases

5. Yordanova, D. (2020). Perceptions of University Entrepreneurship Support among Bulgarian Science and Engineering Students. *Годишник на Стопанския факултет на СУ „Св. Климент Охридски“*, 18(1), 145-157.
6. Yordanova, D. (2020). Bulgarian nascent student technopreneurs: motives, perceptions of barriers, and startup activities. *International journal of multidisciplinary in business and science*, 6(10), 43-53.
7. Yordanova, D., & Filipe, J. A. (2018). Desirability of Technology Entrepreneurship among Bulgarian STEM Students: The Role of Entrepreneurship Education. *European Research Studies Journal*, 21(3), 446-462.

Articles in conference proceedings

8. Yordanova D. (2021). The role of university for desirability of technology entrepreneurship: evidence from Bulgaria. *ICERI2021 Proceedings*, pp. 40-45.

9. Yordanova, D. (2021). Entrepreneurial Learning Among Bulgarian Stem Students. *European Proceedings of Social and Behavioural Sciences (EpSBS)*, vol. 116, pp. 546-552.
10. Yordanova, D., Kanazireva, R., Petkova, I., Mihaylova, I., & Mladenova, I. (2021). Feasibility of technology entrepreneurship among Bulgarian STEM students: the role of university. *Proceedings of CBU in Economics and Business*, 2, pp. 149-154.
11. Yordanova, D., Entrepreneurial attitudes toward technology entrepreneurship among Bulgarian science and engineering students, Сборник доклади Четиринадесета международна научна конференция „Развитие на висшите училища в контекста на европейските изисквания за качество на образователните услуги”, Publisher: изд. МВБУ, 2017, pages:123-132. ISBN 978-954-9432-75-1 (CD).
12. Yordanova, Desislava I., Understanding intentions towards technology entrepreneurship among students, Съвременни управленски практики IX - "Управленска наука, икономика, и бизнес практики - съвременни ракурси и предизвикателства", 2016, БСУ, Център по икономически и управленски науки, Бургас, 17-18 юни 2016 г.стр.:128-135. ISSN: 1313-8758.
13. Yordanova, D., Entrepreneurship among university students: a conceptual model of the role of the university, Сборник с доклади „Иновативни стратегии за конкурентоспособен бизнес“, 2015, МВБУ, Ботевград, изд. МВБУ, стр.:138-145, ISBN 978-954-9432-67-1 (CD).

Other publications

14. Yordanova, D. (2019). Towards entrepreneurial universities in Bulgaria, ERENET Profile, ISSUE Vol. XIV No. 3, pp. 20-25.

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