Computers in Human Behavior 96 (2019) 174–185

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Full length article

Worries of open source projects' contributors: Patterns, structures and engagement implications

Placide Poba-Nzaou[a,*], Sylvestre Uwizeyemungu[b]

[a] Organization and Human Resources Department, ESG School of Management, University of Quebec in Montreal, C.P. 8888, Succursale Centre-ville, Montréal, QC, H3C 3P8, Canada

[b] Accounting Department, University of Quebec in Trois-Rivières , 3351 Boulevard des Forges, Trois-Rivières, QC G9A 5H7, Canada

ARTICLE INFO

Keywords:
Open source
Contributors worries
Engagement
Configurational analysis
Equifinality

ABSTRACT

Several organizations depend on open source software (OSS) code or talent but scholars have expressed concerns about OSS projects sustainability because of the challenges they face and their high dependency on volunteers' contributions. Acknowledging that (1) challenges that contributors worry about may impact their level of engagement (2) there have been few research on nonpathological worry with non-clinical samples in work-related context as opposed to the pathological and clinical focus (3) calls have been made for further empirical research on equifinality perspective at a micro- and meso-level (or group level) as opposed to organizational level, and from a behavioral perspective. This exploratory research uses factor and cluster analysis to derive empirical worrying profiles and examines profile differences in the relative level of relevant antecedents as well as equifinality in terms of contributors' engagement (hours per week working on OSS projects). Based on an open dataset from a worldwide survey (N = 1024), the study reveals the existence of four dimensions of OSS worry construct and five worrying profiles with marked configurational differences: no major worry (34.70%), major worry on software quality (19.30%), major worry on attraction and retention (18.60%), major worry on entrepreneurial responsibilities (12.40%), and major worry on communications (15%). Among the five profiles, two profiles exhibit equifinality with high (equifinal) engagement level.

1. Introduction

Over the past decades, the Free/Libre and open source software (FLOSS) phenomenon has gained momentum and there is a consensus among both the practice and scientific communities that now OSS constitutes a credible alternative to proprietary software. In fact, today many private and public organizations now depend on OSS software or code that they have adopted because of the significant value that these products can offer to them (Ghapanchi, 2015a) and over the years, OSS has acquired increasing economic and political importance (Bonaccorsi, Giannangeli, & Rossi, 2006; Poba-Nzaou, Raymond, & Fabi, 2014). For instance, several governments around the world have launched initiatives or even legislation in favor of OSS adoption (Center for Strategic and International Studies (CSIS), 2010). Daffara (2012) estimated savings for the European Union economy of at least 114 billion euro per year, not including second-order effects, through code reuse and effort reduction; which is equivalent to 30% of the entire software and service market. Other figures reinforce the economic importance of OSS. The results of a recent survey by Black Duck (2015) administered to 1300 respondents highlight the growing importance of OSS: 78% of respondents declared their companies run part or all of its operations on OSS and 66% declared their company produces software for client organizations built on OSS; 93% declared their organization's use of OSS increased or remained the same in the past year; 64% of companies said that they participate in OSS projects; 55% believe open source delivers superior security compared to proprietary solutions.

However, despite the economic importance of OSS outlined below, with the exception of few such OSS projects as Linux, MySQL, Apache, Firefox, WordPress, PHP, and Drupal that are successful and popular, most OSS projects "have difficulties sustaining their development activities, and hence experience failure" and scholars have expressed extensive concern about the sustainability of OSS projects and their high level of dependency on volunteers' contributions (Ghapanchi, 2015a, p. 40; Hippel & Krogh, 2003; Krishnamurthy, Ou, & Tripathi, 2014). In this context, investigating and understanding the challenges that OSS projects face from the perspective of OSS contributors as domains of worry are important for at least four reasons: (1) the rate of failure of OSS development projects is high. It is estimated that over

* Corresponding author.
E-mail addresses: poba-nzaou.placide@uqam.ca (P. Poba-Nzaou), sylvestre.uwizeyemungu@uqtr.ca (S. Uwizeyemungu).

https://doi.org/10.1016/j.chb.2019.02.005
Received 2 September 2018; Received in revised form 1 February 2019; Accepted 7 February 2019
Available online 12 February 2019
0747-5632/

80% (Hertel, Niedner, & Herrmann, 2003) or 50% (Colazo & Fang, 2009; Ghapanchi, 2015a) of OSS development project initiatives fail either totally or partially (2) given the highly fluid nature of OSS contributors' engagement (Powell & Grodal, 2005) the magnitude and persistence of challenges faced by an OSS development project that contributors worry about, may have not only a negative impact on contributors' engagement, but it can drive them out of the projects (3) worry has mostly been investigated with clinical populations, and few studies have investigated nonpathological worry in a non-clinical population, in a work-related context (Dupuy, Beaudoin, Rhéaume, Ladouceur, & Dugas, 2001; Larsen, Øgaard, & Marnburg, 2005; Perkins & Corr, 2005; Sit, Wong, & Tong, 2013; Stöber & Seidenstücker, 1997; Wolff, Larsen, Marnburg, & Øgaard, 2013) (4) exploring equifinality – defined as a concept in which different worrying profiles with different configurations arrive at the same level of the outcome here measure in terms of contributors engagement – will advance our understanding of the worry-engagement relationship and help OSS projects leaders while responding to a call for further empirical research on equifinality (Fiss, 2007) and specifically at a micro- and meso-level as opposed to organizational level, or from a behavioral perspective (Bissola, Imperatori, & Colonel, 2014; Short, Payne, & Ketchen, 2008).

This paper significantly departs from previous studies by first providing a clear conceptualization of the content and structure of OSS projects-related worry of contributors. To our knowledge, no studies have been published concerning the worry of OSS contributors. First, this study aims to identify the underlying dimensions of OSS project challenges as domains of worry for OSS project contributors. Second it seeks to characterize OSS contributors by uncovering typical *worrying profiles*. Third, following previous work on nonpathological worry, the third objective is to determine the extent to which contributors' worrying profiles differ on individual characteristics, and in relative levels of other theoretically relevant antecedents (e.g. levels of education, level of expertise, level of experience, etc.). Lastly, the fourth objective is to explore equifinality (Fiss, 2007) in these profiles, wherein different worrying profiles may be associated with the same level of contributors engagement measured as the average hours per week working on OSS projects (Schroer & Hertel, 2009).

This research contributes to extant knowledge about OSS development projects by providing four meaningful dimensions that have conceptual clarity, and represent the structure of FLOSS projects challenges as domains of worry for contributors. In particular, it provides a set of five empirically grounded and theoretically informed worrying profiles of OSS projects' contributors, and it sheds light on equifinality regarding engagement (average hours per week worked on OSS projects) by revealing two sets of profiles with different configurations that exhibit equifinality in terms of engagement. Exploring the worrying profiles differences extend our knowledge of worrying antecedents and consequences in the context of work-related tasks mostly performed by volunteers. In addition this article help deepen our understanding of worry as also a natural and normal cognition alarm. Overall, the investigation of nonpathological worry in a non-clinical population, in a work-related context, and the empirical examination of equifinality at a meso-level from a behavioral perspective are by themselves major contributions.

Following this introduction, the theoretical context is outlined. Then the research methodology is presented. The subsequent section is dedicated to the presentation and discussion of the research findings. Lastly, the article concludes with implications for research and practice as well as directions for future research.

2. Theoretical context

This study attempts to develop a theoretical perspective on nonpathological worry as explanatory variables as well as possible depend variables that may help explain individuals' differences with regards to levels of some relevant antecedent variables and explores equifinality with regard to levels of engagement in the extant literature. It identifies worrying profiles using a non-clinical sample in work-related context as opposed to the dominant pathological and clinical focus. Consequently, the theoretical context of this research is twofold: (1) a theoretical background based upon the literature on OSS and challenges associated with their sustainability, and (2) a theoretical foreground based upon worry theory and configuration theory.

2.1. Theoretical background

2.1.1. Open source software

Following Crowston, Wei, Howison, and Wiggins (2012, p. 2), we consider Open Source Software (OSS) as “an umbrella term that covers a diversity of kinds of software and approaches to [developing and licensing]”. However, it is important to remember that, although some scholars have used the concept of “Free/Libre software” and “open-source software” interchangeably to the extent to which establishing a distinction between the two is sometimes seen as controversial, they do in fact differ from one another. For instance, according to Stallman (2009), open source is a development methodology whereas free software is a social movement. For the purpose of this research, we define OSS as an umbrella term that includes software whose source code is published and made available to the public, enabling anyone to copy, modify and redistribute the source code with or without conditions (Levi & Woodard, 2004). Although for-profit and not-for-profit organizations are more and more implicated in OSS projects (O'Mahony, 2007), they primarily rely on the volunteer efforts of thousands of programmers, and non-programmers whose contributions include all but programming tasks (Spaeth, von Krogh, & He, 2015).

2.1.2. Open source project development challenges

Although previous studies have noted that a large proportion of OSS development projects are unable to sustain their development activities because of the challenges they face, there is not a consensus on the definition of OSS project sustainability. We adopted the definition provided by Chengalur-Smith, Nevo, and Demertzoglou (2010, p. 665) because it is one of the most cited. OSS development project sustainability is defined “as the ability of the project to exhibit software development and maintenance activity over the long term”.

The concept of OSS projects sustainability has been investigated using different concepts (Ghapanchi, 2015a): “development sustainability”, “program activity in the subsequent period”, “developers' level of activity in [a given period of time]”, “project survival” and “project vitality”. This research focuses on challenges that may impede the sustainability of a OSS project. We define a challenge as any issue or problem encounter by the project and that if not addressed adequately may impede its sustainability.

Given that there is not yet a consensus on the identification of OSS development project challenges that may impede their sustainability, this research relies on the twelve challenges that were identified by a research team[1] composed of members with extensive experience on research and practice on OSS. In addition, we were able to identify the twelve main challenges based on a descriptive review of the literature on OSS project sustainability or success. These challenges are presented in Table 1 along with supporting references from the literature.

It is important to note that in the extant literature these challenges are mentioned as factors that may impede OSS development projects sustainability or health or success.

[1] It is the research team that conducted the survey whose open dataset is used for this research.

Table 1
Challenges of OSS development projects.

	OSS development projects challenges	Support in the literature
1	Make our software stable (reduce bugs)	Chengalur-Smith, Sidorova, and Daniel (2010) Santos, Kuk, Kon, and Pearson (2013) Gamalielsson and Lundell (2014) Amir Hossein Ghapanchi, Aurum, and Low (2011)
2	Feature set	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Santos et al. (2013) Gamalielsson and Lundell (2014) Amir Hossein Ghapanchi et al. (2011)
3	Documentation	Santos et al. (2013) Gamalielsson and Lundell (2014) Amir Hossein Ghapanchi et al. (2011)
4	Make our software cross-platform/mobile/SaaS	Shilton and Greene (2017)
5	Reduce time between releases	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Santos et al. (2013) Gamalielsson and Lundell (2014) Amir Hossein Ghapanchi et al. (2011) Ghapanchi (2015b)
6	Attract users/contributors	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Santos et al. (2013) Gamalielsson and Lundell (2014) Amir Hossein Ghapanchi et al. (2011) Ghapanchi (2015b)
7	Keep users/contributors involved	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Santos et al. (2013) Gamalielsson and Lundell (2014) Amir Hossein Ghapanchi et al. (2011) Ghapanchi (2015b)
8	Leverage the power of the leader/main company	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Santos et al. (2013) Gamalielsson and Lundell (2014) Giuri, Rullani, and Torrisi (2008)
9	Fundraising	Santos et al. (2013) Gamalielsson and Lundell (2014)
10	Legal issues (license, copyright assignments …)	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Santos et al. (2013) Gamalielsson and Lundell (2014)
11	Communication inside the project	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Gamalielsson and Lundell (2014)
12	Communication upstream/ downstream	Chengalur-Smith, Nevo, et al. (2010) and Chengalur-Smith, Sidorova, et al. (2010) Gamalielsson and Lundell (2014)

2.2. Theoretical foreground

2.2.1. Worry theory

For more than four decades, *worry* has depicted a concept that is both, theoretically and empirically fruitful in the anxiety research (Stöber & Joormann, 2001). Broadly speaking, nearly everyone engaged in worry, to a certain degree, about some issue from time to time (Davey & Meeten, 2016; Kelly, 2004; Tallis, Eysenck, & Mathews, 1992). More precisely, from concerns about job performance, to anxiety before a test, to apprehension before a presentation, people commonly worry about the outcomes of future events (Tallis, Davey, & Capuzzo, 1994). Worry is the cognitive component of a more global anxiety construct (Liebert & Morris, 1967) and worry is defined as cognitive concern about the outcome of an event (Meichenbaum & Smart, 1971). In previous research, worry has been defined as "an anticipatory cognitive process involving thoughts and images that contain fear-producing content related to possible traumatic events and their potentially catastrophic implications, which are rehearsed repeatedly without being resolved" (Matthews et al., 2006, p. 51). The authors stressed that worry is a cognitive process that is essentially anticipatory in nature, and principally relating to future capabilities and the dangers or threats they pose. Several scholars distinguish pathological from non-pathological or normal worry. Pathological worry is defined as an undesirable, unmanageable, aversive cognitive activity related to negative thoughts and emotional discomfort (Borkovec, 1994). In fact, for some people the activity of worry can become pathological, uncontrollable and distressing, and negatively affecting social, occupational, and familial functioning (Davey & Meeten, 2016). In contrast, non-pathological refers to worry as experienced by individuals without psychopathology (Tallis et al., 1992, 1994), with the key differences between pathological and nonpathological states being the frequency, intensity, and uncontrollability of these features (Brown, 1997). Matthews et al. (2006, p. 51–52) distinguish between trait worry and state worry. "Trait worry refers to the person's general disposition to become worried, especially in threatening situations" and "state worry refers to the immediate experience of threat-related cognitions intruding into conscious awareness". Based on Zeidner (1998), they stressed that, in many contexts, along with task performance, State worry will have more effect than Trait worry on information processing and behavior of an individual.

Nonpathological worry in the context of a job or "Job-Specific worry" (Larsen et al., 2005) is different from general worry. Whereas general worry reflects a trait in an individual that may be constant in different situational or organizational context, Job-Specific worry is a measure of a state, hence it may vary according to individual experience and situational or organizational context. Job-Specific worry can be defined as "the individual attempts to engage in mental problem solving and situational job-related issues where outcome is thought to be uncertain but contains a possibility for negative results" (Larsen et al., 2005, p. 92).

Eysenck (1992) suggested that worry has three major functions: alarm, prompt, and preparation. According to this model, after an external or internal detection of threat, the alarm function brings information related to the threat into awareness. Thereafter, the prompt function transfers the threat-related thoughts and images from long-term memory into conscious awareness. Finally, the preparation function allows the individual to anticipate negative scenarios of the future. This function also allows the individual to initiate anticipatory coping strategy either by acting to prevent the anticipated negative developments (prevention) or by preparing for the expected negative consequences (anticipatory coping) (Borkovec, Ray, & Stober, 1998).

In a study of 68 white-collar financial workers, Perkins and Corr (2005) found that the tendency to worry is positively correlated with workplace performance amongst individuals at the higher end of the ability scale. In addition, they specifically found that, in the more cognitively able individuals, worrying was positively correlated with performance but as ability diminishes this relationship dissipates. They underscored that, far from being a disorder, worry is a critical "component of motivational cognition" (Perkins & Corr, 2005, p. 25), which is important for effective functioning in a situation that requires caution, self-discipline, and anticipation of threat. In a study of line maintenance mechanics in two aircraft maintenance companies, Sit et al. (2013) found that the level of worry varies significantly across levels of work experience: mechanics who had 30 or more years of work experience had significantly higher worry than mechanics with 10 or less than 10 years of experience and mechanists with between 10 and 19 years of experience. Interestingly, the authors concluded that worry is good for mechanics.

Within the second stream, studies have found that worry has maladaptive consequences such as to interfere with various cognitive processes that contribute to effective task performance (Zeidner, 1998), and high levels of worry often lead to performance decrements (Matthews et al., 2006). In an investigation of job-specific worry among

133 non-supervisory crew members of a ship, Wolff et al. (2013) found that supervisor dispositionism, i.e. supervisors with fixed mindsets, was related to greater amounts of worry among the crew. In addition, they hypothesized that job-specific self-efficacy would be related to job-specific worry, and more specifically higher job-specific self-efficacy (an individual belief in his/her capacity to master his/her job) would be related to lower job-specific worry. However, this hypothesis was not supported. Larsen et al. (2005) investigated job-specific worry in managers in the restaurant industry and found that (1) job-specific worry is inversely correlated to job commitment, but the relation was not statistically significant (2) the more perceived threat at work, the more specific job worry (3) the more hierarchical the organization is perceived to be, the less the managers experience job-specific worry. For their part, Aasa, Brulin, Ängquist, and Barnekow-Bergkvist (2005) stress that although worry is not intrinsically a sign of pathology and might have positive effects on work-related outcome, it might lead to pathological physiological and psychological manifestations such as increased heart rate and sleeping problems.

Although we were not able to find a study using worry theory in IS literature, yet it does provide the rationale and justification of investigating OSS projects' challenges that are worrisome for project sustainability from the perspective of project contributors.

2.2.2. Configuration theory

A configuration of a set of entities can be defined as "any multidimensional constellation of conceptually distinct characteristics that commonly occur together" (Meyer, Tsui, & Hinings, 1993, p. 1175). A configurational approach theorizes that challenges of OSS development projects as domains of worry for contributors are best understood through "as clusters of [project contributors according to interconnected challenges that are worrisome to them], rather than as modular or loosely coupled entities, whose components can be understood in isolation" (Fiss, 2007, p. 1180). In particular, beyond offering a more holistic perspective on understanding activities or behavior of entities such as organizations or individuals, configurational approaches facilitate insights into the equifinality of different configurations (Fiss, 2007). In a broad sense, the principle of equifinality is one of the characteristics of open systems and implies that, "the same final state [or outcomes] may be reached from different initial conditions or [configurations] and in different ways" (Von Bertalanffy, 1968, p. 40). Even though empirical studies generally support the concept of equifinality (Doty, Glick, & Huber, 1993; Gruber, Heinemann, Brettel, & Hungeling, 2010; Payne, 2006), most studies have focused on the firm level and adopted a strategic and/or organizational perspective (Bissola et al., 2014; Short, Payne, & Ketchen, 2008). Few attention has been paid to the adoption and test of this perspective at a micro- and meso-level (group level), or from a behavioral perspective (Bissola et al., 2014; Short et al., 2008), as is the case in our study. All in all, as underscored by Gruber et al. (2010), proponents of the approach have argued that a study of configurations allows to develop insights that would otherwise be out of reach of research that focuses only on the effects of isolated components (Miller, 1981).

3. Methods

3.1. Measures

According to Joormann and Stöber (1997) and Stöber (1998), there are two classes of worry measures: "content-free" and "content-based" measures. Content-free measures are mostly used in research on pathological worry, and is concerned with assessing the excessiveness, duration, etc. of worry. In contrast, research on nonpathological worry such as our research, mostly relies on content-based measures that present a list of potential items of worry and ask the respondents for intensity or frequency ratings (Joormann & Stöber, 1997; Stöber, 1998).

To maintain consistency with the literature on nonpathological worry (Stöber, 1998), this research uses content-based measures that contain a list of potential items of worry related to OSS development project sustainability, and ask OSS contributors for intensity ratings. The content of worry used in this study is based on the list of challenges that is included in the theoretical context of this research. As indicated earlier, the content of the measures was developed by a team of researchers with deep expertise on OSS research and practice. They identified twelve items that are also supported by well-established literature, as indicated in the theoretical background. Each item representing a source of worry was rated on a 6-point Likert-type scale ranging from "it's not important" to "It's driving me/others out of the project". Of note is the fact that contributor's engagement is measures as the average hours per week worked on OSS projects.

3.2. Data source

We used an open dataset from the OSS Survey 2013 conducted by Robles, Reina, and Duenas (2013) and targeting open source contributors. It is important to remind that this survey is the second edition of a survey conducted in 2002 (Ghosh, Glott, Krieger, & Robles, 2002, p. 4) that provided "insights in fundamental features of the OS/FS community and its economic principles. It sheds a light on personal features of OS/FS developers, of their work and project organization, their motivations, expectations, and orientations." In the same manner as the 2002 survey, the 2013 survey was open and web-based, and contributors were self-selected (Robles, Reina, Serebrenik, Vasilescu, & González-Barahona, 2014). To attract contributors, the survey was publicized on social media platforms and OSS mailing lists. The survey opened November 12, 2013, and closed December 6, 2013, and was managed using an open source software called LimeSurvey. The survey instrument was published in English and Spanish and was composed of 58 questions that can be grouped into the following seven areas: Personal situation (gender, civil status, number of children, country of birth and of residence/work); Education (highest level of education, level of English); Professional situation (profession, satisfaction, income); OSS perspective (free software vs. open source); Development (age when joining OSS, reasons and motivations for joining, reasons and motivations for still participating, earn money with OSS, perceived challenges faced by OSS projects); Technology (favorite editor, programming languages); Economic and community rewards (job opportunities, expectations from other developers, challenges).

3.3. Sample

The initial dataset was composed of 2183 respondents but there were incomplete questionnaires that were removed from the study, leading to 1365 complete questionnaires. Thereafter, the factor analysis computer program rejected 341 observations because of missing data. There remained a total of 1024 respondents on which the analysis was performed. A statistical analysis of the 341 dropped surveys indicated no nonresponse bias. As indicated by Table 2, the 341 respondents were not significantly different from the actual sample on any descriptive measure or individual characteristics. In other words, the subsample used for this study is representative of the initial sample. Within the actual sample of the study, respondents were residents of 235 different countries. Among them, slightly more than half (55%) were residents of five countries: the US (29%), Germany (8%), Spain (7%), the UK (6%), Canada (5%). For all other countries, the contributors accounted for less than 5% of the actual sample. The large majority hold a university degree (80%), and half of the sample respondents are software engineers or programmers; although more than 50% of contributors are not directly paid for contributing to OSS projects, 97.40% considers that their expertise in the OSS community has a positive impact on job opportunities. The mean age of the participants was 35.36 (± 9.20) years and they have an average of 10.59 ((± 6.53) year of experience in OSS. In terms of roles, 49% contributes in programming tasks only

Table 2
Numbers and percentages of actual respondents and excluded respondents by characteristics.

Variables	Total sample N = 1365		Actual respondents N = 1024		Excluded respondents N = 341		χ^2
	N	%	N	%	N	%	
Role							
Code programming only	664	48.60	501	48.90	163	47.80	0.23
Other contributions	322	23.60	242	23.60	80	23.50	
Programming and other contributions (documentation, translations, tests, artwork, etc.)	379	28.70	281	27.40	98	27.80	
Gender							
Male	1187	88.8	885	88.9	302	91	2.00
Female	149	11.20	119	11.9	30	9	
Marital status							
Single	533	39.40	397	29.30	136	40.40	0.19
Married or having a partner	821	60.60	620	61.00	201	59.60	
Number of children							
0	898	67.10	669	66.60	229	68.60	1.31
1	168	12.60	129	12.80	39	11.70	
2	194	14.50	144	14.30	50	15.00	
More than 2	78	5.80	62	6.20	16	4.80	
Education							
Non-University degree	270	19.80	199	19.50	71	20.90	0.46
University-Bachelors	554	40.70	420	41.10	134	39.50	
University-Masters	426	31.60	319	31.20	107	31.30	
University-PhD	111	8.20	84	8.20	27	8.00	
Profession							
Software engineer	557	40.90	415	40.60	142	41.80	10.91
Programmer	155	11.40	111	10.90	44	12.90	
Consultant (IT)	123	9.00	104	10.20	19	5.60	
Other IT profession	260	19.10	196	19.20	64	18.80	
Engineering (other than IT)	45	3.30	38	3.70	7	2.10	
Other non-IT professions	222	16.30	158	15.50	64	18.80	
Employment status							
Employed	920	69.10	697	69.50	223	68.00	2.50
Self-employed	270	20.30	206	20.50	64	19.50	
Not paid work (student, stay home, etc.)	100	7.50	73	7.30	27	8.20	
Unemployed	41	3.10	27	2.70	14	4.30	

*: $p < 0.05$ **: $p < 0.01$ ***: $p < 0.001$.

while 24% contributes in non-programming tasks only (e.g. writing documentation) and 27% contributes in both programming and non-programming tasks.

3.4. Statistical analysis

3.4.1. Factor analysis

Before proceeding with cluster analysis, we diagnosed the factorability of the correlation matrix composed of the twelve selected items (Hair, Black, & Anderson, 2010). Factor analysis allows the data to suggest ways in which the dimensions of OSS projects' worry domains correlate, thus allowing the researcher to reduce one set of observed variables to a smaller set of variables. Such a reduction creates a new, parsimonious representation of the original set of variables and provides evidence of the construct validity of the underlying dimensions of OSS projects' worry domains, and also permits the comparison of factor structures from previous or future studies. An important note here is that the sample size was largely superior to the minimum recommended by several researchers for exploratory factor analysis (5–10 times the number of items) (Costello & Osborne, 2005; Hair, Black, & Anderson, 2010).

We performed the Kaiser-Meyer-Oklin (KMO) test of sampling adequacy and the Bartlett test of sphericity to evaluate whether the matrix was appropriate for factor analysis. The Bartlett's test of sphericity was found to be highly significant (χ 2 (45) = 2641.56, $p < 0.000$), and the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was greater than the suggested threshold value of 0.50 (KMO = 0.76) (Kaiser, 1974) indicating that the correlation matrix was adequate for factor analysis. We used Kaiser Criterion (eigenvalues greater than 1), Cattell's Scree Test and the theoretical interpretability of dimensions to decide which factors to retain (Hair et al., 2010).

We performed exploratory factor analysis several times. In the first stage, an exploratory factor analysis was carried-out (using principal component analysis (PCA) with orthogonal Varimax rotation) on the 12 items from the questionnaire that are related to worries. The results confirmed that the dataset was suitable for factor analysis and suggested a 4-factor structure. The factor analysis was then repeated with two items being removed one at a time, because they loaded simultaneously on two dimensions with both loadings being greater than 0.32 (Costello & Osborne, 2005): “reduce time between releases” and “make our software cross-platform/mobile/SaaS”. The item “reduce time between releases” was discarded first. After removing the second item “make our software cross-platform/mobile/SaaS”, the analysis suggested a 3-factor solution. Afterwards, an additional PCA with Varimax rotation was performed, forcing the number of factors to four. Table 3 shows the factors and their loadings, along with the four constructs developed from the factors, and their names derived from the items

Table 3
Results of the principal component factor analyses of OSS challenges.

Items	Factor loadings	Mean	SD
Factor 1: Software quality *(Eigenvalue = 3.39; percent of variance explained = 33.85; Cronbach's alpha = 0.67)*		3.52	0.99
Feature set	0.82		
Make our software stable (reduce bugs)	0.81		
Documentation	0.63		
Factor 2: Attraction and retention of contributors and users *(Eigenvalue = 1.44; percent of variance explained = 14.42; Cronbach's alpha = 0.84)*		3.39	1.17
Attract users/contributors	0.90		
Keep users/contributors involved	0.88		
Factor 3: Inside and outside communication *(Eigenvalue = 1.10; percent of variance explained = 10.85; Cronbach's = 0.82)*		3.02	1.13
Communication upstream/downstream	0.86		
Communication inside the project	0.83		
Factor 4: Entrepreneurial responsibilities *(Eigenvalue = 0.98; percent of variance explained = 9.80; Cronbach's alpha = 0.62)*		2.40	1.00
Fundraising	0.79		
Leverage the power of the leader/main company	0.71		
Legal issues (license, copyright assignments …)	0.65		

Notes: (n = 1024); only factor loadings greater than 0.40 are displayed; total variance explained: 68.93.

labels within each factor group as well as means, standard deviations, and Cronbach alphas.

At this stage, we concur with Zirger and Maidique (1990) in that our four-factor solution provides a good description of the underlying constructs of OSS challenges as domains of worry for the following reasons: (1) the factor loadings of the variables averaged more than 0.75 (2) the four-factor model explained 68.93% of the variance (3) the variable groupings have theoretical support and are interpretable by relating each group of worry domains to OSS challenges literature (Hair et al., 2010). All except one factor had an eigenvalue greater than one ("Entrepreneurial responsibilities" (Eigenvalue = 0.98)), a standard criterion generally accepted by researchers. Since there is not one correct method to identify the number of factors in the data set (Hair et al., 2010; Kim & Mueller, 1978; Norman & Streiner, 2008), the one factor with an eigenvalue less than one was included because of its contribution to our underlying model (Zirger & Maidique, 1990). In addition, we were able to match this factor in extant OSS literature and, this factor proved to be of overwhelming importance in understanding challenges of OSS development projects as domains of worry.

Further, Norman and Streiner (2008, p. 214) as well as Hardy and Bryman (2004, p. 29) underscore that the Kaiser criterion as an upper bound for the number of factors to retain presents at least two problems. First, it is somewhat arbitrary, as it allows one to retain a factor with an eigenvalue of 1.01, but to reject a factor with an eigenvalue of 0.99; knowing that "eigenvalues, as with any other parameter in statistics, are measured with some degree of error". Thus, "on replication, these numbers will likely change to some degree, leading to a different solution". Second, it has been shown that the Kaiser criterion generally results in too many factors (i.e., including factors that may not materialize if we were to duplicate the study) when greater or more than around 50 variables are studied and too few factors when less than 20 are examined such as in the present study (Horn & Engstrom, 1979). Thus, retaining a four-factor structure seems justified.

3.4.2. Cluster analysis

We employed cluster analysis to group OSS contributors with regard to the nature and magnitude of their worry about factors that may undermine the sustainability of OSS projects. Cluster analysis is a group of multivariate techniques that allows objects to be grouped based on the characteristics they possess (Hair et al., 2010). It is "a purely empirical method of classification and as such is primarily an inductive technique" (Punj & Stewart, 1983, p. 135). Several researchers have used cluster analysis within the fields of Information Systems (Lowry et al., 2013; Malhotra, Gosain, & Sawy, 2005), as well as when studying worry or related constructs such as anxiety or procrastination (Doron, Thomas-Ollivier, Vachon, & Fortes-Bourbousson, 2013; Jin, Wu, Becken, & Ding, 2016; Rozental et al., 2015).

To identify the clusters, we followed a three-step procedure (Gruber et al., 2010; Homburg, Jensen, & Krohmer, 2008) wherein a hierarchical algorithm is first used to identify the "natural" number of clusters and define the cluster centroids; the results are later used as initial seeds in a nonhierarchical algorithm (Ketchen & Shook, 1996; Punj & Stewart, 1983). As a further step, we validated the cluster solution based on discriminant cross-validation and the use of a criterion variable (Hair et al., 2010; Punj & Stewart, 1983).

We first performed cluster analysis using Ward minimum variance algorithm combined with the squared Euclidian distance (Hair et al., 2010). The algorithm was performed with the four constructs resulting from the factor analysis as clustering variables: *software quality*, *inside and outside communication*, *attraction and retention of contributors and users*, and *entrepreneurial responsibilities*. To identify the optimum number of clusters, we first inspected the Euclidian distances across the clusters in the dendrogram produced by Ward's hierarchical clustering algorithm. This analysis revealed that a 4-cluster or 5-cluster solution would be optimal. The procedure was replicated with random subsamples of the total population using SPSS random selection functionality (80%, 60%, 30%), which reveals the 5-cluster solution as the most stable.

In addition, the degree of pairwise spatial separation between the clusters centroids, as indicated by the discriminant functions plots, supported the 5-cluster solution as optimum. The effectiveness of the discriminant functions in predicting clusters membership was assessed by computing the Hit ratio, that is the percentage of OSS developers correctly predicted by the discriminant functions. Following Hair et al. (2010), we adopted the cross-validation approach in which the total sample is randomly split into two subsamples, the analysis sample and the holdout sample. Our analysis and holdout samples accounted for about 60% and 40% respectively. For the 5-cluster solution, the Hit ratio for the analysis sample was 92.20% whereas that for the holdout sample was 91.60%. To assess the group membership prediction accuracy, we employed two statistics: the proportional chance criterion (C_{pro} = 23%) and the maximum chance criterion (C_{max} = 35%.) (Hair et al., 2010). The two hit ratios exceeded the threshold value of Max [1.25 (C_{pro}; C_{max})], indicating that classification results were better than chance (Hair et al., 2010). Hence, the null hypothesis that the percentage of contributors that were correctly classified was not significantly different from what would be classified by chance alone was rejected.

Based on the preceding results, we concluded that the 5-cluster solution best captured the underlying structure of the data. In addition, the constituted clusters formed well-separated groups that had strong meanings and had a highly significant ANOVA F, for all four factors as explained in the results section.

4. Results

Descriptive statistics for each variable are provided in Table 4. An overview of individual variables that comprise each of the four factors reveals, "making the software stable or reducing bugs", as the most worrisome challenge for contributors (mean = 3.64) followed by "software documentation" (mean = 3.51). The lowest scores are observed on one of the two items representing the entrepreneurial responsibilities dimension: "leverage the power of the leader/main company" (mean = 2.38) and "legal issues" (2.39). Ranking the items in descending order by contributors' role reveals that for those who contribute for programming only, the main worry is about to "make the software stable" mean = 3.66 (± 1.37) and the least worry is about "fundraising" mean = 2.14 (± 1.31); for those who contribute on non-programming tasks only, the main worry is about "documentation" mean = 3.57 (± 1.21); for those who contribute for both programming and non-programming tasks, the main worry is about to "make the software stable" mean = 3.85 (± 1.34).

Table 5 shows the results of the cluster analysis. Tamhane's T2 Post-Hoc Multiple Pair-Wise Comparisons Test was used to identify significant differences between the means (Hochberg & Tamhane, 1987). Groups that were identified as significantly different using the Tamhane's T2 post-hoc test are denoted with different subscripts; means values that share a subscript do not differ significantly from each other. The resulting 5-cluster solution as well as individual characteristics that were significantly associated with each cluster ($p < 0.05$) are also presented in Table 5 and are described below. The five clusters are labeled according to the nature of the dimensions of OSS projects challenges that are highly worrisome. Thus, cluster 1, cluster 2, cluster 3, cluster 4, and cluster 5 are respectively labeled: "no worry", "software quality worry", "attraction and retention worry", "communication worry", and "entrepreneurial responsibilities worry". The description of the five clusters is presented below.

Cluster 1—No Major Worry. This cluster consists of 355 OSS contributors, representing 34.70% of the sample and is the largest cluster in terms of size. Overall, compared with the other four clusters, this is the only one that does not express a high level of worry on any of the four challenges factors. This group depicts the lowest level of worry on

Table 4
Descriptive statistics of the cluster variables.

N = 1024 Items	Min	Max	Median	Mean	SD
Software quality	1	6	3.33	3.52	0.99
Make our software stable (reduce bugs)	1	6	3.00	3.64	1.35
Feature set	1	6	3.00	3.41	1.30
Documentation	1	6	3.00	3.51	1.89
Attraction and retention of contributors/users	1	6	3.00	3.39	1.17
Attract contributors and users	1	6	3.00	3.41	1.28
Keep contributors and users involved	1	6	3.00	3.37	1.25
Project Inside and outside communication	1	6	3.00	3.02	1.13
Communication inside the project	1	6	3.00	3.00	1.23
Communication upstream/downstream	1	6	3.00	3.05	1.23
Entrepreneurial responsibilities	1	6	2.33	2.40	1.00
Leverage the power of the leader/main company	1	6	2.00	2.38	1.39
Fundraising	1	6	2.00	2.42	1.40
Legal issues (license, copyright assignments …)	1	6	2.00	2.39	1.21

Scale: (1): It's not important (2): It's OK (3): It's OK, it could be better (4): I'm worried but got no ideas (5): I'm participating in dealing with this (6): It's driving me/other out of the project

software quality (LL) as well as on attraction and retention of contributors and users (L). However, the group presents the second-lowest level of worry on project communication matters, while presenting a medium level of concern about project entrepreneurial responsibilities challenges (M). As such, this cluster is formed by contributors who have the lowest level of worry about OSS development project challenges. For contributors within cluster 1, none of the four domains of worry exhibit a high score of worry. Since this cluster has no major worry about OSS projects challenges, it is labeled "No Major Worry" or shortly "No Worry".

Cluster 2—Major Worry about Software Quality. This cluster consists of 198 OSS contributors, representing 19.30% of the sample and is the second-largest cluster in terms of size. Contributors within this cluster exhibit a low (L) or very low score (LL) about all other challenges except software quality. Compared with other clusters, cluster 2 is formed by contributors who worried the most about software quality. This cluster is the only one for which the level of worry about software quality is high (H), hence, it is labeled "Major Worry about Software Quality" or in short "Software Quality Worry".

Cluster 3—Major Worry about Attraction and Retention. This cluster consists of 190 contributors, representing 18.60% of the sample and is the third-largest cluster in terms of size. Contributors within this cluster exhibit a very low score (LL) of worry about the projects inside/outside communication challenges. At the same time, they tend to worry about software quality and entrepreneurial responsibilities as the group exhibits a medium (M) score on the two challenges. Overall, compared with the other clusters, cluster 3 is formed by contributors who worried the most about the ability of OSS projects to attract and retain contributors and users. This cluster is the only one for which the level of worry about attraction and retention of contributors/users is high (H), thus, it is labeled "Major Worry about Attraction and Retention" or in short "Attraction and Retention Worry" (Fig. 1).

Cluster 4—Major Worry about Communication. This cluster consists of 127 contributors, representing 12.40% of the sample and is the smallest cluster in terms of size. Contributors within this cluster exhibit a very low score (LL) of worry about projects' entrepreneurial responsibilities worry. At the same time, they worry about software quality and attraction as well as attraction and retention of contributors and users as the group has a medium (M) score on the two challenges. Overall, compared with other clusters, cluster 4 is formed by contributors who worried the most about OSS projects inside and outside communication. This cluster is the only one for which the level of worry about project communication is high (H), hence it is labeled "Major Worry about Communication" or in short "Communication Worry".

Cluster 5—Major Worry about Entrepreneurial responsibilities. This cluster consists of 154 contributors, representing 15% of the sample and is the second-smallest cluster in terms of size. Contributors within this cluster tend to worry about three challenges moderately (software quality, attraction and retention of contributor and users, and communication), as the group exhibits a medium (M) score of worry about

Table 5
OSS Contributors Worrying Profiles.

N = 1024 Factors	Cluster I *No Major Worry* (355; 34.70%)	Cluster II Major Worry Soft. Qual. (198; 19.30%)	Cluster III Major Worry Attract./ ret. (190; 18.60%)	Cluster IV Major Worry Comm. (127; 12.40%)	Cluster V Major Worry Entrepr. respons. (154; 15.00%)	Anova F-test
	centroid	centroid	centroid	centroid	centroid	
Software quality	**L** -0.91_{c}	**H** 0.85_{a}	**M** 0.24_{b}	**M** 0.40_{b}	**M** 0.39_{b}	238.15^{***}
Attraction and retention of contributors/users	**LL** -0.28_{d}	**L** -0.86_{c}	**H** 1.23_{a}	**M** 0.17_{b}	**M** 0.09_{b}	212.18^{***}
Project inside and outside communication	**L** -0.17_{c}	**LL** -0.54_{d}	**LL** -0.64_{d}	**H** 1.74_{a}	**M** 0.45_{b}	308.57^{***}
Entrepreneurial responsibilities	**M** -0.12_{b}	**L** -0.38_{c}	**M** $-0.23_{b,\ c}$	**LL** -0.68_{d}	**H** 1.63_{a}	254.07^{***}
Engagement (average work hours/week spend on OSS projects)						
Contributors' engagement	**L** 2.82_{a}	**M** $3.08_{a,\ b}$	**M** $3.21_{a,\ b}$	**H** 3.50_{b}	**H** 3.56_{b}	6.80^{***}

$^{a,\ b,\ c}$ Within rows, different subscripts indicate significant ($p < 0.05$) pairwise differences between means on Tamhane's T2 (post hoc) test. H (High), M (Moderate), MH (Moderate High), L (Low), LL (Very Low) indicate relative magnitude the group means on each variable across the five clusters. *: $p < 0.05$: **: $p < 0.01$ ***: $p < 0.001$.

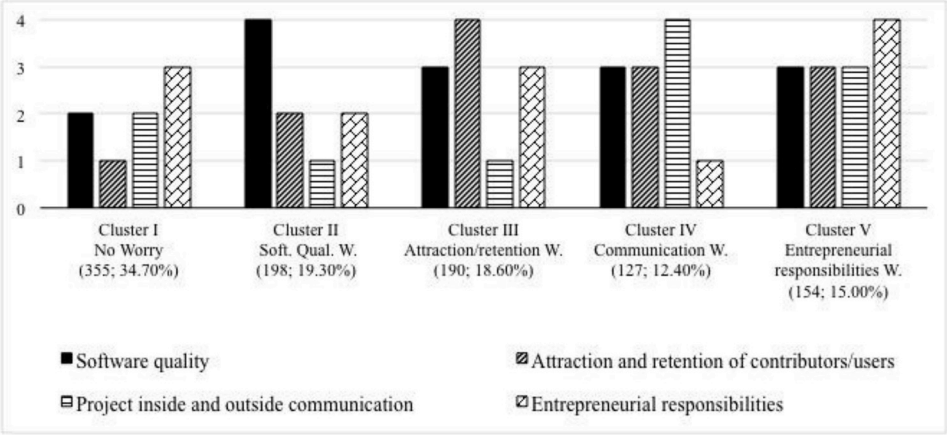

Fig. 1. Graphical representation of OSS contributors worrying profiles.

them. Overall, compared with other clusters, cluster 5 is formed by contributors who worried the most about OSS projects' entrepreneurial responsibilities. This cluster is the only one for which the level of worry about project entrepreneurial responsibilities is highly (H), hence it is labeled "Major Worry about Entrepreneurial Responsibilities" or in short "Entrepreneurial Responsibilities Worry".

For parsimony reasons, for the remainder of this paper, the five clusters will be identified with shorter names: No Worry (cluster I), Software Quality (cluster 2), Attraction and Retention (cluster 3), Communication (cluster 4), and Entrepreneurial Responsibilities (cluster 5).

4.1. Differences with regard to theoretically relevant antecedent variables

Recalling our third research objective, one may ascertain the extent to which contributors' worrying profiles differ on individual characteristics and in the relative level of other theoretically relevant antecedent variables.

For continuous variables, a One Way Anova test was performed to identify differences between clusters by the levels of experience (number of years in OSS projects), levels of expertise (measured by the number of software programming languages mastered), and the age of contributors. The results indicate no statistically significant difference between the five clusters. Chi-square tests of independence were performed to determine whether cluster membership differed significantly by some categorical variables. Results indicate no statistically significant cluster differences with respect to the following individual characteristics: gender, marital status, number of children, highest level of education, employment status, continent of residence. However, a chi-square test of goodness-of-fit (see Appendix A) confirmed that the following characteristics were statistically significantly unequally distributed among the clusters: main contribution to OSS projects, monthly gross income, number of OSS projects the contributor has been involved, number of OSS project the contributor has been involved in as a leader or a coordinator. More specifically, the tests indicate that contributing individuals who hold a doctorate degree are the most likely not to express major worry about OSS project challenges (χ^2 [4, N = 84] = 15.72, p < 0.01); those who contribute on software code programming only are most likely to express major worry about software quality (χ^2 [4, N = 84] = 18.27, p < 0.01) whereas those whose contribution is all but software code programming are the least likely to express major worry about software quality (χ^2 [4, N = 242] = 26.49, p < 0.001); and contributors whose contributions include programing and non-programming tasks are most likely to have major worry about project communication (χ^2 [4, N = 283] = 14.27, p < 0.01).

In addition, the results indicate that contributors with a monthly gross income between $1 and $1000 (on a scale of income varying between $0 and more than $10 000) are the most likely not to express major worry about OSS project challenges (χ^2 [4, N = 123] = 13.92, p < 0.01).

The results also reveal that contributors who have been involved in more than 30 OSS projects are the most likely to express major worry about entrepreneurial responsibilities challenges of OSS projects (χ^2 [4, N = 128] = 15.59, p < 0.05) while those who have not had the leadership or coordination role within OSS projects are the most likely not to express major worry about OSS project challenges (χ^2 [4, N = 296] = 14.22, p < 0.01).

The five clusters were also compared according to whether contributors earn money from OSS, either directly or indirectly. We used either Person Chi-Square or the Fisher's Exact test depending on whether the contingency table has a cell with an expected count of less than 5 (Peat & Barton, 2005; Plichta, Kelvin, & Munro, 2013). The results reveal statistically significant unequal distribution of the nine categories of contributors among the clusters with Fisher exact test (χ^2 [28, N = 1021] = 48.92, p < 0.01). More specifically, contributors who do not earn money from OSS are the most likely not to express major worry about OSS project challenges whereas those who are paid directly for developing OSS are the most likely to depict major worry about software quality; those who are paid directly for supporting OSS are the most likely to express major worry about OSS projects communication while those who are paid directly for administrating OSS are the most likely to express major worry about entrepreneurial activities.

4.2. Exploring equifinality in engagement outcomes across worrying profiles

First, it is interesting to note that cluster I ("no worry") exhibiting no major worry about any of the four dimensions of OSS projects worries is also the one that exhibits the lowest level of engagement in terms of average work hours per week worked on OSS projects.

The cluster analysis also reveals four profiles that exhibit equifinality two-by-two, in engagement outcomes: ("software quality" & "attraction/retention") and ("communication" & "entrepreneurial responsibilities". Specifically, Table 5 indicates that two profiles ("software quality" and "attraction/retention") are associated with medium (equifinal) level of engagement whereas two other profiles ("communication" and "entrepreneurial responsibilities" are associated with high (equifinal) level of engagement. From a worry theory perspective, this pattern is not necessarily surprising because the four clusters depict at least one domain of major worry with regard to OSS project challenges compared to the 'no worry' cluster. This result indicates that, broadly speaking, contributors who worry the most tend to have higher levels of engagement towards OSS development projects in terms of average work hours per week on OSS projects, whatever their domains of major worries are.

5. Discussion and implications

Using an open dataset obtained from an international survey of over 1024 OSS contributors, the present study reveals the structure and patterns of OSS project developers' worry as well as implications for contributors engagement. The present study sought to improve our understanding of nonpathological worry with a non-clinical sample in work-related context as opposed to the dominant pathological and clinical focus. It aimed firstly to identify the structure or the underlying dimensions of OSS development projects challenges as domains of worry for contributors. Secondly, it seeks to characterize OSS contributors by uncovering typical worrying profiles. Finally, it examines the extent to which contributors worrying profiles differ on theoretically relevant antecedent variables and explore equifinality in terms of contributors engagement.

First, based on careful measurements we identify four meaningful dimensions of OSS challenges as domains of worry for OSS contributors that have conceptual clarity. Second, our analysis highlight five worrying profiles, with two exhibiting equifinality associated with higher level of engagement (cluster IV – "communication" and cluster V –"entrepreneurial responsibilities"). Following Burch and Anderson (2008, p. 263) call on personality and work-related behavior or engagement research to take "a more diverse and integrated approach to research by investigating a wider range of variables and the relationship that may exist between them," we investigated a wider range of variables that may influence the uncovered five worrying profiles.

We believe that our findings provide a number of interesting insights for Information Systems and OSS as well as worry researchers, in addition to having normative implications.

First, following Eysenck (1992, p. 102), we assert that numerous positions can be distinguished with respect to individual disparities in the content of worry. "If the amount that a person worries is solely a function of his or her personality, then individuals might be consistent in their levels of worry across the major areas of life [such as work-related tasks or outcomes]. As a result, areas or domains of worry would correlate highly with each other, and there would be a single major worry factor". However, the current research corroborates Eysenck (1992) by clearly demonstrating that it is not the case. Instead, our results confirm that the "amount of an individual worry depends primarily on his or her experiences, in [this] case the [four] domains of worry correlate modestly or not at all with each other" and the dimensions or the structure of worry domains are identifiable and patterns of worry vary from individual to individual, and meaningful clusters are uncovered, as in Tallis et al. (1992). Our results show that OSS contributors' challenges may be conceptualized as domains of worry composed of four dimensions. In addition, five clusters emerge from the cluster analysis when the four factors of the construct of worry are used as cluster variables, suggesting that there are only a few internally consistent configurations of contributors based on challenges that they worry about. Surprisingly, we find that OSS contributors tend to have at most one domain of major worry, and contributors who express major worry tend to exhibit higher level of engagement. The characterization of the empirical structure of worry construct along with the revealing of five worrying profiles with a non-clinical sample in a work-related context, are by themselves important theoretical contributions to the IS and open source as well as worry literature. To our knowledge, this study is the first empirical contribution to conceptualize OSS challenges as domains of worry and to identify the structure of the associated worry construct as well as equifinality.

After conceptualizing OSS development projects challenges as domains of worry for contributors, we examined relationships among constructs that have not been explored before, in addition with a relatively large sample of OSS contributors. Our detailed analysis, not only clarifies the potential impact of different individual work-related worries on their engagement outcomes (as measured by the average work hours per week the contributor spends on OSS development projects), but it also highlights the complexity of this relationship. In particular, our results reveal four worrying profiles that exhibit equifinality two-by-two, with two associated with medium (equifinal) engagement; the other two with high (equifinal) engagement. One of the theoretical contributions of this study is the provision of an empirical evidence of equifinality at a meso-level. In doing so, this research contributes to the configuration literature by responding to a call for further empirical research on equifinality (Fiss, 2007) and specifically at a micro- and meso-level, or from a behavioral perspective (Bissola et al., 2014).

Second, when comparing cluster 1 ('no worry') with the other four clusters, a much clearer picture emerges with an intuitively appealing consistency. In fact, contributors within cluster 1 do not express major worry about any of the four dimensions of OSS projects challenges and this cluster exhibits the lowest level of engagement. This finding suggests that worry configurations that led to relatively higher engagement in terms of effort put in OSS projects are the inverse of those that lead to lower engagement (presence of a domain of major worry versus no domain of major worry). This finding provides an empirical support to the claim that job specific worry as a "cognitive process" that is associated with task performance; which is consistent with other studies (e.g. Perkins & Corr, 2005). More specifically, the last author found that the tendency to worry is positively correlated with workplace performance amongst individuals at the higher end of the ability scale. In addition, they specifically found that, in the more cognitively able individuals, worrying was positively correlated with performance, but as ability diminishes this relationship dissipates. However, our results reveal a contrast because the comparison of the five clusters according to expertise (measured by the number of programming languages mastered by the contributor) revealed not statistically significant differences between the five clusters. Our results also present a difference when compared with Sit et al. (2013). In fact, they found that the most experienced mechanists tend to express more worry but our study reveals not statistically significant difference between the clusters regarding experiences.

A much less obvious picture emerges when screening cluster 1 (about 35% of the sample). It is worth noting that, within the sample, one in three individuals does not express major worry about any one of the four dimensions of OSS projects, challenges. Contributors within this group tend not to be highly educated (holding a doctorate); they tend to receive a monthly gross income of less than $1,000; they also tend not to have had a leadership or coordination role within OSS projects as well; they tend not to earn money from OSS and they exhibit the lowest level of engagement.

Our results also have several normative implications. Although our investigation focuses on elements of OSS development projects that cannot directly be shaped by projects' leaders through their actions, the results are nevertheless illuminating. In particular, our findings provide insights into the critical question of whether major worry by contributors about OSS projects challenges have a negative impact on their engagement. If leaders and managers learn about equifinal worrying profiles, they could use that knowledge to manage their relationships with projects contributors regarding task allocation, for instance, and they could use this knowledge as a basis knowledge for building adequate attitudes and responses towards worries expressed by contributors. Given that each group exhibits major worry on exactly one domain, it can be advised that OSS project leaders should create different groups dedicated to dealing with only one of the four domains of the worry construct. In addition, given that contributors who express an area of major worry tend to exhibit a higher level of engagement, project leaders would be well advised to widely share with contributors, the challenges face by their OSS project from both perspectives of the project leader and of the contributors, concerning one of the four domains of worry at a time. In doing so, leaders are encouraged to display a "positive attitude" towards contributors to allow them to fully express their thoughts about the challenges that they worry about.

Furthermore, the four dimensions of the worry construct could be used to organize online discussions or threaded email messages, which are very common and important in the dynamics of an OSS project development. In terms of prioritizing the allocation of scarce resources, whenever possible we encourage project leaders to first address "entrepreneurial responsibilities" as well as "inside and outside communication" challenges faced by their OSS project as contributors who express more worry about these challenges tend to exhibit a higher level of engagement.

6. Conclusion

This research is an exploratory study of a topic that has received very little attention so far. When interpreting its results, one must keep in mind certain limitations. One of the most important among them is perhaps the fact that the measure of engagement utilized in this research is self-reported and based only on one element. Further research may distinguish the time spend on OSS projects during work hours or spare time (Luthiger & Jungwirth, 2007). Finally, the use of secondary data collected by other researchers constitutes another limitation albeit the fact that this practice is very common in IS (e.g. Seddon, Calvert, & Yang, 2010).

We hope that the results of this study will encourage other researchers to enhance our knowledge of the underlying dimensions of worry construct in non-clinical population (OSS contributors) in work-related context and how worry influence engagement. For instance, further research is necessary to understand why each profile exhibits exactly one area of major worry and why contributors who express major worry about OSS projects' communication (cluster IV) and those who express major worry about entrepreneurial responsibilities (cluster V) equifinally exhibit the highest level of engagement, followed by those who express major worry about the attraction and retention of contributors and users (cluster III) and those who express major worry about the software quality (cluster II) in equifinal manner. Another question worth investigating is the extent to which OSS worrying profiles may exhibit 2 areas of major worry and their implication on the level of engagement. Lastly, it will be worth comparing worry profiles of open source projects contributors with that of proprietary software contributors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2019.02.005.

Appendix A1. Influence of Individual Characteristics on Worrying Profiles

	Cluster I *No Worry* (355; 34.70%) centroid			Cluster II Soft. Qual. W (198; 19.30%) centroid			Cluster III Attraction/retention W. (190; 18.60%) centroid			Cluster IV Communication W. (127; 12.40%) centroid			Cluster V Entrepreneurial responsibilities W. (154; 15.00%) centroid			χ^2
	O	E	R	O	E	R	O	E	R	O	E	R	O	E	R	
Education																
Non—University	68	68.9	-.9	41	38.4	2.6	36	37.0	−1.0	28	24.7	3.3	28	24.7	3.3	1.19
Univ.-Bachelors	140	145.5	−5.5	80	81.0	−1.0	78	78.1	-.1	65	63.3	1.7	57	52.2	4.8	0.71
Univ.-Masters	102	110.5	−8.5	66	61.5	4.5	65	59.3	5.7	48	48.1	-.1	38	39.6	−1.6	1.60
Univ.-PhD	44	29.1	14.9	10	16.2	−6.2	11	15.6	−4.6	15	12.7	2.3	4	10.4	−6.4	15.71**
Main contributions																
Code, programming only	168	173.7	−5.7	129	96.9	32.1	98	93.0	5.0	58	75.3	−17.3	48	62.1	−14.1	18.266**
Other contribution	106	83.9	22.1	21	46.8	−25.8	40	44.9	−4.9	50	36.4	13.6	25	30.0	−5.0	26.494***
Both	81	97.4	−16.4	48	54.3	−6.3	52	52.1	-.1	46	42.3	3.7	54	34.9	19.1	14.269**

*: p < 0.05: **: p < 0.01 ***: p < 0.001.

Appendix A2. . Influence of Individual Characteristics on Worrying Profiles (continue I)

	Cluster I *No Worry* (355; 34.70%) centroid			Cluster II Soft. Qual. W (198; 19.30%) centroid			Cluster III Attraction/retention W. (190; 18.60%) centroid			Cluster IV Communication W. (127; 12.40%) centroid			Cluster V Entrepreneurial responsibilities W. (154; 15.00%) centroid			χ^2
	O	E	R	O	E	R	O	E	R	O	E	R	O	E	R	
Monthly gross income																
0	19	16.9	2.1	12	9.5	2.5	9	9.2	-.2	7	7.5	-.5	2	5.9	−3.9	3.534
1–1000	56	42.5	13.5	29	23.8	5.2	12	23.0	−11.0	18	18.8	-.8	8	14,9	−6,9	13.915**
1001–5000	148	166.0	−18.0	94	93.1	.9	100	90.1	9.9	81	73.5	7.5	58	58.4	-.4	3.817
5001–10000	73	76.3	−3.3	39	42.8	−3.8	45	41.4	3.6	29	33.8	−4.8	35	26.8	8.2	3.986
more than 10000	34	28.3	5.7	11	15.9	−4.9	13	15.4	−2.4	11	12.5	−1.5	13	9.9	3.1	4.183
Average work hours/week spend on OSS projects																
Less than 2	111	82.4	28.6	47	46.0	1.0	34	44.1	−10.1	23	35.9	−12.9	23	29.6	−6.6	18.369**
2–5	73	74.4	−1.4	46	41.5	4.5	44	39.8	4.2	31	32.5	−1.5	21	26.8	−5.8	2.282
6–10	57	57.8	-.8	29	32.3	−3.3	39	30.9	8.1	22	25.2	−3.2	20	20.8	-.8	2.909
11–20	37	41.9	−4.9	23	23.4	-.4	21	22.4	−1.4	23	18.3	4.7	17	15.1	1.9	2.115
21–40	32	44.3	−12.3	24	24.7	-.7	22	23.7	−1.7	25	19.3	5.7	25	15.9	9.1	10.440*
More than 40	43	52.3	−9.3	28	29.2	−1.2	29	28.0	1.0	30	22.8	7.2	21	18.8	2.2	4.273

*: p < 0.05: **: p < 0.01 ***: p < 0.001.

Appendix A3. Influence of Individual Characteristics on Worrying Profiles (continue II)

	Cluster I *No Worry* (355; 34.70%) centroid			Cluster II Soft. Qual. W (198; 19.30%) centroid			Cluster III Attraction/retention W. (190; 18.60%) centroid			Cluster IV Communication W. (127; 12.40%) centroid			Cluster V Entrepreneurial responsibilities W. (154; 15.00%) centroid			χ^2
	O	E	R	O	E	R	O	E	R	O	E	R	O	E	R	
Number of OSS project involved in																
1–5	221	203.4	17.6	113	113.4	-.4	100	108.8	−8.8	89	87.6	1.4	63	72.7	−9.7	3.552
6–10	86	86.8	-.8	48	48.4	-.4	54	46.4	7.6	27	37.4	−10.4	35	31.0	4.0	4.664
11–30	34	45.1	−11.1	30	25.2	4.8	28	24.1	3.9	19	19.4	-.4	19	16.1	2.9	4.804
More than 30	14	19.8	−5.8	7	11.0	−4.0	8	10.6	−2.6	18	8.5	9.5	10	7.1	2.9	15.593**
Number of OSS project involved in as a leader/coordinator																
None	129	102.8	26.2	53	57.1	−4.1	36	55.0	−19.0	46	44.3	1.7	32	36.8	−4.8	14.227**
1	74	83.0	−9.0	49	46.1	2.9	51	44.4	6.6	36	35.8	.2	29	29.7	-.7	2.157
2	55	59.7	−4.7	38	33.2	4.8	40	32.0	8.0	16	25.7	−9.7	23	21.4	1.6	6.845
3–5	71	80.2	−9.2	44	44.5	-.5	51	42.9	8.1	35	34.6	.4	30	28.7	1.3	2.653
More than 5	26	29.2	−3.2	13	16.2	−3.2	12	15.6	−3.6	20	12.6	7.4	13	10.4	2.6	6.810

*: $p < 0.05$: **: $p < 0.01$ ***: $p < 0.001$.

References

Aasa, U., Brulin, C., Ängquist, K. A., & Barnekow-Bergkvist, M. (2005). Work-related psychosocial factors, worry about work conditions and health complaints among female and male ambulance personnel. *Scandinavian Journal of Caring Sciences, 19*(3), 251–258. https://doi.org/10.1111/j.1471-6712.2005.00333.x.

Bissola, R., Imperatori, B., & Colonel, R. T. (2014). Enhancing the creative performance of new product teams: An organizational configurational approach. *Journal of Product Innovation Management, 31*(2), 375–391.

Black duck (2015). *Open source experts weigh in on the future of open source 2015 future of open source survey results.* https://www.blackducksoftware.com/resources/webinar/2015-future-open-source-survey-results Accessed 02 December 2016.

Bonaccorsi, A., Giannangeli, S., & Rossi, C. (2006). Entry strategies under competing standards: Hybrid business models in the open source software industry. *Management Science, 52*(7), 1085–1098. https://doi.org/10.1287/mnsc.1060.0547.

Borkovec, T. D. (1994). The nature, function, and origins of worry. In G. C. L. Davey, & F. Tallis (Eds.). *Worrying: Perspectives on theory, assessment and treatment* (pp. 5–33). UK: Wiley.

Borkovec, T. D., Ray, W. J., & Stober, J. (1998). Worry: A cognitive phenomenon intimately linked to affective, physiological, and interpersonal behavioral processes. *Cognitive Therapy and Research, 22*(6), 561–576.

Brown, T. A. (1997). The nature of generalized anxiety disorder and pathological worry: Current evidence and conceptual models. *Canadian Journal of Psychiatry, 42*(8), 817–825. https://doi.org/10.1177/070674379704200803.

Burch, G. S. J., & Anderson, N. (2008). 8 personality as a predictor of work-related behavior and performance: Recent advances and directions for future research. *International Review of Industrial and Organizational Psychology, 23*, 261.

Center for Strategic and International Studies (CSIS) (2010). *Government open source policies.* Retrieved from https://opensource.org/files/100416_Open_Source_Policies.pdf.

Chengalur-Smith, I. S., Nevo, S., & Demertzoglou, P. (2010). An empirical analysis of the business value of open source infrastructure technologies. *Journal of the Association for Information Systems, 11*(11), 708–729.

Chengalur-Smith, I. S., Sidorova, A., & Daniel, S. (2010). Sustainability of free/Libre open source projects: A longitudinal study. *Journal of the Association for Information Systems, 11*(11), 657–683.

Colazo, J., & Fang, Y. (2009). Impact of license choice on open source software development activity. *Journal of the American Society for Information Science and Technology, 60*(5), 997–1011. https://doi.org/10.1002/asi.21039.

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*(7), 1–9.

Crowston, K., Wei, K., Howison, J., & Wiggins, A. (2012). Free/Libre open-source software development: What we know and what we do not know. *ACM Computing Surveys (CSUR), 44*(2), 7.

Daffara, C. (2012). Estimating the economic contribution of open source software to the european economy. September 2012 *Paper presented at the the first OpenForum academy conference, Belgium.*

Davey, G. C., & Meeten, F. (2016). The perseverative worry bout: A review of cognitive, affective and motivational factors that contribute to worry perseveration. *Biological Psychology, 121*, 233–243.

Doron, J., Thomas-Ollivier, V., Vachon, H., & Fortes-Bourbousson, M. (2013). Relationships between cognitive coping, self-esteem, anxiety and depression: A cluster-analysis approach. *Personality and Individual Differences, 55*(5), 515–520.

Doty, D. H., Glick, W. H., & Huber, G. P. (1993). Fit, equifinality, and organizational effectiveness: A test of two configurational theories. *Academy of Management Journal, 36*(6), 1196–1250.

Dupuy, J.-B., Beaudoin, S., Rhéaume, J., Ladouceur, R., & Dugas, M. (2001). Worry: Daily self-report in clinical and non-clinical populations. *Behaviour Research and Therapy, 39*(10), 1249–1255.

Eysenck, M. W. (1992). *Anxiety: The cognitive perspective.* England: Erlbaum: Psychology Press.

Fiss, P. C. (2007). A set-theoretic approach to organizational configurations. *Academy of Management Review, 32*(4), 1190–1198.

Gamalielsson, J., & Lundell, B. (2014). Sustainability of Open Source software communities beyond a fork: How and why has the LibreOffice project evolved? *Journal of Systems and Software, 89*(1), 128–145. https://doi.org/10.1016/j.jss.2013.11.1077.

Ghapanchi, A. H. (2015a). Investigating the interrelationships among success measures of open source software projects. *Journal of Organizational Computing & Electronic Commerce, 25*(1), 28–46.

Ghapanchi, A. H. (2015b). Predicting software future sustainability: A longitudinal perspective. *Information Systems, 49*, 40–51. https://doi.org/10.1016/j.is.2014.10.005.

Ghapanchi, A. H., Aurum, A., & Low, G. (2011). A taxonomy for measuring the success of open source software projects. *First Monday, 16*(8).

Ghosh, R. A., Glott, R., Krieger, B., & Robles, G. (2002). *Free/libre and open source software: Survey and study.* Retrieved from Maastricht, The Netherlands http://www.math.unipd.it/~bellio/FLOSS%20Final%20Report%20-%20Part%204%20-%20Survey%20of%20Developers.pdf.

Giuri, P., Rullani, F., & Torrisi, S. (2008). Explaining leadership in virtual teams: The case of open source software. *Information Economics and Policy, 20*(4), 305–315. https://doi.org/10.1016/j.infoecopol.2008.06.002.

Gruber, M., Heinemann, F., Brettel, M., & Hungeling, S. (2010). Configurations of resources and capabilities and their performance implications: An exploratory study on technology ventures. *Strategic Management Journal, 31*(12), 1337–1356.

Hair, J. F., Black, W. C., J., B. B, & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective* (7th ed.). Upper Saddle River, New Jersey (USA): Prentice Hall.

Hardy, M. A., & Bryman, A. (2004). *Handbook of data analysis.* London: Sage.

Hertel, G., Niedner, S., & Herrmann, S. (2003). Motivation of software developers in open source projects: An internet-based survey of contributors to the Linux kernel. *Research Policy, 32*(7), 1159–1177.

Hippel, E. v., & Krogh, G. v. (2003). Open source software and the "private-collective" innovation model: Issues for organization science. *Organization Science, 14*(2), 209–223.

Hochberg, Y., & Tamhane, A. (1987). *Multiple comparison procedures.* New York: Wiley.

Homburg, C., Jensen, O., & Krohmer, H. (2008). Configurations of marketing and sales: A taxonomy. *Journal of Marketing, 72*(2), 133–154.

Horn, J. L., & Engstrom, R. (1979). Cattell's scree test in relation to Bartlett's chi-square test and other observations on the number of factors problem. *Multivariate Behavioral Research, 14*(3), 283–300.

Jin, X., Wu, L., Becken, S., & Ding, P. (2016). How do worry, self-efficacy, and coping interact? Examining Chinese tourists to Australia. *Journal of China Tourism Research, 12*(3–4), 374–393.

Joormann, J., & Stöber, J. (1997). Measuring facets of worry: A lisrel analysis of the worry domains questionnaire. *Personality and Individual Differences, 23*(5), 827–837. https://doi.org/10.1016/S0191-8869 (97)00075-5.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*(1), 31–36.

Kelly, W. E. (2004). A brief measure of general worry: The three item worry index. *North American Journal of Psychology, 6*(2), 219–226.

Ketchen, D. J., & Shook, C. L. (1996). The application of cluster analysis in strategic management research: An analysis and critique. *Strategic Management Journal, 17*(6), 441–458.

Kim, J.-O., & Mueller, C. W. (1978). *Factor analysis: Statistical methods and practical issues, Vol. 14.* Sage.

Krishnamurthy, S., Ou, S., & Tripathi, A. K. (2014). Acceptance of monetary rewards in open source software development. *Research Policy, 43*(4), 632–644. https://doi.org/10.1016/j.respol.2013.10.007.

Larsen, S., Øgaard, T., & Marnburg, E. (2005). Worries in restaurant managers. *Scandinavian Journal of Psychology, 46*(1), 91–96. https://doi.org/10.1111/j.1467-

9450.2005.00439.x.
Levi, S. D., & Woodard, A. (2004). Open source software: How to use it and control it in the corporate environment. *Computer and Internet Lawyer, 21*(8), 8–13.
Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports, 20*(3), 975–978. https://doi.org/10.2466/pr0.1967.20.3.975.
Lowry, P. B., Moody, G. D., Gaskin, J., Galletta, D. F., Humpherys, S. L., Barlow, J. B., et al. (2013). Evaluating journal quality and the association for information systems senior scholars' journal basket via bibliometric measures: Do expert journal assessments add value? *MIS Quarterly, 37*(4), 993–1012.
Luthiger, B., & Jungwirth, C. (2007). Pervasive fun. *First Monday, 12*(1).
Malhotra, A., Gosain, S., & Sawy, O. A. E. (2005). Absorptive capacity configurations in supply chains: Gearing for partner-enabled market knowledge creation. *MIS Quarterly,* 145–187.
Matthews, G., Emo, A. K., Funke, G., Zeidner, M., Roberts, R. D., Costa, P. T., Jr., et al. (2006). Emotional intelligence, personality, and task-induced stress. *Journal of Experimental Psychology: Applied, 12*(2), 96.
Meichenbaum, D. H., & Smart, I. (1971). Use of direct expectancy to modify academic performance and attitudes of college students. *Journal of Counseling Psychology, 18*(6), 531–535. https://doi.org/10.1037/h0031749.
Meyer, A. D., Tsui, A. S., & Hinings, C. R. (1993). Configurational approaches to organizational analysis. *Academy of Management Journal, 36*(6), 1175–1195.
Miller, D. (1981). Toward a new contingency approach: The search for organizational gestalts. *Journal of Management Studies, 18*(1), 1–26.
Norman, G. R., & Streiner, D. L. (2008). *Biostatistics: The bare essentials.* Hamilton, Ontario: BC Decker.
O'Mahony, S. (2007). The governance of open source initiatives: What does it mean to be community managed? *Journal of Management & Governance, 11*(2), 139–150. https://doi.org/10.1007/s10997-007-9024-7.
Payne, G. T. (2006). Examining configurations and firm performance in a suboptimal equifinality context. *Organization Science, 17*(6), 756–770.
Peat, J., & Barton, B. (2005). *Categorical variables: Risk statistics. Medical statistics: A guide to data analysis and critical appraisal.* 241–266.
Perkins, A. M., & Corr, P. J. (2005). Can worriers be winners? The association between worrying and job performance. *Personality and Individual Differences, 38*(1), 25–31. https://doi.org/10.1016/j.paid.2004.03.008.
Plichta, S. B., Kelvin, E. A., & Munro, B. H. (2013). *Munro's statistical methods for health care research.* Wolters Kluwer Health/Lippincott Williams & Wilkins.
Poba-Nzaou, P., Raymond, L., & Fabi, B. (2014). Risk of adopting mission-critical OSS applications: An interpretive case study. *International Journal of Operations & Production Management, 34*(4), 477–512.
Powell, W. W., & Grodal, S. (2005). Networks of innovators. In F. J, M. D. C, & N. R. R (Eds.). *The oxford handbook of innovation* (pp. 56–85). Oxford/New York: Oxford University Press.
Punj, G., & Stewart, D. W. (1983). Cluster analysis in marketing research: Review and suggestions for application. *Journal of Marketing Research,* 134–148.
Robles, G., Reina, L.-A., & Duenas, S. (2013). *OSS 2013 survey.* Retrieved from http://OSS2013.libresoft.es.
Robles, G., Reina, L. A., Serebrenik, A., Vasilescu, B., & González-Barahona, J. M. (2014). Floss 2013: A survey dataset about free software contributors: Challenges for curating, sharing, and combining. *Paper presented at the proceedings of the 11th working conference on mining software repositories*.
Rozental, A., Forsell, E., Svensson, A., Forsström, D., Andersson, G., & Carlbring, P. (2015). Differentiating procrastinators from each other: A cluster analysis. *Cognitive behavior therapy, 44*(6), 480–490.
Santos, C., Kuk, G., Kon, F., & Pearson, J. (2013). The attraction of contributors in free and open source software projects. *The Journal of Strategic Information Systems, 22*(1), 26–45. https://doi.org/10.1016/j.jsis.2012.07.004.
Schroer, J., & Hertel, G. (2009). Voluntary engagement in an open web-based encyclopedia: Wikipedians and why they do it. *Media Psychology, 12*(1), 96–120. https://doi.org/10.1080/15213260802669466.
Seddon, P. B., Calvert, C., & Yang, S. (2010). A multi-project model of key factors affecting organizational benefits from enterprise systems. *MIS Quarterly, 34*(2), 305–328.
Shilton, K., & Greene, D. (2017). Linking platforms, practices, and developer ethics: Levers for privacy discourse in mobile application development. *Journal of Business Ethics,* 1–16.
Short, J. C., Payne, G. T., & Ketchen, D. J., Jr. (2008). Research on organizational configurations: Past accomplishments and future challenges. *Journal of Management, 34*(6), 1053–1079.
Sit, T., Wong, A., & Tong, C. (2013). The impact of line maintenance mechanics' attitude, behavioral intentions, and behavior on aircraft safety: A study of two aircraft maintenance companies in Hong Kong. *Journal of Management Research, 5*(2), 133.
Spaeth, S., von Krogh, G., & He, F. (2015). Perceived firm attributes and intrinsic motivation in sponsored open source software projects. *Information Systems Research, 26*(1), 224–237. https://doi.org/10.1287/isre.2014.0539.
Stallman, R. (2009). Viewpoint Why open source misses the point of free software. *Communications of the ACM, 52*(6), 31–33.
Stöber, J. (1998). Reliability and validity of two widely-used worry questionnaires: Self-report and self-peer convergence. *Personality and Individual Differences, 24*(6), 887–890.
Stöber, J., & Joormann, J. (2001). A short form of the Worry Domains Questionnaire: Construction and factorial validation. *Personality and Individual Differences, 31*(4), 591–598.
Stöber, J., & Seidenstücker, B. (1997). A new inventory for assessing worry in managers: Correlates with job involvement and self-reliance. *Personality and Individual Differences, 23*(6), 1085–1087.
Tallis, F., Davey, G. C. L., & Capuzzo, N. (1994). The phenomenology of non-pathological worry: A preliminary investigation. In G. C. L. D. F. Tallis (Ed.). *Worrying: Perspectives on theory, assessment and treatment* (pp. 61–89). New York: Wiley.
Tallis, F., Eysenck, M., & Mathews, A. (1992). A questionnaire for the measurement of nonpathological worry. *Personality and Individual Differences, 13*(2), 161–168.
Von Bertalanffy, L. (1968). *General system theory. New York.* 40 41973 (1968).
Wolff, K., Larsen, S., Marnburg, E., & Øgaard, T. (2013). Worry and its correlates onboard cruise ships. *International Maritime Health, 64*(2), 95–100.
Zeidner, M. (1998). *Test anxiety: The state of the art.* Springer Science & Business Media.
Zirger, B. J., & Maidique, M. A. (1990). A model of new product development: An empirical test. *Management Science, 36*(7), 867–883.