Motivation as a Supplementary Requirement

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Motivation is a well established topic in psychology and other disciplines such as business management, education, and health care. Despite the differences in defining motivation, see [4], motivation is widely seen as the"psychological processes that cause the arousal, direction, and persistence of behaviour" [6]. A motive can be described as the substance that can increase the will of a person to perform a particular behaviour. Motivation is a requirement per se and can also supplement other functional and non-functional requirements such as increasing productivity and the social and mental well-being within workplaces [7]. A correct engineering of motivational mechanisms could eliminate non-productive behaviours and improve group work [1, 3].

Psychologists have proposed different models and theories to understand and improve motivation in people. Well-known examples include the Maslow's hierarchy of needs [5] and Herzberg's two-factor theory [2]. Maslow's hierarchy specifies levels of needs that should be satisfied to keep one happy. Herzberg categorised influential factors in two groups: *motivators* and *hygiene factors*. Presence of motivators (e.g. social recognition) can increase motivation in employees and give positive satisfaction; whereas hygiene factors (e.g. job security) will not lead to motivation, even though a lack of them decreases motivation.

In the field of requirements engineering, systems are generally seen as socio-technical systems (STS) consisting of various inter-dependent social and technical actors. It is important to keep the social actors motivated to play their roles and achieve the requirements allocated to them and enhance their efficiency and also work experience. Such motivation could be also facilitated via software. Gamification is a term which generally denotes software-based motivation solutions. While motivation involves a wide range of physical and psychological needs, software-based motivation is mostly able to aid in fulfilling a subset of psychological needs. From the perspective of Maslow's hierarchy and Herzberg's two-factor theory, software-based solutions create environments that can influence motivator factors and affect hygiene factors. For instance, providing a leader-board can fulfil one's need for social recognition, which is a *motivator*.

We advocate that two macro types of information should be captured when applying motivation in an STS. The first relates to the motive being designed, i.e. a rewarding system. This includes descriptors of rewards, the means to achieve them, the data being collected and how they are stored to enable, amongst other things, inferring those rewards. The second relates to the STS itself. This includes the task to which motivation is being applied, the roles of the users involved in the reward, and the management style.

We also argue that the ad-hoc application of software-based motivation techniques could have negative effects such as isolation, clustering and stress and result in harms to the business goals and communication between constituent of an STS. Hence, introducing software-based motivation requires a carefully planned engineering process. We also illustrated compatibility issues amongst working environment types, nature of rewards, and personality traits. Our argument is supported by our initial results in [7].

Example. In a business environment, new staff members usually go through training sessions. These sessions are collaborative by nature. In order to evaluate the progress of new staff, quizzes may be held and top scores are displayed in a leader-board. While this may seem fine, our findings suggest that adding competitive motive, the leader-board, to a collaborative task can increase tension and put pressure on new staff members and hinder the core training requirements.

Finally, we advocate the need to model motivation and its inter-relations with the other requirements of an STS so that we can reason about properties such as the alignment between the rewarding system and business requirements. We plan to start with mainstream modelling languages for requirements of such systems, e.g., goal models and business process models, and augment them with a motivational layer. Such a systematic modelling of motivation as a separate concern can aid developers to better manage and understand the possible impacts of introducing software-based motivation. Our systematic approach will be supported by a recommender system that will enable identification of proper motives in a given environment to better achieve requirements and, also, to predict the side effects of adding certain motives. The approach and the recommender will also allow learning and adaptation to cater for changes in the business and people's perceptions of the reward and motivation techniques over time.

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