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Assessing Academics' Third Mission Engagement by Individual and Organisational Predictors

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Abstract: In recent years, the coming of the entrepreneurial university has brought about a third role in academia, which involves greater visible exchange of academics with society and industry. In this paper, the authors investigate to what extent individual and organisational factors influence the propensity of academics to engage in different types of Third Mission (TM) activities. This study is based on a large-scale survey of academics in Iceland regarding engagement in socio-economic activities. The results indicate that "soft" activities such as community activities and external teaching and training can be better predicted by individual factors, while hard activities such as *applied contract research* and *commercialisation* can be better predicted by organisational factors. Overall, academics are most likely to participate in community-related activities. Hereby, academics from the STEM and health disciplines, with work experience outside of academia and who are open to new experiences are more likely to be engaged in applied contract research and commercialisation. Academics belonging to disciplines other than STEM and health sciences and those that on an average publish more peer-reviewed articles are more likely to disseminate their knowledge to a wider audience outside of academia through public science communication. Gender, rank, and teaching do not affect TM participation, but openness, performance, or discipline do.

Keywords: third mission; entrepreneurial university; personality traits; commercialisation; contract research; science communication

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1. Introduction

The introduction of the entrepreneurial university has magnified the work obligations of academics by adding socio-economic activities to their traditional research and teaching responsibilities (Addie 2017). The model anticipates more intensive interaction with industry and society, with academics taking up a third role (Westnes et al. 2009) or a "regional development role" (Jaeger and Kopper 2014). The purpose of this third role, or Third Mission (TM) is then to increase knowledge and technology transfer to society, for instance, by incorporating formal and informal commercialisation activities (Perkmann et al. 2013) to enhance innovation and create a more profitable university by allowing more diverse sources of allocation. This then supplements universities in their role within the triple helix (Etzkowitz 2002; Leydesdorff and Etzkowitz 1996).

What complicates the situation is that the literature on TM and entrepreneurial universities is broad, the stakeholders many, and the activity outcomes at times difficult to measure. This makes it challenging to capture TM and the entrepreneurial university at their full scope. As per definition, the TM and entrepreneurial universities are in line with each other. Philpott et al. (2011) explain: "a university that embraces its role within the triple helix model and adopts the mission of contributing to regional/national development is referred to as an 'entrepreneurial university'" (p. 162). Hereby, the "entrepreneurial university adopts the third mission" (p. 162). However, what represents an entrepreneurial university is not restricted by innovation and entrepreneurship, but also includes direct and indirect academic engagement with their immediate environment. This relates to actors from industry, research organisations, other educational establishments, the public, and society in general. Examples are science communication, organising lifelong-learning activities and policy development. As the recipients from industry and other stakeholders interacting with academia have different purposes and intentions themselves, it is important that universities and researchers do not solely link the TM concept or entrepreneurial activities, with activities related to economic development or research commercialisation (Philpott et al. 2011). It is therefore crucial for the university to follow a balanced approach to satisfy multiple economic and social interests of its many stakeholders with respect to its social responsibility within the community (Barrena Martínez et al. 2016).

The impact of the TM is broad and can also be linked to non-profit and informal aspects. Consequently, there have been calls from within the university that the current academic performance system, which rewards scientific publications and teaching activities, is insufficient, as it does not capture the socio-economic impact of the TM efforts well-enough (Dahlborg et al. 2017). Different opinions and criteria exist on how to evaluate and measure the performance of an entrepreneurial university and academics' TM engagement, as no common frameworks exist yet (Gür et al. 2017; Mazdeh et al. 2013; Secundo et al. 2017).

Academics are used to high levels of autonomy, especially at public universities. In this regard, it seems crucial to analyse personal characteristics and link them to TM engagement. Moreover, entrepreneurial intention seems to be highly driven by intrinsic motivation and can be mediated by academic position and work context (Antonioli et al. 2016). There are studies that have reviewed the influence of individual and organisational motivational causes on innovation and entrepreneurship participation (e.g., Liñán and Fayolle 2015; Molino et al. 2018), or that have focused on the academic context in particular (Johnson et al. 2017; Miller et al. 2018; Neves and Brito 2020). This article does both by concentrating on individual and organisational factors influencing academic engagement in five types of TM activities.

Moreover, while previous research on TM activities of academics has focused on either commercialisation or university-industry collaboration (UIC) (Baycan and Olcay 2021; Knudsen et al. 2021; Ranga et al. 2016; Stefanelli et al. 2020), we will focus on a broader variety of TM activity engagement. However, to do so, it is crucial to conceptualise TM first, as for the operationalisation to be valid and reliable. For this study, we follow the definition of Molas-Gallart et al. (2002) who define TM as the "interactions between universities and the rest of society" (p. iv), whereby TM activities are mainly driven by the "generation, use, application and exploitation of knowledge and other university capabilities outside academic environments" (p. 2).

To design policies and performance reward systems, it is important to know which role academics play when it comes to socio-economic engagement and what factors impact the extent and frequency of their engagement. Therefore, we pose the following research question:

To what extent do individual and organisational factors influence the propensity of academics to engage in different types of Third Mission activities?

We will also evaluate what academic profile suits the different TM activities by examining how immutable individual and organisational factors that are inherent to the organisation relate to TM participation. We assume that academics cannot be engaged in all different TM activities simultaneously, hence the tendency of academics to engage in some activities more than in others. By examining both individual and organisational determinants, we are answering to a call by Huyghe and Knockaert (2015) for the need of broader analysis.

Much of the existing research concentrates on company creation or patenting, and it has also been criticised that industry interaction is commonly only partly evaluated. Subsequently, there is the risk of missing out on important other types of knowledge interactions (Schartinger et al. 2002). Getting a better understanding of TM activities does not only facilitate the creation of an entrepreneurial university structure but it helps building a powerful and dynamic research environment in regional innovation systems through purposeful allocation of funding, the creation of appropriate organisational structures and incentives, and through the development of policies (Karlsen et al. 2017; Lehmann et al. 2009; Nilsson 2006). The objective of this study is thus to shed light on the way academic institutions can encourage academic employees to participate in TM activities.

This study makes several contributions. First, it considers academic organisational variables such as rank, discipline, academic work experience, outside academia experience and academic performance (Dahlborg et al. 2017; Holmen and Ljungberg 2015). Bourelos et al. (2012) emphasize that variables related to the individual and the organisational support structure should be included in the context of policy formulation due to the complexity of entrepreneurship. In this study, we therefore examine how individual factors and organisational factors influence researchers' entrepreneurial and societal engagement (Fogelberg and Lundqvist 2013). Second, no prior research evaluates all academic disciplines or compares Science, technology, engineering and mathematics (STEM) and health disciplines towards all other scientific disciplines, and propensity of researchers towards TM. Most research has been conducted in engineering and natural or medical sciences with an emphasis on commercial aspects of TM (D'Este and Patel 2007). Third, this article contributes to theory building as, to date, only single aspects of the TM have been researched, while this research considers TM from a broader perspective. Although all of these aspects have been applied in other studies, our study is the first to integrate all three aspects in one model.

Results reveal that academics participate most in community-related activities. Further, participation in TM activities is not affected by factors such as gender, teaching, or rank, but is affected by factors such as openness to experience, performance, or discipline.

2. Literature Review

So far, myriad research has been conducted on factors influencing academic productivity and success (Feist 2011; Feist and Gorman 1998). Such factors can be on the individual level and be affiliated with age, gender, personality characteristics, academic rank, and specialisation. External factors are in contrast related to the working environment, group dynamics, or incentives (Antonio-García et al. 2014). So far, there are opposing results on industry collaboration having a positive effect on academic productivity and teaching performance (Bikard et al. 2019; Garcia et al. 2019) or not or even a negative effect (Brooks and Randazzese 1998; Hottenrott and Lawson 2014; Nelson 2004; Zhang and Wang 2017). Regarding academic consulting, results depend on the field of science if it is negatively (STEM) or positively (SSH) correlated with number of publications (Rentocchini et al. 2014).

Research has shown that knowledge transfer, which is based on mutual collaboration, is mostly fostered by individual researchers and not universities or university departments (Breschi and Catalini 2010; D'Este and Patel 2007). Moreover, Bourelos et al. (2012) also showed that it is crucial to include variables based on individual level of academics such as research performance and personal networks.

Likewise, the innovative activity of individuals and, in this context, entrepreneurship has been studied profoundly. When summarising previous research in regard to gender, male academics are more likely to collaborate with the industry and are more committed to innovation and entrepreneurship (Calvo et al. 2019; Pita et al. 2021). Possible reasons are that men seem to have a denser network outside of academia (Abreu and Grinevich 2013; Bozeman and Gaughan 2011). Additionally, the proportion of men is higher in disciplines of natural and health sciences, where innovation and applied research are practiced more than in other sciences (Klofsten and Jones-Evans 2000). Further, women are generally more risk averse than men, especially in regard to financial decisions (Brindley 2005; Gimenez-Jimenez et al. 2020; Humbert and Brindley 2015), and they also dislike competition more than men (Gneezy et al. 2003; Niederle and Vesterlund 2007, 2011). On the other hand, female academics are more engaged in teaching and teaching related activities (Hughes et al. 2016).

Regarding the age of academics and research productivity, age does not seem to be a good predictor as results are either ambiguous (Kotrlik et al. 2002) or only weakly correlated (Stephan 1996). Seniority seems to be a better predictor, whereas higher seniority positively influences patenting behaviour due to bigger networks and university-industry collaboration (UIC) activities (Boardman and Ponomariov 2009; Carayol 2007; D'Este and Perkmann 2011; Grimm and Jaenicke 2015). This is facilitated as mature academics have developed higher human capital (e.g., in the form of scientific publications and patents) and social capital (e.g., in the form of research partnerships, collaborations, and networks) (Calvo et al. 2019). However, the older a person becomes, the less likely it is that he or she will start a new company (Karlsson and Wigren 2012). Younger academics have smaller networks and less experience in collaborative activities. They further need to establish themselves first in academia by following academic excellence to move up to higher positions (Klofsten and Jones-Evans 2000). Therefore, less time is invested into entrepreneurial activities.

Studies have further examined different types of universities, thereby looking into distinctions within older, more established universities, and younger, less research-oriented universities where commercialisation is in the foreground (Sanchez-Barrioluengo et al. 2019). Regarding the size of universities or university departments, results reveal mixed effects (Bonaccorsi et al. 2014), with medium-sized universities being more engaged in TM. Additionally, location can give evidence, whereby regional universities are less collaborating with industry (Sanchez-Barrioluengo et al. 2019). Regarding the type of university, it is easier for private universities to follow a business model that incorporates TM such as commercial transfer, as private universities are—especially financially—more independent (Gaus and Raith 2016). Specialisation of university can further influence organisation of TM activities, whereas for example, a concentration on engineering disciplines gives evidence for a much higher TM involvement (Rolfo and Finardi 2014). Academic funding does not only increase overall publication rate (Gush et al. 2017; Payne and Siow 2003), but government funding further stimulates industry collaboration (Fan et al. 2019; Muscio et al. 2013; Nugent et al. 2021; Silva et al. 2018), and it is positively correlated to research performance (Mejlgaard and Ryan 2017; Muscio et al. 2017), but has no effect on entrepreneurial outputs (Gulbrandsen and Smeby 2005).

The work experience of academics outside academia is another important factor when it comes to academic entrepreneurship, which according to Bourelos et al. (2012, p. 774) further "helps the researcher at the research institute or university to specify and define new sets of research problems". Previous research has confirmed that academics with former industry experience have a positive influence on academic entrepreneurship (Jonsson et al. 2015; Klofsten and Jones-Evans 2000; Krabel and Mueller 2009; Nielsen 2015). In addition, academics have built up more diverse and stronger network ties affecting future collaboration (Dietz and Bozeman 2005). This is especially true in fields of medical science and engineering and, consequently, the propensity of academics in engineering, technology, or natural sciences to participate in contracts with companies is significantly higher than those in social sciences or humanities (Azagra-Caro 2007). Generally, it is well known that the type of discipline or field of study has an influence on knowledge and technology transfer, and academic entrepreneurship (Bekkers and Freitas 2008; Bercovitz and Feldman 2008; Giuliani et al. 2010; Martinelli et al. 2008; Perkmann et al. 2013; Stuart and Ding 2006). Therefore, health sciences and disciplines belonging to STEM are often leading when it comes to entrepreneurial or commercialisation activities such as patenting, licensing, or starting businesses (Bercovitz and Feldman 2008; Delmar et al. 2003; Hughes et al. 2016; Laukkanen 2003; Owen-Smith and Powell 2001; Powers 2003; Stuart and Ding 2006).

Previous studies have tried to explain scientific success (Feist and Gorman 1998) and entrepreneurial activity (Crant 1996; Wu et al. 2019) in relation to personality traits. Feist (1998, 2011) has thereby studied the "psychology of science" and suggested that particular personality traits such as conscientiousness, but a lower degree of openness to experience are more prevalent among scientists than non-scientists. High levels of conscientiousness and openness to experience give scientists the feeling to be more "embedded within norms of academic system" so that they "report greater appreciation of the impact of their work on their academic peers" (Azagra-Caro and Llopis 2017, p. 568). However, creative scientists are more likely to score higher in openness and confidence, but less in conscientiousness than less creative scientists (Feist and Gorman 1998). Further, scientists that score higher in openness to experience and conscientiousness state higher perceived academic impact, yet with higher chance of experiencing a conflict of interest regarding industry (Azagra-Caro and Llopis 2017). Feist was a forerunner when it comes to analysing the personality of scientists and gives a good overview and summary of previous research on the topic. Therefore, it can be said that scientists are more ambitious, driven and dominant than non-scientists, work more independently, are more introverted and less sociable (Feist 2011; Feist and Gorman 1998, 2012).

Considering TM activities as a dependent variable, the authors formed the following hypotheses:

H1. *Male academics are more likely to be engaged in TM activities related to research commercialisation and knowledge and technology transfer.*

H2. *Female academics are more likely to be engaged in TM activities related to teaching and community engagement.*

H3. *Academics in disciplines of natural and health sciences as well as more senior academics are more likely to be engaged in TM activities related to research commercialisation and knowledge and technology transfer.*

H4. *Academics with work experience outside of academia are more likely to be engaged in TM activities related to research commercialisation and knowledge and technology transfer.*

H5. *Academics who score higher in openness to experiences are more likely to be engaged in TM activities in general.*

3. Data and Methods

At the start of 2021, a quantitative survey among academics in Icelandic universities was conducted with the aim of obtaining information about their engagement in TM activities. The target group comprised the total population of academics, working as either adjunct, assistant, associate- or full professor, at one of the seven Icelandic universities. The majority (n = 674)[1] worked for the University of Iceland, the others (n = 360) for other universities to the time of data collection.

The survey question design was based on the outcomes of a literature review (Schnurbus and Edvardsson 2020) and inspired by a prior study on university-industry collaboration (Karlsdottir et al. 2021). The survey was pre-tested among several academics and staff from university administration, and adjustments were made accordingly. Email addresses were obtained from the institutions' public homepages. The survey was conducted through *QuestionPro* and was open for 21 days. Two reminders were sent out after the initial invitation, but the response rate remained low. We collected 183 responses whereby not all participants completed the questionnaire. The response rate was therefore 17.7%. Possible reasons for the low response are the survey length, survey fatigue (Olson 2014), a general lack of participation in TM and collaboration activities in Iceland, and a lack of interest in the survey topic. Even though Roscoe (1975) and Hair et al. (2019) argue that the rate is acceptable for further analysis, we are aware of the limitations this raises when it comes to extensive data analysis.

A non-response analysis was performed by comparing late and early responses (Hair et al. 2019). T-tests did not reveal any statistically significant differences between means of these two groups in terms of demographic characteristics such as *gender*, *age*, *rank*, and *outside academic experience* ($p > 0.05$). Moreover, it is worth emphasizing that this study builds on a target population, not a sample, and that academic disciplines that have to date mainly been neglected in studies on TM, are included in this study.

Table 1 presents the demographics and academic profile of the participants. Women tend to participate in surveys in a larger extent than men (Groves et al. 2011), and this is also a case in our study where a higher proportion of female academics participated (57%) even though the current proportion of female academics is less than male academics at Icelandic universities. Almost half of the participants hold a full professor position. Most responses (63%) came from academics aged 50 years or older, and almost one-third of responding academics were 60+. More than half of participants are affiliated with either the School of Social Sciences (27%) or the School of Natural Sciences (26%).

Table 1. Participants' profile.

	Percentage (N)
Women	56% (84)
Men	44% (66)
Younger than 40 years	6% (9)
40–49	31% (47)
50–59	32% (49)
60 years old or older	31% (48)
School of Natural Sciences	26% (39)
School of Health	13% (20)
School of Humanities	13% (19)
School of Education	19% (29)
School of Social Sciences	27% (40)
School of Agriculture	3% (4)
STEM/Health Sciences	39% (59)
Other Sciences	61% (92)
Adjunct lecturer (Aðjúnkt)	7% (10)
Assistant professor (Lektor)	24% (36)
Associate professor (Dósent)	23% (34)
Full professor (Prófessor)	47% (70)

3.1. Measures

In this study, there are five dependent variables, each representing one of the five TM activities: *community activities, science communication, external teaching and training, applied contract research* and *commercialisation*. They are composite variables, with Table 2 listing the items the variables represent, as well as Cronbach's alpha values. N implies the number of answers. As we also included partial respondents (pairwise deletion), the number of answers slightly differs between components.

Most items were inspired by previous study measurements on the commercialisation of research (Nilsson et al. 2010), industry interaction (D'Este and Patel 2007; Inzelt 2004; Schartinger et al. 2002), and academic entrepreneurship activities (Klofsten and Jones-Evans 2000), and adapted to the Icelandic context. The answer scale comprised a five-point Likert scale measuring how often a certain activity was performed, in a 3-year period prior to the survey (i.e., 2018–2020), ranging from "never" (1) to "very often" (5).

Community Activities represent collaborative activities with educational- and other public institutions, and also includes voluntary work for the benefit of the community. In general, lectures and public debates could also be considered external teaching and training activities, which is another activity within the TM model, but as the item only corresponded to the community component in our study, it was accommodated there.

Table 2. Five components (dependent variables) of the Third Mission.

Name of Component (Dependent Variable)	N	Number of Items	Items	Cronbach's α	Mean	SD
Community Activities	152	5	Collaboration and communication with preceding school levels Volunteer contribution to the community Organising conferences and workshops Contribution to public policy Lectures, public debates or talks to non-academic organisations	0.753	2.566	0.866
Science Communication	142	6	Print media interviews Interviews for web-based media TV programs Radio programs Podcasts Writing of newspaper articles	0.857	1.891	0.921
External Teaching and Training	155	3	Training/coaching of company employees Joint teaching courses or programs with industry or public organisations Taking part in lifelong-learning activities	0.804	1.951	0.982
Applied Contract Research	178	2	Application for funding together with industry/public organisation Formal R&D co-operations such as contract research or joint research projects	0.768 (r = 0.623) **	2.610	1.247
Commercialisation	143	6	Publishing patents or patent applications as co-inventor or applicant Licensing Participating or initiating cluster creation or development of Science Park or Technology Transfer Office Creation of or participation in the creation of spin-off or start-up Application for funding together with industry/public organisation Formal R&D co-operations such as contract research or joint research projects	0.656	1.614	0.541

Pearson's correlation was calculated for components with fewer than 3 items (** represents significant results, $p < 0.01$).

The component *science communication* contains mainly items of public science communication. These refer to a type of science communication that is often referred to as popular science communication. In academia, it is considered less prestigious than peer-reviewed content, but media appearance often reaches a greater audience instead. In turn, the awareness in society for certain scientific results can lead to additional trust in science and changed social behaviour (Huber et al. 2019; Marcinkowski and Kohring 2014; Schäfer 2016).

External Teaching and training includes TM activities such as training and guidance on the job, and teaching outside of academia, for instance, by developing programs for life-long learning activities (Icelandic: *endurmenntun*).

The component *applied contract research* includes activities related to funding and participation in collaborations on formal research and development projects. From a theoretical point of view, it would be preferable to highlight the *commercialisation* aspect (e.g., registration of patents, licensing, and cluster or start-up creation) but retrospectively, the answers in this study do not allow for such focus. Only a very small percentage of participants takes part in commercialisation activities.

The independent variables contain measurements at the individual and organisational level. First, starting with the individual factors, there is a dummy variable for gender (1 = men, 0 = women), and five personality traits (extraversion, agreeableness, conscientiousness, emotional stability and openness) were measured according to a 10-item measure of the Big-Five dimensions based on Gosling et al. (2003) on a Likert-scale from 1 (disagree strongly) to 7 (agree strongly). After reversing some items, results for single items were averaged to produce a general outcome for each trait and reliability analysis was conducted (Table 3). As *agreeableness* and *emotional stability* have a low reliability, caution is in order when interpreting the results.

Table 3. The Big Five Personality traits (based on Payne and Harper (2020) and Gosling et al. (2003)).

Factors	N	Items	Description of Factors	Cronbach's α	Correlation	Mean	SD
Extraversion	**148**	Extraverted, enthusiastic Reserved, quiet (reversed)	The ability of a person to engage with the external world; the opposite is introversion.	0.643	0.480 **	4.595	1.349
Agreeableness	**148**	Critical, quarrelsome (reversed) Sympathetic, warm	Demonstrates how people are different regarding cooperation and social harmony; the opposite is disagreeableness.	0.323	0.205 **	5.243	1.087
Conscientiousness	**149**	Dependable, self-disciplined Disorganised, careless (reversed)	The capability of a person to manage, regulate, organise, and direct emotions or impulses; the opposite is easy going, disorderly, and with no self-control.	0.716	0.574 **	5.768	1.178
Emotional Stability	**148**	Anxious, easily upset (reversed) Calm, emotionally stable	Describes how a person experiences positive feelings; the opposite is being emotionally unstable.	0.375	0.241 **	5.368	1.168
Openness to Experience	**146**	Open to new experiences, complex Conventional, uncreative (reversed)	Describes and distinguishes people's creativity and intellectual awareness; the opposite is not accepting change, being traditional, liking familiar routines, and a narrower choice of interests.	0.682	0.529 **	5.558	1.124

** Correlation is significant at the 0.01 level (2-tailed).

Second, six organisational dummy variables were created. The first one yime spent on teaching (1 = I spend most of my time on teaching, 0 = I do not spend most of my time on teaching) captures the focus of the academic work. Academic rank (1 = full professor, 0 = other position) measures the progression through the academic system. Academic work experience measures the number of years academics have worked in academia (1 = more than 10 years, 0 = 10 years or less). The only organisational variable that is not measured as a dummy variable is Academic performance. Inspired by Bourelos et al. (2012) and Karlsson and Wigren (2012), participants were asked about the number of publications in academic peer-reviewed journals in the last three years. In the survey, data on article authorship were collected separately for single-authored articles, for first-author articles, and for authorship in non-leading author positions. The Academic performance variable was created by adding the mid-scores of the ranges for all authorship types. The scale ranges from 0 up to 7+ articles and shows the average number of articles per year. Academic discipline captures differences between STEM and health disciplines (1) compared to other disciplines (e.g., Social Sciences, Humanities, Education, and Agriculture) (0), similar to the research conducted by Huyghe and Knockaert (2015). About 39% of participants belonged to STEM and health disciplines, the rest (61%) to other schools. Finally, the dummy variable Outside academia experience (1 = yes, 0 = no) measures if academics have experience working outside of academia, i.e., in companies or organisations such as the national hospital.

3.2. Data Analyses

Data were analysed with assistance of Statistical Package for Social Science (SPSS) 26. For all models, regression diagnostics were used to assess whether modelling assumptions were satisfied. The kurtosis and skewness values were nearly all within the conventional range of ± 1.96 (Ghasemi and Zahediasl 2012). Before the independent variables were transformed into dummy variables, normal probability plots (P-P) were created. They did not reveal any major deviations from normality. Outliers, however, were visible for the personality traits, emotional stability, agreeableness, and conscientiousness, as well as for the number of publications. The outliers were replaced by the mean, but this did not significantly affect the results and thus the outliers were kept in place during the analysis. No issues of multicollinearity were found among the independent variables with VIF in all cases greater than one and lower than three.

Due to the low response rate, the number of cases within this study can be deemed relatively small. However, following Tabachnick et al.'s (2007) rule of thumb, the minimum amount of cases relates to $N \geq 50 + 8m$. As our model contains 12 independent variables, the analysis requires a minimum of 146 cases (50 + 8*12). With the exception of the independent variable most time spent on teaching (N = 120), all other independent variables live up to the requirement.

This study presents five regression analyses each comprising of three models. In the first model, a block with individual factors (gender, and all five personality traits) is added and in the second model, a block of organisational variables (teaching, rank, academic work experience, performance, discipline, and outside academia experience) is added. The third model includes all 12 variables. By comparing the variance explained (adjusted R2), it is possible to compare the relative importance of the two different factors (individual and organisational) in predicting participation in TM activities. We build the analysis on two-tailed tests which are more rigorous than the one-tailed test.

4. Results

Descriptive statistics and correlations for all variables are presented in Table 4. Most of the correlations are weak (<0.3); however, openness correlates moderately with the TM activity community activities (r = 0.381). There are also moderate correlations observed for the organisational factor discipline and applied contract research and commercialisation (r = 0.339 ** and r = 0.398 **, respectively). Further, there is weak to moderate correlation for performance regarding community activities and science communication (r = 0.263 ** and r = 0.307 **). No such correlations were found for the TM activity external teaching and training.

The multiple regression results of all five models are described as follows (Table 5).

Table 4. Measures of central tendency and dispersion and Pearson's r correlations for all variables in the model.

		Mean	SD	N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Dependent Variables																			
1.	**Community Activities**	2.566	0.866	152																
2.	**Science Communication**	1.891	0.921	142	0.331 **															
3.	**External Teaching and Training**	1.951	0.982	155	0.597 **	0.016														
4.	**Applied Contract Research**	2.610	1.247	178	0.483 **	0.072	0.394 **													
5.	**Commercialisation**	1.614	0.541	143	0.511 **	0.041	0.324 **	0.940 **												
	Independent Variables																			
6.	**Male**	0.440	0.498	150	−0.017	0.048	−0.112	0.054	0.126											
7.	**Extraversion**	4.595	1.349	148	0.259 **	0.262 **	0.111	−0.003	−0.034	−0.154										
8.	**Agreeableness**	5.243	1.087	148	0.202 *	0.066	0.160	0.032	−0.001	−0.049	0.015									
9.	**Conscientiousness**	5.768	1.178	149	0.066	0.071	0.049	0.013	−0.068	−0.216 **	0.248 **	0.300 **								
10.	**Emotional Stability**	5.368	1.168	148	0.104	0.051	0.025	0.104	0.056	0.053	0.127	0.260 **	0.302 **							
11.	**Openness**	5.558	1.124	146	0.381 **	0.121	0.262 **	0.274 **	0.293 **	−0.075	0.286 **	0.192 *	0.235 **	0.284 **						
12.	**Most Time Spent Teaching**	0.642	0.482	120	−0.108	−0.110	0.009	−0.233 *	−0.217 *	−0.123	−0.086	0.138	0.093	0.039	−0.060					
13.	**Professor**	0.467	0.501	150	0.138	0.151	−0.069	0.157	0.106	0.294 **	0.020	0.104	0.052	0.058	0.013	−0.376 **				
14.	**Academic Work Experience**	0.656	0.477	151	0.086	−0.063	0.064	0.011	0.000	0.177 *	−0.015	0.013	−0.151	0.047	0.033	−0.195 *	0.450 **			
15.	**Performance**	1.976	1.511	182	0.263 **	0.307 **	0.014	0.173 *	0.228 **	0.139	0.082	−0.044	0.035	0.064	0.100	−0.345 **	0.393 **	0.141		
16.	**STEM/Health Sciences**	0.391	0.490	151	0.010	−.219 *	−0.057	0.339 **	0.398 **	0.174 *	−0.212 *	−0.051	−0.170 *	−0.110	−0.151	−0.135	0.057	−0.051	−0.039	
17.	**Outside academia experience**	0.303	0.461	155	0.047	−0.008	0.125	0.258 **	0.254 **	−0.020	0.033	−0.050	−0.001	0.015	0.070	−0.112	−0.056	−0.055	−0.040	0.190 *

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table 5. Multiple regression models for predicting Third Mission activities.

Variable	Community Activities			Science Communication			External Teaching and Training			Applied Contract Research			Commercialisation		
	B	ß	SE	B	ß	SE	B	ß	SE	B	ß	SE	B	ß	SE
Constant	0.026		0.635	1.081		0.716	0.323		0.780	0.320		0.884	0.631 *		0.379
Male	−0.059	−0.034	0.166	0.134	0.072	0.187	−0.135	−0.069	0.204	−0.104	−0.042	0.231	0.037	0.034	0.099
Extraversion	0.125 **	0.194	0.061	0.146 **	0.214	0.068	0.034	0.047	0.074	−0.047	−0.051	0.084	−0.023	−0.057	0.036
Agreeableness	0.149 *	0.187	0.076	0.072	0.085	0.085	0.146	0.162	0.093	−0.002	−0.002	0.105	−0.001	−0.002	0.045
Conscientiousness	−0.071	−0.096	0.075	−0.050	−0.064	0.084	−0.029	−0.035	0.092	−0.022	−0.021	0.104	−0.034	−0.075	0.045
Emotional Stability	−0.025	−0.034	0.071	−0.019	−0.024	0.080	−0.066	−0.078	0.087	0.068	0.064	0.099	0.008	0.017	0.042
Openness	0.238 **	0.309	0.074	0.013	0.016	0.083	0.197 **	0.226	0.091	0.328 ***	0.295	0.103	0.169 ***	0.351	0.044
Most Time Spent Teaching	0.036	0.020	0.180	−0.031	−0.016	0.203	0.013	0.006	0.221	−0.253	−0.098	0.251	−0.066	−0.059	0.108
Professor	0.040	0.023	0.197	0.201	0.109	0.222	−0.252	−0.128	0.242	0.248	0.099	0.274	−0.001	−0.001	0.118
Academic Work Experience	0.066	0.036	0.182	−0.348 *	−0.180	0.205	0.254	0.123	0.223	−0.132	−0.051	0.253	−0.047	−0.042	0.108
Performance	0.133 **	0.232	0.056	0.156 **	0.256	0.063	0.032	0.050	0.069	0.086	0.104	0.078	0.072 **	0.202	0.034
STEM/Health Sciences	0.179	0.101	0.166	−0.389 **	−0.207	0.187	−0.027	−0.013	0.204	0.849 ***	0.333	0.231	0.432 ***	0.390	0.099
Experience outside Academia	0.045	0.024	0.168	0.067	0.034	0.190	0.257	0.121	0.206	0.458 *	0.169	0.234	0.184 *	0.157	0.100
R^2		0.264			0.214			0.128			0.298			0.369	
Adjusted R^2		0.174			0.114			0.023			0.214			0.288	
F-Statistics		2.954 ***			2.136 **			1.220			3.566 ***			4.532 ***	

* $p \leq 0.1$. ** $p \leq 0.05$. *** $p \leq 0.01$.

4.1. Community Activities

Table A1 reveals that only the models including individual variables (1a and 1c) significantly contribute to predicting engagement in community tasks. Model 1a explains approximately 16% of the variability (adjusted R^2), Model 1b only 2.3% (insignificant), and together, these variables (Model 1c) explain 17.4% of the variability within community activity. Three of the five personality traits have a significant effect on engagement in community activities: being open to new experiences (ß = 0.238 **), extraversion (ß = 0.125 **), and readiness to cooperate (agreeableness) (ß = 0.149 *). Overall, openness is the most important predictor in this model. The results also indicate that more research productive academics are more active on this dimension (ß = 0.133 **), but that discipline is not playing a significant role. That is, there is no significant difference in participation in community activities between academics from the STEM/health discipline and other disciplines.

4.2. Science Communication

The models for predicting engagement in science communication show that the individual factors (Model 2a in Table A2) contribute to a smaller extent than the organisational factors (Model 2b). Being extroverted (ß = 0.146 **) is the only individual factor that significantly contributes to Model 2a. When looking at organisational factors (Model 2b), publishing scientific articles (performance) (ß = 0.156 **) has a positive effect on science communication engagement, while academic work experience has a negative effect (ß = −0.348 *). A similar negative effect is found for academics working in STEM/health disciplines (ß = −0.389 **), which indicates that academics in other disciplines tend to be more involved in science communication activities. Publishing scientific articles (performance) is nevertheless the strongest predictor (ß = 0.156 **) in Model 2c, which explains 11.4% (adjusted R^2) of the variability in engagement in science communication.

4.3. External Teaching and Training

Teaching and Training activities are badly predicted by the models in Table A3, whereby only the independent variable openness (ß = 0.216 **) is statistically significant.

4.4. Applied Contract Research

From Table A4, it can be deduced that as with the *external Teaching and training* activity, being open to new experiences (ß = 0.328 ***) is positively related to engagement in applied contract research activities (Model 4a). Moreover, organisational factors such as having work experience outside of academia (ß = 0.458 *) and working in STEM/health disciplines (ß = 0.849 ***), compared to other disciplines, also positively influence engagement in applied contract research activities (Model 4 b, c). Overall, Model 4c explains 21.4% (adjusted R^2) of the variability, with the strongest predictor being working in STEM/health disciplines.

4.5. Commercialisation

Regarding involvement in commercialisation activities, the variables that influence this type of TM activity bear striking resemblances to that of the applied contract research activities. Being open to new experiences (ß = 0.169 ***), having work experience outside of academia (ß = 0.184 *), and working for STEM/health disciplines (ß = 0.432 ***) all have a significant effect, with working in STEM/health disciplines being the strongest predictor again. However, having an active publication record (ß = 0.072 **) also significantly contributes to engagement in commercialisation activities, which was not the case for the applied contract research activity. Overall, Model 5c in Table A5 explains 28.8% (adjusted R^2) of the variability within the engagement in commercialisation activity.

5. Summary and Discussion

In this study, we determined which individual and organisational factors influence the propensity of academics to take part in TM activities. From the findings, it appears that in general, academics in Icelandic are not very engaged in or occupied with TM activities. Not only was the response rate for the survey low, so was the extent to which respondents participated in TM activities. While these are important insights that were brought to light, they can also be considered limitations of this study. Moreover, as some of the TM activities are currently unrecorded within the academic performance system, in some cases, we had to rely on the individual assessment of the academics themselves. Despite these limitations, this study has provided us with various insights.

5.1. Theoretical Implication

First of all, academics participate overall most in community related activities, which is in line with previous research (Hughes et al. 2016). Second, the models were most successful in predicting engagement in *community activities*, *commercialisation*, *science communication*, and *applied contract research*, and the least successful in predicting participation in *external teaching and training* activities. We began this study by asking the following question: To what extent do individual and organisational factors influence the propensity of academics to engage in different types of Third Mission activities? From the results, it appears that engagement in the "soft" TM activities, that is *community activities* and *external teaching and training* can better be predicted by individual factors, while engagement in the "hard activities" such as *applied contract research* and *commercialisation* are better predicted by organisational factors.

Second, the most common factor influencing TM engagement was the personality trait openness, influencing participation in all TM activities except for science communication. Here, we can say that hypothesis 5 can be confirmed. This lines up with the notion that academics that are open to new experiences in general are potentially also open to engaging in TM activities. In general, the variables gender, academic rank, and time spent on teaching were no significant predictors for any of the TM activities which means that hypotheses 1 and 2 cannot be approved. While it could be argued that academics that spend most of their time on teaching may not have the time to invest in TM activities, the results for gender contradict those of previous research (Azagra-Caro 2007; Bozeman and Gaughan 2011; Giuliani et al. 2010; Link et al. 2007; Meng 2016). While we can only speculate for the reason, Icelandic academia may be more gender equal than other academic environments, while the relatively small response rate and therefore data collection size may have something to do with this as well. The non-significance of rank may be explained by the fact that academics of all ranks may be struggling to engage in TM activities, albeit possibly for different reasons. Negative correlations were indeed observed between *time spent on teaching* and engagement in *applied contract research* and *commercialisation* activities; however, the regression coefficient is not statistically different from zero. Academics that teach a lot may have less time left to spend on TM activities. These results are in line with Muscio et al. (2017), where academics that are more engaged in innovation activities are less engaged in teaching and research activities. A recent study by Reymert and Thune (2022), however, shows that taking on multiple responsibilities does not consequently mean less work performance regarding research output, suggesting that some academics seem to handle multitasking rather as complementary tasks. Our study supports these results as those academics that show higher levels of research productivity (performance) are also more engaged in TM activities. The findings are also in accordance with previous studies on research activity and commercialisation among academics (Bercovitz and Feldman 2008; Bikard et al. 2019; Delmar et al. 2003; Garcia et al. 2019; Laukkanen 2003; Owen-Smith and Powell 2001; Powers 2003; Stuart and Ding 2006).

Third, when looking at differences among academics, academics from STEM and Health disciplines with experience outside of academia work that are open to new experiences are more likely to be engaged in *applied contract research* and *commercial activities*. Here, we can note that both hypotheses 3 and 4 are validated. This is in line with previous research where academics from engineering, technology, and natural sciences collaborate significantly more than academics belonging to, e.g., social sciences and humanities, and where academics are senior faculty members, and male (Abreu and Grinevich 2013; Azagra-Caro 2007; Bozeman and Gaughan 2011; Gulbrandsen and Smeby 2005; Hughes et al. 2016; Tartari and Salter 2015; Zhou et al. 2016). Most important factors here are discipline and openness. On the other hand, academics belonging to disciplines other than STEM and Health sciences and those that on an average publish more peer-reviewed articles are more likely to disseminate their knowledge to a wider audience outside of academia by *science communication*. This is interesting in light of the fact that academics in STEM/health sciences publish on average more than academics in other disciplines (Steinþórsdóttir et al. 2017). However, regarding this study, there was no difference between STEM/health sciences and academic performance.

Summing the results up, Table 6 shows the direction of influence of the independent variables on each dependent variable, i.e., different types of TM activities. Here, we see that several variables such as gender, teaching, or rank do not have an effect on TM participation, whereas other variables such as openness, performance, or discipline have an effect on some types of TM activities.

Table 6. Individual and organisational factors influencing different types of TM activities.

	Community Activities	Science Communication	External Teaching and Training	Applied Contract Research	Commercialisation
Male	-	-	-	-	-
Extraversion	↑	↑	-	-	-
Agreeableness	↑	-	-	-	-
Conscientiousness	-	-	-	-	-
Emotional Stability	-	-	-	-	-
Openness	↑	-	↑	↑	↑
Most Time Spent Teaching	-	-	-	-	-
Professor	-	-	-	-	-
Academic Work Experience	-	↓	-	-	-
Performance	↑	↑	-	-	↑
STEM/Health Sciences	-	↓	-	↑	↑
Experience outside Academia	-	-	-	↑	↑

Note: - no effect; ↑ positive effect; ↓ negative effect.

5.2. Practical Implications

Finally, what are the implications of this study for the entrepreneurial university? First of all, this study helps policy makers to distinguish between different types of TM and to identify future focal points. Second, the results revealed that organisational attributes are more important when it comes to direct or "hard" TM engagement, and that for less visible or "soft" activities, individual factors play a more important role. University management and policies will therefore have to reach out to academics on an individual basis as well. Hereby, university management and national policies can influence the amount of teaching, funding, and incentives within the different scientific disciplines. Further, both policies and academic institutions can increase their focus on labour mobility, by promoting the exchange of employees within and outside of academia. Third, a practical contribution of this study is therefore also the realisation that universities can let go of looking for the perfect academic profile when it comes to TM missions. Instead, academic institutions would do well in recruiting a broad variety of academics who then as a collaborative, can balance their engagement in a variety of TM activities. Diversity seems key in this context.

5.3. Future Research

In future studies, the TM model could be further enhanced by different variables that were not considered, such as if academics have been studying abroad or have been doing research abroad. These are important aspects as it is often different not only between universities but also between various countries how TM engagement is developed and thus has an impact on academics. However, to do so, the data collection would need to be expanded. Individual level aspects such as marital status and number of children could be considered as these aspects are related to time issues, which can result in negative effect on TM participation. Additionally, it would be possible to collect qualitative data to get more insight into the reasons that hinder TM participation as well as into academics' position towards TM activities. Further, future studies should also focus on sustainable entrepreneurship strategies as part of TM (Pascucci et al. 2022).

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Appendix A

Table A1. Multiple regression models for predicting engagement in community activities.

Variable	N	Model 1a			Model 1b			Model 1c		
		B	ß	SE	B	ß	SE	B	ß	SE
Constant	152	0.378		0.524	2.161 ***		0.272	0.026		0.635
Male	150	0.047	0.027	0.141				−0.059	−0.034	0.166
Extraversion	148	0.125 **	0.195	0.054				0.125 **	0.194	0.061
Agreeableness	148	0.139 **	0.175	0.067				0.149 *	0.187	0.076
Conscientiousness	149	−0.071	−0.096	0.065				−0.071	−0.096	0.075
Emotional Stability	148	−0.023	−0.031	0.064				−0.025	−0.034	0.071
Openness	146	0.250 ***	0.325	0.066				0.238 **	0.309	0.074
Most Time Spent Teaching	120				0.009	0.005	0.191	0.036	0.020	0.180
Professor	150				0.041	0.024	0.203	0.040	0.023	0.197
Academic Work Experience	151				0.081	0.045	0.192	0.066	0.036	0.182
Performance	182				0.144 **	0.251	0.061	0.133 **	0.232	0.056
STEM/Health Sciences	151				0.018	0.010	0.172	0.179	0.101	0.166
Experience outside Academia	155				0.112	0.060	0.182	0.045	0.024	0.168
R^2			0.199			0.076			0.264	
Adjusted R^2			0.163			0.023			0.174	
F-Statistics			5.439 ***			1.430			2.954 ***	

Note. In Model 1a, we entered individual variables; in Model 1b, only organisational;, in Model 1c all independent variables. * $p \leq 0.1$. ** $p \leq 0.05$. *** $p \leq 0.01$.

Table A2. Multiple regression models for predicting engagement in science communication.

Variable	N	Model 2a			Model 2b			Model 2c		
		B	ß	SE	B	ß	SE	B	ß	SE
Constant	142	0.564		0.613	1.872 ***		0.282	1.081		0.716
Male	150	0.179	0.097	0.165				0.134	0.072	0.187
Extraversion	148	0.180 **	0.264	0.063				0.146 **	0.214	0.068
Agreeableness	148	0.053	0.062	0.079				0.072	0.085	0.085
Conscientiousness	149	0.002	0.002	0.077				−0.050	−0.064	0.084
Emotional Stability	148	−0.014	−0.018	0.075				−0.019	−0.024	0.080
Openness	146	0.037	0.046	0.077				0.013	0.016	0.083
Most Time Spent Teaching	120				−0.061	−0.032	0.198	−0.031	−0.016	0.203
Professor	150				0.241	0.131	0.210	0.201	0.109	0.222
Academic Work Experience	151				−0.338 *	−0.175	0.199	−0.348 *	−0.180	0.205
Performance	182				0.160 **	0.262	0.063	0.156 **	0.256	0.063
STEM/Health Sciences	151				−0.446 **	−0.237	0.178	−0.389 **	−0.207	0.187
Experience outside Academia	155				0.083	0.042	0.188	0.067	0.034	0.190
R^2			0.083			0.166			0.214	
Adjusted R^2			0.038			0.116			0.114	
F-Statistics			1.863 *			3.321 **			2.136 **	

Note. In Model 2a we entered individual variables; in Model 2b, only organisational; in Model 2c, all independent variables. * $p \leq 0.1$. ** $p \leq 0.05$. *** $p \leq 0.01$.

Table A3. Multiple regression models predicting engagement in external teaching and training activities.

Variable	N	Model 3a			Model 3b			Model 3c		
		B	ß	SE	B	ß	SE	B	ß	SE
Constant	155	0.584		0.628	1.787 ***		0.313	0.323		0.780
Male	150	−0.176	−0.089	0.169				−0.135	−0.069	0.204
Extraversion	148	0.036	0.049	0.065				0.034	0.047	0.074
Agreeableness	148	0.130	0.144	0.080				0.146	0.162	0.093
Conscientiousness	149	−0.054	−0.064	0.078				−0.029	−0.035	0.092
Emotional Stability	148	−0.055	−0.065	0.077				−0.066	−0.078	0.087
Openness	146	0.216 **	0.248	0.079				0.197 **	0.226	0.091
Most Time Spent Teaching	120				0.018	0.009	0.220	0.013	0.006	0.221
Professor	150				−0.254	−0.129	0.233	−0.252	−0.128	0.242
Academic Work Experience	151				0.248	0.121	0.221	0.254	0.123	0.223
Performance	182				0.035	0.054	0.070	0.032	0.050	0.069
STEM/Health Sciences	151				−0.134	−0.067	0.198	−0.027	−0.013	0.204
Experience outside Academia	155				0.299	0.140	0.209	0.257	0.121	0.206
R^2			0.099			0.039			0.128	
Adjusted R^2			0.058			−0.016			0.023	
F-Statistics			2.407 **			0.713			1.220	

Note. In Model 3a we entered individual variables; in Model 3b, only organisational; in Model 3c, all independent variables. ** $p \leq 0.05$. *** $p \leq 0.01$.

Table A4. Multiple regression models for predicting engagement in applied contract research activities.

Variable	N	Model 4a			Model 4b			Model 4c		
		B	ß	SE	B	ß	SE	B	ß	SE
Constant	178	1.121		0.789	2.099 ***		0.355	0.320		0.884
Male	150	0.136	0.054	0.213				−0.104	−0.042	0.231
Extraversion	148	−0.072	−0.078	0.081				−0.047	−0.051	0.084
Agreeableness	148	−0.026	−0.023	0.101				−0.002	−0.002	0.105
Conscientiousness	149	−0.034	−0.032	0.099				−0.022	−0.021	0.104
Emotional Stability	148	0.044	0.041	0.096				0.068	0.064	0.099
Openness	146	0.333 ***	0.300	0.099				0.328 ***	0.295	0.103
Most Time Spent Teaching	120				−0.273	−0.105	0.249	−0.253	−0.098	0.251
Professor	150				0.194	0.078	0.264	0.248	0.099	0.274
Academic Work Experience	151				−0.098	−0.038	0.250	−0.132	−0.051	0.253
Performance	182				0.108	0.130	0.079	0.086	0.104	0.078
STEM/Health Sciences	151				0.726 ***	0.285	0.224	0.849 ***	0.333	0.231
Experience outside Academia	155				0.538 **	0.199	0.236	0.458 *	0.169	0.234
R^2			0.089			0.207			0.298	
Adjusted R^2			0.048			0.164			0.214	
F-Statistics			2.204 **			4.782 ***			3.566 ***	

Note. In Model 4a we entered individual variables; in Model 4b, only organisational; in Model 4c, all independent variables. * $p \leq 0.1$. ** $p \leq 0.05$. *** $p \leq 0.01$.

Table A5. Multiple regression models for predicting engagement in commercialisation activities.

Variable	N	Model 5a			Model 5b			Model 5c		
		B	ß	SE	B	ß	SE	B	ß	SE
Constant	143	1.114 **		0.352	1.301 ***		0.157	0.631 *		0.379
Male	150	0.127	0.117	0.095				0.037	0.034	0.099
Extraversion	148	−0.038	−0.094	0.036				−0.023	−0.057	0.036
Agreeableness	148	−0.017	−0.033	0.045				−0.001	−0.002	0.045
Conscientiousness	149	−0.043	−0.093	0.044				−0.034	−0.075	0.045
Emotional Stability	148	−0.001	−0.003	0.043				0.008	0.017	0.042
Openness	146	0.172 ***	0.358	0.044				0.169 ***	0.351	0.044
Most Time Spent Teaching	120				−0.087	−0.077	0.110	−0.066	−0.059	0.108
Professor	150				−0.022	−0.020	0.117	−0.001	−0.001	0.118
Academic Work Experience	151				−0.012	−0.010	0.111	−0.047	−0.042	0.108
Performance	182				0.083 **	0.232	0.035	0.072 **	0.202	0.034
STEM/Health Sciences	151				0.401 ***	0.362	0.099	0.432 ***	0.390	0.099
Experience outside Academia	155				0.216 **	0.184	0.105	0.184 *	0.157	0.100
R^2			0.129			0.259			0.369	
Adjusted R^2			0.086			0.214			0.288	
F-Statistics			3.033 **			5.759 ***			4.532 ***	

Note. In Model 5a, we entered individual variables; in Model 5b, only organisational; in Model 5c, all independent variables. * $p \leq 0.1$. ** $p \leq 0.05$. *** $p \leq 0.01$.

Note

1 Thereof 62 adjunct lecturers, 147 assistant professors, 126 associate professors, and 339 professors.

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