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Exploring motivations for contributing to open source initiatives: The roles of contribution context and personal values

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Abstract

We explore contextual and dispositional correlates of the motivation to contribute to open source initiatives. We examine how the context of the open source project, and the personal values of contributors, are related to the types of motivations for contributing. A web-based survey was administered to 300 contributors in two prominent open source contexts: software and content. As hypothesized, software contributors placed a greater emphasis on reputation-gaining and self-development motivations, compared with content contributors, who placed a greater emphasis on altruistic motives. Furthermore, the hypothesized relationships were found between contributors' personal values and their motivations for contributing.
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In recent years there has been a growing interest in open source software and open source content development initiatives (e.g. Awazu & Desouza, 2004; Opderbeck, 2004; Raymond, 1999; von Krogh, Spaeth, & Lakhani, 2003). While the term ''open source'' in its strict sense denotes only the type of license under which a product is made available (von Hippel & von Krogh, 2003), the open source mechanism, which was first manifested

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in software development, involves the idea that by drawing on the contributions of volunteers, software can be created that are technically superior to software created in traditional, closed development environments (Markus, Manville, & Agres, 2000). In the present paper we focus on these volunteers' motivations and on some of the factors that could explain them. An outline of our research model is presented in Fig. 1.

While open source initiatives appear in many forms, there are two primary types: open source software and open source content. Open source software development is based on a collaborative effort where software is created by a community of volunteers or members of organizations who support the open source software movement. Software projects have "owners" who initiate projects and have the right to redistribute modified versions of the software (Bergquist & Ljungberg, 2001). The projects' development process often involves a review system that is similar in nature to the peer-review system common in academia (Bezroukov, 1999; Raymond, 1999): people share their knowledge and skills, the software they write undergoes peer-review by the owners of the open source software project, and if deemed good enough it is accepted and its contributors gain credit for it (Bergquist & Ljungberg, 2001). Thus, contributors need to have a reasonable level of expertise and to have this expertise made public in order for them to make a creditable contribution.

Whereas the product in open source software initiatives is software, open source content projects involve the creation of a body of knowledge (hence the term "content"). These projects take on various forms, such as online discussion forums (Gu & Jarvenpaa, 2003; Wasko & Faraj, 2000), consumers' reviews (Chevalier & Mayzlin, 2006), collaborative website tagging (Golder & Huberman, 2006; McAfee, 2006) and online encyclopedias, including perhaps the most well known content project – Wikipedia (Denning, Horning, & Weinstein, 2005). Wikipedia is a free online encyclopedia, written and edited by volunteers, containing close to 2,000,000 entries in 82 languages (Seelye, 2005). It allows multiple users to add and edit content (Wagner, 2004). This way, Wikipedia avoids the delays associated with a formal review process (Denning et al., 2005).
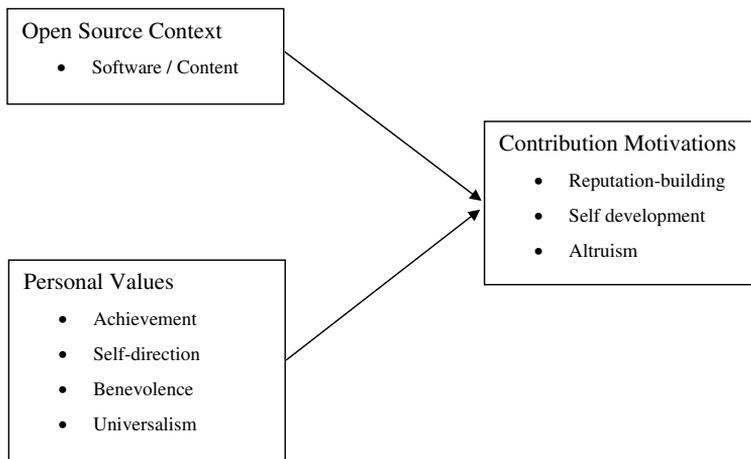

Fig. 1. Context and personal values as antecedents of contribution motivations.

Similar to software projects, content projects such as Wikipedia are whereby created collaboratively by individuals who volunteer their time, effort and skills to creating a product that is available to all. However, unlike the software case, content initiatives do not generally involve a review process. For example, any page on Wikipedia can be edited by anyone, and contributions immediately change the end-product that is published. Wikipedia contributors are mostly knowledgeable amateurs (Bryant, Forte, & Bruckman, 2005; Rettberg, 2005). The barriers to entry for contributors, then, seem to be quite different in the two contexts. Whereas software contribution requires a certain threshold of expertise in order to pass the review process, content contribution, such as in Wikipedia, has virtually no barriers to entry other than basic computer literacy.

Like other online community venues, such as online message boards (e.g., Kang, Lee, Lee, & Choi, 2007) and online gaming forums (e.g., Sun, Lin, & Hong Ho, 2006), the open source world, including both software and content contexts, involves a fascinating setting in which individuals voluntarily invest time and effort for the benefit of the broader community. Considering that this mode of operation is still relatively new, there is much we don't know about individuals' motivations for participating in these initiatives. Indeed, a central theme in open source research and practice addresses the motivations of these contributors (Roberts, Hann, & Slaughter, 2006).

Extant research focuses on the types of motivations that drive open source contributions (e.g. Hars & Ou, 2002; Lakhani & von Hippel, 2003). However, previous work has not considered the underlying sources of these motivations. In the present study we are concerned with the relationship between context, personality and contribution motivations. More specifically, we ask the following questions: what is it about the type of open source context, and about the type of individuals involved, that yields, or activates, certain types of motivations? Are some motivations more dominant in certain contexts? Are they more frequently exhibited among certain types of individuals? In other words, whereas previous studies have aimed to explain *why* individuals contribute, our study is aimed at understanding *who* these individuals are, and *when* or *where* the various motivations are more likely to arise.

We adopt an interactionist perspective (e.g., Blass, 1984), whereby both context and personality are believed to determine individuals' behavior and motivations. Early studies in psychology, aimed at explaining human behavior, have typically been associated with one of two camps: the ''personality'' camp, which espoused explanations that focus on individual differences, and the ''situation'' camp, which espoused explanations that focus on the characteristics of the situation, or context, where behavior takes place. As a result of the debate between the two camps, the interactionist approach has emerged, which highlights the joint contribution of person and situation factors to explaining human behavior (Buss, 1977). Not only does such a perspective incorporate a broader range of explanations, it also allows one to test the effect of one set of variables (i.e., personality or situation) while controlling for the other. Since its establishment, the interactionist model has been applied in a variety of contexts, to explain behaviors such as ethical decision making (Trevino, 1986), individuals' reactions to organizational changes (Oreg, 2006), and creativity (Woodman & Schoenfeldt, 1990).

As depicted in Fig. 1, in the present study we adopt the interactionist model for explaining individuals' motivations for contributing to open source initiatives. First, we suggest that the motivations to contribute vary across contribution contexts.

Specifically, we suggest that people's primary motivation to contribute to open source initiatives of one kind (e.g., software), may be different than their motivation to contribute to another (e.g., content). Second, we argue that, based on their personal value system, some people are more likely than others to express certain contribution motivations.

1. Open source contribution motivations

Current research on the open source phenomenon follows several directions, ranging from software engineering issues (e.g. Gyimóthy, Ferenc, & Siket, 2005; Yu, Schach, Chenand, & Offutt, 2004) to organizational and social aspects of its processes and implications (e.g., Nov & Rao, forthcoming; von Hippel & von Krogh, 2003). Of particular relevance for the present study, one line of research has aimed at understanding what motivates contributors to dedicate time and effort to open source projects (e.g., Hars & Ou, 2002; Lakhani & von Hippel, 2003). Indeed, much of the open source literature has focused on identifying the various motivations that individuals have for contributing to open source initiatives (e.g., Hars & Ou, 2002; Lakhani, Wolf, Bates, & DiBona, 2002; Lakhani & von Hippel, 2003; Roberts et al., 2006; Stewart & Gosain, 2006; von Hippel & von Krogh, 2003).

Overall, a large variety of motivations has been indicated. An important distinction made by Roberts et al. (2006), as well as in Lakhani and Wolf's (2005) review of the research on open source motivations, is between intrinsic and extrinsic motivations. This distinction reiterates earlier formulations in the study of motivation, such as in Deci and Ryan's (1985) self-determination theory. Extrinsic motivations are instrumental in nature and represent cases with a focus on extrinsic rewards, where the expected benefits of contributing are believed to exceed the contribution's costs (Lerner & Tirole, 2002). These include, for example, improvement of programming skills (Lakhani & von Hippel, 2003), creation of required, yet otherwise unavailable, code, and the enhancement of professional status (Lakhani & Wolf, 2005; McLure-Wasko & Faraj, 2005). Intrinsic motivations, on the other hand, tend to be terminal in that they emphasize inherent satisfactions rather than their separable consequence (Ryan & Deci, 2000). They include motivations such as altruism (Zeityln, 2003), fun (Torvalds & Diamond, 2001), reciprocity (McLure-Wasko & Faraj, 2005), intellectual stimulations, and a sense of obligation to contribute (Bryant et al., 2005; Lakhani & Wolf, 2005).

Similar distinctions are evident in a number of goal theories (e.g., Dweck, 1999; Heckhausen & Kuhl, 1985; Nicholls, Cobb, Yackel, Wood, & Wheatley, 1990). For example, Nicholls et al. (1990) distinguish between ego-involved goals, which are oriented outwards and focus on maximizing favorable evaluations from the environment, and task-involved goals, which have a more internal orientation with a focus on mastering tasks and increasing one's sense of personal competence. Similarly, Dweck (1999) distinguishes between performance goals, which are similar to ego-involved goals and focus on the external outcomes of one's behavior, and learning goals, that are like task-involved goals and involve a more intrinsic process of personal enhancement. Another goal theory that more explicitly addresses the issue of instrumentality in the context of the intrinsic–extrinsic distinction is Heckhausen and Kuhl's (1985) goal typology. Heckhausen and Kuhl distinguish between end-states that are least instrumental and are pursued for intrinsic interest and enjoyment and those that are most instrumental and are pursued for the external consequences that they ensue.

In line with this distinction, in the present work we sample a range of motivations by focusing on three key motivations, with high, mid-range, and low degrees of instrumentality. The first, and most instrumental in nature, involves individuals' desire to establish their reputation and to gain approval from others in the field (e.g., Hars & Ou, 2002; Lakhani & von Hippel, 2003; Lerner & Tirole, 2002; McLure-Wasko & Faraj, 2005). This motivation is considered extrinsic because of its instrumental value in enhancing contributors' job prospects (Lakhani & Wolf, 2005).

The second motivation involves a desire for self-development through learning from others in the field, receiving feedback, and enhancing one's abilities and skills (e.g. Bonaccorsi & Rossi, 2003; von Hippel & von Krogh, 2003). While Lakhani and Wolf (2005) consider the learning motivation to be extrinsic because of its instrumental value (e.g., the prospect of getting a good job), this motivation is also related to what is termed in other works as *flow* (e.g., Sharafi, Hedman, & Montgomery, 2006), and is driven by internal needs for growth and self-actualization, which are end-goals of themselves (e.g., Deci & Ryan, 1985).

The third, and least instrumental, motivation involves altruism, or the desire to help others in the community (e.g., Bryant et al., 2005; Faraj & Wasko, 2001; Hars & Ou, 2002; Lakhani & von Hippel, 2003). The emphasis here is on the direct satisfaction and on the internal sense of obligation that drives behavior.

While the existence of these three motivations has been established in several studies of open source projects, few attempts have been made to examine their antecedents. In the present work we suggest two potential antecedents. First, we suggest that the salience of each motivation will differ across contexts. In other words, we expect the particular context of the open source initiative to be associated with the strength of the motivations for contributing. The findings on contribution motivations described above are based on studies conducted in either software *or* content contexts. In no study were both contexts tested simultaneously, using the same theory and measures, thus precluding a direct comparison of motivations across contexts.

Second, we suggest that individuals' dispositional orientation corresponds with the types of motivations expressed for contributing. Our focus here is on personal value systems (Schwartz, 1992). We expect different values to be associated with different contribution motivations.

In the next two sections we develop our hypotheses about these relationships with contribution motivations: first, we address the relationship between open source context and motivations, and in the following section we will establish our hypotheses about personal values and motivations.

2. Contribution context and motivations

2.1. Gaining reputation

Building one's reputation is discussed extensively in the literature as an open-source software contribution motivation (Bezroukov, 1999; Lakhani & von Hippel, 2003; Markus et al., 2000; Perkins, 1999; Raymond, 1999). By contributing to open source software initiatives contributors signal their status (Kollock, 1999; Raymond, 1999), identity (Hertel, Niedner, & Herrmann, 2003), and abilities (Osterloh, Rota, & Kuster, 2003; Raymond, 1999). Furthermore, companies seeking programmers with particular skills can find potential hires

by examining open-source software code (Lakhani & Wolf, 2005). Thus, gaining reputation is very instrumental in helping them to advance their careers in the software industry (Lerner & Tirole, 2002). Reputation is found to be a motivator for content contributors as well (McLure-Wasko & Faraj, 2005). The prospect of gaining reputation motivates people as it is an asset they can leverage to achieve and maintain status (Jones, Hesterly, & Borgatti, 1997).

However, there would also seem to be some cardinal differences in the relevance of this motivation for the two contexts. Contrary to the software context, in the content context many contributors are not professional content creators (Rettberg, 2005). In the software context most contributors work in software-related jobs (e.g., software development, system administration, etc.) and need to exhibit a reasonable level of expertise to successfully get through the review system. Therefore, the need to exhibit expertise in an environment populated by other experts is likely to make reputation a stronger and more direct determinant of contributors' careers. Furthermore, empirical data from two studies of on reputation as a motivation to contribute – one in the software context, and another in the content context – suggest that differences in the weight of this motivation can indeed be expected. In the software context, Lakhani and von Hippel's study (2003) of Apache Usenet contribution found a mean level of 4.7 (out of 7) for reputation as a motivator, while in the content context McLure-Wasko and Faraj's study (2005) of knowledge contribution found a mean level of 2.6 (out of 5). Accordingly, in our direct comparison of the software and content contexts we expect to find higher levels of the reputation-building motivation among software contributors compared with content contributors.

Hypothesis 1. Reputation-building motivation levels will be higher among open source software contributors than among open source content contributors.

2.2. Self-development

As noted above, the open source software development process involves an intensive peer-review mechanism, through which contributors receive feedback from peers in the project team, from software users, and from interested outsiders (von Krogh et al., 2003). Such a peer-review system, through which contributors can gain feedback about faulty programming styles, conventions, and logic, helps contributors enhance their professional skills (Lakhani & Wolf, 2005). Indeed, learning and skill development are cited as a prominent reason for contributing to open source software development (Lakhani & Wolf, 2005). In line with this, empirical research suggests that self-development is highly important for software contributors: 88% of the software-contributing respondents surveyed by Hars and Ou (2002) ranked human capital enhancement as high or very high – the highest percentage among the motivations studied. On the other hand, peer-review is not a common practice for content contributors, and, as an example, does not exist in Wikipedia at all. This may imply that software contributors would be more motivated to contribute by the prospect of receiving feedback and learning than content contributors. Furthermore, the relatively low barriers to entry that characterizes the open source content context may lead to lower expectations of self-development on the part of contributors. However, as far as we could tell no previous studies have empirically examined the role of self-development motivations for

the content context. In the present study we expect to find higher levels of self-development motivations among software contributors.

Hypothesis 2. Self-development motivation levels will be higher among open source software contributors than among open source content contributors.

2.3. Altruism

Altruism is considered a motivator in both software (Hars & Ou, 2002; Lakhani et al., 2002) and content contexts (Gu & Jarvenpaa, 2003; McLure-Wasko & Faraj, 2005). The altruism case mirrors, to some extent, the other differences discussed in the last two sections across the two contexts: content contributors are often knowledgeable people who want to share what they know with the community (Bryant et al., 2005). Contrarily, software contributors are more focused on what they may have to gain from others in the community (Bonaccorsi & Rossi, 2003) and may also have in mind the implications of their contribution on their career prospects (Lerner & Tirole, 2002). Empirical studies also suggest a difference between the contexts in the levels of altruism as a motivator: McLure-Wasko and Faraj's (2005) study of knowledge contribution found a high mean level (4.1 out of 5) for enjoyment of helping as a contribution motivator, whereas Hars and Ou's (2002) study of software contributors found that only 16.5% of the respondents ranked altruism as high (6 out of 7) or very high (7 out of 7) – compared with 43% who ranked peer-recognition and 88% who ranked human capital enhancement as high or very high. The difference between community-oriented contribution and self-oriented contribution, and the findings from previous empirical research lead us to expect higher levels of altruistic motivations among content contributors compared with software contributors:

Hypothesis 3. Altruism motivation levels will be higher among open source content contributors than among open source software contributors.

3. Personal values and contribution motivations

Beyond an understanding of the role that context has in yielding the motivation to contribute, it is also important to explore the *dispositional* (i.e., personality-based) forces that might underlie such motivations. Do the strengths of these motivations differ across individuals? Are some people more likely to exhibit one type of motivation while others another? While the literature provides some insight into the motivations themselves (e.g. Bonaccorsi & Rossi, 2003; Bryant et al., 2005; Gu & Jarvenpaa, 2003; Hars & Ou, 2002; Hertel et al., 2003; Lakhani & von Hippel, 2003; McLure-Wasko & Faraj, 2005), it does not shed much light on their underlying sources. Personal values are conceptualized as deeply-embedded motivational sources (e.g., Schwartz, 1992) and constitute a promising starting point for our investigations. They involve cognitive representations of motivational goals (Schwartz, 1992) and are often defined as trans-situational goals that vary in their importance and serve as guiding principles in people's lives (Kluckhohn, 1951; Rokeach, 1973; Schwartz, 1992). Values serve as standards or criteria and provide social justification for choices and behaviors, distinguishing them from personal attributes such as traits or interests (Bilsky & Schwartz, 1994; Roccas, Sagiv, Schwartz, & Knafo, 2002).

They are different from needs and motives in that they are, by definition, inherently desirable and are represented cognitively in ways that enable people to communicate about them (Roccas et al., 2002). Values are also distinct from contribution motivations in several respects. First, whereas contribution motivations address specific desires or aims, values represent a much broader and more general set of aims. Second, as we argue above, the motivation to contribute is partly influenced by the particular context within one contributes. Thus, contribution motivations are somewhat malleable. Contrarily, values are conceptualized as relatively stable and enduring over time and across contexts. Thus, we suggest that alongside the particular contribution context that is considered, personal values constitute a second predictor of individuals' motivations to contribute.

3.1. Schwartz's theory of human values

Schwartz (1992) describes 10 distinct motivational goals that are each expressed as a value type: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity and security. His theory of personal values also explicates a structural aspect of values, namely, the dynamic relations among them. Actions in pursuit of any value have psychological, practical, and social consequences that may conflict or be congruent with the pursuit of other values. The total pattern of relations of conflict and compatibility among values yields the structure represented in Fig. 2, validated across over 70 cultural groups (e.g., Schwartz, 1992, 1995). Competing value types emanate in opposing directions from the center; complementary types are in close proximity.

As can be seen in Fig. 2, the values circumplex is based on two broader value dimensions. The first involves the contrast between self-enhancement, which includes power
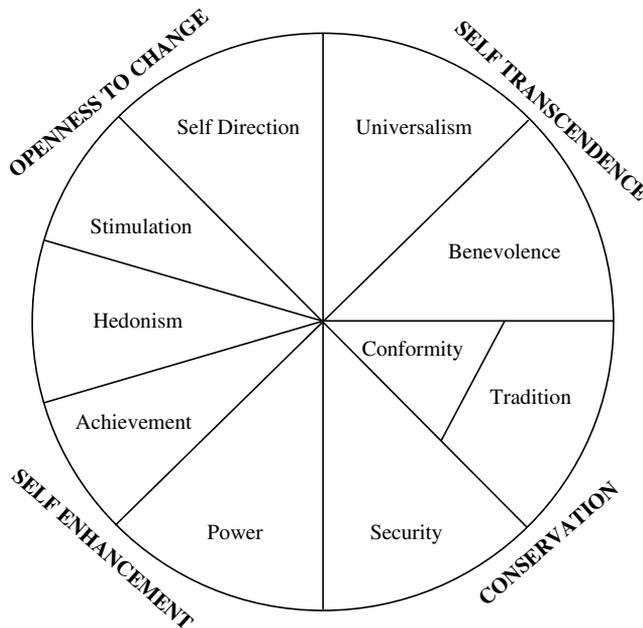
Fig. 2. Theoretical model of Schwartz's ten value types (adapted from Schwartz, 1992).

and achievement values, and self-transcendence, which includes the values of universalism and benevolence. This contrast describes the tension between individuals' emphasis on the pursuit of one's own interests versus an emphasis on the welfare of others. The second contrast is between openness values, comprising the values of self-direction and stimulation, and conservation, comprising the values of security, tradition and conformity. Whereas openness values represent an emphasis on change, on the pursuit of new ideas, and on free and autonomous thinking, conservation values prescribe the status quo, the avoidance of threat and the abidance to rules and norms.

Schwartz's theory has been used to explain systematic relationship patterns between value priorities and a variety of attitudes, beliefs and behaviors, such as consumer purchases (Puohiniemi, 1995), environmental behavior (e.g., Bianchi & Rosova, 1992; Grunert & Juhl, 1995), voting behavior (Barnea & Schwartz, 1998), sexual behavior (Goodwin et al., 2002) and day-to-day behaviors across a variety of domains (e.g., Bardi & Schwartz, 2003). For the present context, we employ the theory to explain individuals' motivations for contributing to the open source phenomena. We suggest that individuals' value systems are associated with the types of reasons that people have for contributing and that different values are responsible for different motivation categories. We establish these proposed links next.

3.2. Values and motivations for contributing

An examination of Schwartz's (1992) definitions suggests a number of straightforward connections between values and each of the open source contribution motivations described above, i.e. the desire to gain approval and to establish one's reputation and abilities, the desire for self-development and the enhancement of one's skills, and the altruistic desire to contribute to the benefit and welfare of others.

The *achievement* value involves an emphasis on "personal success through demonstrating competence according to social standards. [These values] emphasize demonstrating competence in terms of prevailing cultural standards, thereby obtaining social approval. This differs from [others'] definitions of achievement motivation to meet internal standards of excellence" (Schwartz, 1992, p. 8). We would therefore expect individuals who set a high priority to achievement values to use the open source context as an opportunity to gain social approval by establishing their reputation.

Hypothesis 4. There will be a positive correlation between achievement values and the reputation-building motivation for contributing.

The value of *self-direction* involves an emphasis on making one's own choices, and on learning, creating and exploring. People who identify with this value tend to appreciate creativity, freedom and opportunities for self-enhancement. Self-direction values have been shown to guide individuals' attention and action towards intrinsically rewarding intellectual opportunities (Van Dijk & Kluger, 2004). Because of the meaningful opportunity that the open source context provides for individuals to extend and hone their skills, we would expect a positive relationship between the priority that individuals' place on self-direction values and the extent to which self-development constitutes a motivation for their contribution to open source software and content.

Hypothesis 5. There will be a positive correlation between self-direction values and the self-development motivation for contributing.

Two other values appear to be related to the motivations for contributing in the open source context, both of which would appear to correspond with the altruistic motivation for contributing. Benevolence values focus on the concern for the welfare of close others in everyday interaction. According to Schwartz (1992) this value stems from the need "to promote the flourishing of groups" (p. 11). Similarly, universalism values also highlight a concern for others, yet in a somewhat broader sense. Universalism focuses on a concern for the welfare of all people, and not specifically one's immediate environment. Universalism is said to derive from the survival needs of groups and individuals in the context of resource scarcity. For the open source context we can expect both benevolence and universalism to be associated with individuals' altruistic motivations for contributing.

Hypothesis 6a. There will be a positive correlation between benevolence values and the altruistic motivation for contributing.

Hypothesis 6b. There will be a positive correlation between universalism values and the altruistic motivation for contributing.

Considering the circumplex structure of Schwartz's value system, one could expect that values adjacent to those highlighted above would yield similar, yet weaker, patterns of relationships with contribution motivations. However, in our formulations we specifically focus on those values that are conceptually most closely and directly related to the three contribution motivations. We therefore restrict our formulations and analyses to the four values included in our hypotheses.

In line with the interactionist perspective, our two sets of hypotheses (i.e., 1–3 and 4–6) pertain to the two categories of antecedents: Hypotheses 1–3 pertain to the impact of the situation on contribution motivations, and Hypotheses 4–6 focus on the person-factor that explains individual differences in contribution motivations. To follow through with the spirit of the interacionist model, the next step would be to simultaneously test the impact of the situation and of personality. Such a simultaneous test is important because the situation and personality factors in our study are not necessarily independent of one another. Indeed, one of the factors that may lead individuals to take part in "software" and "content" initiatives may be their values. Therefore, contrary to our formulations, a confirmation of Hypotheses 1–3 could be merely indicative of software and content participants holding different values. However, such an alternative explanation would be refuted if the significant effects for the context variable would remain after controlling for values.

Furthermore, while the relationships we expect between values and motivations should hold for both the software and content contexts, this is not to say that the magnitude of effects would necessarily be the same across the two contexts. In other words, context and values may interact in their effect such that contexts moderates the relationship between values and motivations. Considering the lack of previous research on the antecedents of contribution motivations we do not formulate hypotheses, but rather adopt an exploratory approach to testing possible interaction effects.

4. Method

4.1. Participants and procedure

Data for the present study were collected from two samples of participants. The first consisted of participants in open source software development projects, available on sourceforge.net. Sourceforge is an online database of open source software projects. Users and potential contributors can access information about the projects and download current versions of the software being developed. It is one of the largest hosts of free software and open source projects (O'Mahony, 2003).

The Sourceforge site includes projects at varying stages of development. Projects in early stages do not typically include source code and therefore do not involve the primary and typical contributors that we aimed to study in this context. We therefore excluded members of these projects from our sampling frame and, in line with previous work (e.g., Lakhani & Wolf, 2005), randomly selected projects from the remaining, more developed, projects. Twenty eight projects were sampled, and the 1037 contributors listed in association with these projects were contacted via email. The actual pool of these projects' contributors, however, may have been smaller because some of the contributors listed may have no longer been actively involved in the project.

A total of 185 participants filled out the study questionnaire, consistent with the relatively low response rates typical of web-based, electronically distributed, questionnaires (e.g., Couper, 2000). Respondents' mean age was 31.6 (SD = 8.1), and 97.8% were male. These demographics are highly comparable to those found by Hertel et al. (2003), and by Lakhani and Wolf (2005), where the mean ages were 30.0 and 29.8, and the percentages of male respondents were 91.5% and 97.5%, respectively. Participants reported a variety of occupations ranging from software engineers to veterinarians. As would be expected, and in line with previous work (Lakhani & Wolf, 2005), the large majority of participants comprised people working in the information technology industry, such as engineers, computer programmers, and system administrators.

Our second sample consisted of Wikipedia contributors who were contacted directly through the Wikipedia site. The English Wikipedia *Alphabetical list of Wikipedians* lists 2847 contributors.[3] Of these, a random sample of 354 Wikipedians were emailed a request to participate in a web-based survey. One hundred and fifteen individuals responded to the request and filled out the study questionnaires. Ten respondents were female (8.7%) and the mean age was 31.8 (SD = 12.0). These demographics are highly comparable to those found by Nov (2007), with 8.3% female respondents and a mean age of 30.9 (SD = 11.4). As would be expected from the context of this contribution, a large variety of occupations was reported in this sample. Common occupations reported were of computer scientists, academic researchers, and graduate students.

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[3] The contributors listed are only those who, in addition to creating content, have also created a personal-user page. There are likely many others who contribute to Wikipedia, yet these are not systematically listed and we therefore excluded them from our sampling frame.

4.2. Measures

Values were measured using the Portrait Values Questionnaire (PVQ, Schwartz et al., 2001). The PVQ includes 40 short verbal portraits of different individuals. Different portraits highlight different values by describing a person's goal or aspiration. Example items for the four values upon which we focused in the present study are: "It's very important to him to show his abilities. He wants people to admire what he does"[4] (achievement), "Thinking up new ideas and being creative is important to him. He likes to do things in his own original way" (self-direction), "It's very important to him to help the people around him. He wants to care for their well-being" (benevolence), and "He believes that people throughout the world should live in harmony. Promoting peace among all groups in the world is important to him" (universalism). The scale has been administered across a large variety of samples and countries and is considered a reliable and valid measure of personal values (Schwartz, 2005).

For each portrait, respondents are requested to indicate the extent to which they consider the target person similar to themselves by selecting one of six response options ranging from "not at all like me" (1) to "very much like me" (6). Self-direction, achievement, and benevolence were measured with four items each; universalism was measured with six items. The Alpha coefficients for the four values were 0.81 (achievement), 0.63 (self-direction), 0.71 (benevolence) and 0.79 (universalism). With the exception of self-direction, for which the reliability is slightly lower than the desired 0.7 convention, all reliabilities were satisfactory. The sub-optimal alpha for self-direction corresponds with the fact that values are typically reported as having lower reliability coefficients in comparison with other psychological constructs such as traits (e.g., Schwartz et al., 2001).

Contribution motivations were measured with a 9-item scale developed for the present study. Three items were composed for each of the three contribution motivations (see Appendix). A confirmatory factor analysis (CFA) on data from both samples ($N = 300$) supported the scale's three-factor structure: all items loaded significantly ($p < 0.01$) on their expected factors and the model's overall fit was satisfactory (Comparative Fit Index: 0.97; Tucker-Lewis Index: 0.94). An alternative one-factor model presented much poorer fit (Comparative Fit Index: 0.63; Tucker-Lewis Index: 0.42). For each item, respondents were asked to rate the extent to which the item constituted a factor in their decision to contribute. Response options ranged from "not at all a factor" (1) to "a key factor" (6). Scale reliability coefficients (Alpha) for reputation-building, self-development, and altruism were 0.79, 0.82 and 0.72, respectively.

5. Results

Means and standard deviations of the study variables for the software and content samples are presented in Table 1. Table 2 presents means, standard deviations and correlations among the study variables for the combined sample. As Table 1 indicates, in describing their reasons for contributing, individuals in the software context give the highest rating to the self-development motive, followed by the altruistic motive and lastly the reputation-building motivation. Those in the content context give the highest rating to their

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[4] Separate versions of the questionnaire are administered to men and to women.

Table 1
Descriptive statistics for variables in the software and content samples

Variable	Software sample ($N = 185$)		Content sample ($N = 115$)	
	Mean	SD	Mean	SD
Values				
Achievement	3.90	1.02	3.73	0.94
Self-direction	5.05	0.70	5.00	0.59
Benevolence	4.32	0.85	4.32	0.78
Universalism	4.29	0.88	4.44	0.81
Motivations				
Reputation-building	3.73	1.35	3.23	1.37
Self-development	4.69	1.12	4.32	1.14
Altruism	4.36	1.04	4.83	1.01

Table 2
Descriptive statistics and correlations for study variables – combined sample ($N = 300$)

Variable	Mean	SD	1	2	3	4	5	6	7
Values[a]									
1. Achievement	3.84	.99	(0.81)						
2. Self-direction	5.03	0.66	0.05	(0.63)					
3. Benevolence	4.32	0.82	−0.26**	−0.08	(0.71)				
4. Universalism	4.35	0.86	−0.43**	−0.08	0.23**	(0.79)			
Motivations									
5. Reputation-building	3.54	1.38	0.39**	0.09	−0.07	−0.16**	(0.79)		
6. Self-development	4.55	1.14	0.00	0.14*	0.023	−0.07	0.32**	(0.82)	
7. Altruism	4.54	1.05	−0.16**	0.06	0.20**	0.31**	0.22**	16**	(0.72)

Numbers in parentheses represent scale reliability coefficients.

[a] Correlations with values are corrected for base rates.

* $p < 0.05$.

altruistic motivations, and only then come the self-development and reputation-building motivations. Paired-sampled *t*-tests indicated that, in both samples, the differences in motivation ratings were significant.[5]

An analysis of variance (ANOVA) revealed no significant differences in mean scores for any of the value variables across the two samples. We therefore combined the data from the two samples before running further analyses. Hypotheses 1–3 were tested with three ANOVAs where the independent variable was the open source context (software versus content) and the dependent variables were the three contribution motivations. As hypothesized, differences in mean scores were significant for all three motivations, such that participants in the software context tended to be higher on the reputation-building ($F[1,293] = 9.20$, $p < 0.01$) and self-development ($F[1,295] = 7.62, p < 0.01$) motivations, whereas participants in the content context tended to be higher in the altruistic motivation ($F[1,296] = 14.71$,

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[5] In the software sample, between self-development and altruism ($t[182] = 3.06$, $p < 0.01$), and between altruism and reputation-building ($t[182] = 5.72$, $p < 0.001$); and in the content sample between altruism and self-development ($t[113] = 4.23$, $p < 0.001$), and between self-development and reputation-building ($t[113] = 8.00$, $p < 0.001$).

$p < 0.001$). ANCOVAs, where in addition to context respondents' gender and age were included as controls, yielded equivalent results and did not alter significance levels.

Hypotheses 4–6 were tested through multiple regression analyses, where personal values were included as the independent variables, and in each analysis a different motivation was included as the dependent variable. According to Schwartz (1992), what is important in the value measure is the relative standing of each value within the individual, rather than its ranking across individuals. We therefore followed Schwartz's guidelines and included respondents' mean response to the entire value scale as a control variable in the analyses. As hypothesized, achievement values were significantly related to reputation-building motivations ($\beta = 0.46$, $p < 0.001$); self-direction values were significantly related to self-development motivations ($\beta = 0.16$, $p < 0.05$); and both benevolence ($\beta = 0.19$, $p < 0.01$) and universalism ($\beta = 0.31$, $p < 0.001$) values were significantly related to altruistic motivations. None of the relationships that were not hypothesized between values and motivations were statistically significant. Separate analyses in each of the two samples (i.e., software and content), as well as the inclusion of gender and age as controls, did not alter these findings.

To simultaneously test the impact of context and values we ran three additional regression analyses (one for each contribution motivation), this time including both context and values as independent variables. Results of these analyses are presented in Table 3. As can be seen, all of the effects found in testing Hypotheses 1–6 were maintained: context yielded a significant negative effect on reputation-building motivations and on self-development, and a significant positive effect on altruistic motivations. In addition, achievement values were significantly related to reputation-building motivations; self-direction values were significantly related to self-development motivations; and both benevolence and universalism were significantly related to altruistic motivations.

Finally, to test for the possibility of interaction effects we used Aiken and West's (1991) procedures for testing moderation. We ran three additional regression analyses, this time including as independent variables the centered context and values variables and their products. In all three analyses, none of the interaction effects were significant, while all of the expected main effects remained significant.

6. Discussion

The present study sought to extend current knowledge about individuals' motivations for contributing to open-source projects. We go beyond a description of contributors'

Table 3
Results of multiple regression analyses including both context and values as predictors

Predictor	Dependent variable								
	Reputation-building			Self-development			Altruism		
	B	SE B	β	B	SE B	β	B	SE B	β
Context[a]	−0.37	0.15	−0.13[*]	−0.32	0.13	−0.14[*]	0.44	0.11	0.20[**]
Achievement	0.63	0.10	0.45[**]	−0.05	0.08	−0.04	0.01	0.07	0.01
Self-direction	0.17	0.13	0.08	0.27	0.11	0.15[*]	0.19	0.10	0.11
Benevolence	0.07	0.12	0.04	0.08	0.11	0.06	0.25	0.09	0.19[**]
Universalism	0.04	0.12	0.02	0.11	0.10	0.08	0.36	0.09	0.29[**]

[a] Context coding: 1 = Software, 2 = Content.
[*] $p < 0.05$.
[**] $p < 0.01$.

motivations, first, by highlighting differences in the relative weight of these motivations across two distinct open-source contexts. In line with our hypotheses, individuals in the open source software sample rated the self-development and reputation-building motivations higher than open source content contributors' ratings of these motivations. Contrarily, individuals in the content sample gave higher ratings to altruistic motivations.

Furthermore, the present work extends previous research on open source contribution motivations by exploring some of the more deeply-embedded motivational sources of people's contributions. As expected, the motivation to build up one's reputation as an open-source expert was associated with individuals' dispositional emphasis on achievement as a guiding principle in their lives; the motivation to enhance their skills was associated with their personal emphasis on growth, autonomy and free thinking; and the motivation to assist their open-source community appears to be driven by a high value that contributors place on promoting the welfare of their close and distant others. These relationships were found within both the software and content contribution contexts.

Contrary to previous research on contributor motivation, which has tended to view the open source model as a uniform phenomenon, our findings offer a more complex view that emphasizes the unique nature of particular open source contexts. Beyond the characteristics shared by the software and content models, our study highlights meaningful, psychologically-relevant, differences. Additionally, our findings provide information on the personal characteristics of those who contribute.

Although reputation-gaining was, as hypothesized, stronger in the software context than in the content context, it was nevertheless unexpectedly the weakest motivation of the three, in both contexts. Given contributors' requirement to establish and make their expertise public, we expected reputation-gaining to be among the stronger, rather than weaker, motivations for this context. One possible reason for its low rating, compared with altruism, may be the effect of social desirability (see Crowne & Marlowe, 1960) on participants' responses to the questionnaires. Whereas altruistic motivations are highly valued in society, a tendency to flaunt one's abilities is not. Respondents may have thus been prone to a bias in their responses to these questions. Nevertheless, this bias becomes irrelevant when comparing motivations across the two contexts because individuals in both contexts are just as inclined to provide socially desirable responses. Such a bias, were it to exist, should also not influence the relationships found between values and motivations, because it should have a similar effect on both predictor and criterion. Therefore, while such a bias could explain differences in the mean response to each of the motivation types, is does not offer a likely alternative explanation of our main findings.

A number of limitations in the study should be acknowledged. First, as in most studies of open source contributors, because of the nature of our sampling design we lack information on the extent to which each of our samples represents its context (software or content) population. Although the demographics of our samples closely correspond with those in previous studies of open source software and content projects, this provides only a limited assurance. Nevertheless, the fact that the differences found between contexts are in line with our theoretical formulations, provides yet additional confidence in the validity of our findings. We cannot identify any systematic sampling bias that could explain the particular differences we have found.

Second, we focused in this study on only three, out of a relatively broad range, of relevant motivations. Our study constitutes a first step in highlighting the importance

of context and dispositions for understanding contribution motivations, and future work should consider expanding the range of motivations under investigation. That said, we did not choose a merely random subset of motivations. Our choice of motivations corresponds with the key distinction between intrinsic and extrinsic motivations, which differentiates among motivations on the basis of their degree of instrumentality. By choosing reputation-building, self-direction, and altruism, we included central motivations, with a broad range of instrumentalities.

6.1. Implications

Understanding the differences in motivations across contexts, and their relationship to contributors' values, can help software and content projects that rely on volunteers to more effectively utilize the open source model. Our findings provide several insights into the different types of incentives that can be tapped in different contexts: in the case of open source software, organizations or project leaders who rely on volunteering contributors may want to highlight aspects of learning and recognition as experts, whereas in content-based projects, leaders may want to highlight aspects of reciprocity and altruism, such as the benefit to the community. To illustrate this, suppose that two projects are being created: a new open source software development initiative and a new open-source online content repository. In the former, it may make sense to focus the efforts of recruiting and retaining contributors on highlighting the opportunity for contributors to build software development expertise and receive feedback from experts in the field. In the latter case it may be more prudent for leaders to highlight the opportunities for helping others who can make use of the contributors' knowledge. Furthermore, knowledge of the personal values that underlie contributors' motivations offers a deeper and more complete understanding of contributors' goals and preferences. Taken together, the link between personal values, context and motivations could help leaders of open source projects to recruit, select and cultivate individuals with a high potential to fit their project.

Appendix. The contribution motivations scale

Reputation-building
1. I like to be recognized for my abilities.
2. I enjoy the fact that others consider me an expert in this field.
3. It helps me build up my reputation as an expert.

Self-development
4. It provides me with a means of developing my skills.
5. It gives me an opportunity to learn new things.
6. It enables me to become more proficient and enhance my expertise.

Altruism
7. I enjoy helping others if I can.
8. I think this is a great opportunity to help the community.
9. I want to contribute my share to free access to information.

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