A Novel Risk-based Approach for Online Community Management

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***Abstract*—Online communities play a pivotal role in innovation, marketing, corporate expertise management, product support and advertising. Communities in the order of millions of users are becoming the norm. However, this proliferation of demand is not met with intelligent, scalable, easy to use community management approaches. Current methods are based on basic statistical tools that aggregate data for the community owner/moderator to interpret and take appropriate actions. The data reflects only the current state of the community, which does not constitute an effective warning system of future events. Moreover, the community health becomes highly dependent on the owner's skill, interpretation, intimate knowledge of the community and its evolution path. This paper presents a proactive, extensible, risk-based management framework supporting advanced analytical services for managing online communities. The solution allows community owners to focus on the community objectives and proactively manage favourable/unfavourable events at the user and community level.**

***Index Terms*—Risk management; online communities; risks and opportunities; modelling; simulation; prediction.**

I. INTRODUCTION

Online communities generate major economic value and form pivotal parts of corporate expertise management, facilitating knowledge dissemination and communication as well as boosting performance and innovation [1], [2]. Research by McKinsey [3] shows that companies see a number of benefits in using collaborative technologies not only within their organisational boundaries but also for the purpose of reaching out to their customers, partners and suppliers. These advantages include faster access to knowledge and experts; increased customer and employee satisfaction; and a reduction of communication time and travel costs.

These findings are confirmed by further analysis by Deloitte and Frost & Sullivan [4], [5], [6], examining how social collaboration technologies impact business performance. Their research have shown that organisations who decide to deploy social networking tools within their organisational boundaries have much greater chance to improve their performance, attract customers, and establish profitable and long-term relations with them. Whilst there is a clear gain provided by such infrastructures, the management and preservation of their efficient operation is not trivial [7]. Communities can exceed millions of users and infrastructures must support hundreds of millions discussion threads that link together billions of posts. Current management solutions fail to meet current challenges of scale and growth, let alone the support for understanding and managing the business, social and economic objectives of the users and the host [1], [2], [8].

Current solutions usually consist of a dashboard for monitoring a set of Key Performance Indicators (KPIs, e.g., page views, number of posts, average time for responding/closing users' queries) judged relevant for the users' and the community's quality of service and experience. These KPIs present the state of the community at a certain point in time, current or past, but offer little to support what managers really need to effectively manage risks in the community; an insight onto the future state of the community. Community managers can be proactive if they have knowledge such as the likelihood that an expert's activity will drop within the next month and the impact on the community if this happens, the likelihood that they will miss their performance target of solving any query within 3 days, or the likelihood that negative sentiment will be developed on a certain topic. This information about the future state of the community is not provided by current management approaches. A successful community requires that the manager be empowered with new tools to break out of the current reactive framework by predicting the community future trends and the impact of any intervention across the community landscape as well as decide whether this is in line with the set of community objectives.

ROBUST [9] is an EC FP7-ICT project targeting an integrated, coherent view of the community dynamics in relation to the community objectives, offering a consistent, proactive approach to the management of the community. ROBUST is addressing the next generation of community management where the focus is not limited to managing failures but to manage risks and opportunities [7], [10], [11]. This paper presents the risk management work done in the ROBUST project, focusing on the risk management process applied to online communities and the architectural design of the proposed framework developed.

In Section II, we review the existing approaches for community management and their limitations. Section III present the risk management context from risk management standards perspective. Section IV details the risk specification work being done in the ROBUST project in the context of online communities. In Section V we present the risk management framework architecture. The conclusions and future work are

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addressed in Section VI.

II. Managing Online Communities

Whilst the overall trend in adopting social technologies is positive, recent stories of BASF [12] and Alcatel-Lucent [13], who successfully deployed social networking technologies within their organisational boundaries, confirm that the benefits of these tools come at a cost. First, transforming the company into a social, collaborative network of employees, customers and partners is a disruptive step that breaks down traditional, hierarchical business models upon which a company relied (possibly from its inception). Second, the key to the successful transformation is not the technology itself (e.g., deploying wikis, social portals, messaging tools) but the understanding how this technology can be applied by people to achieve company-level goals (such as fast access to knowledge and experts, collaborative problem solving and cut in communication cost). This, in turn, not only requires clear understanding of the goals that such social systems need to fulfil, but more importantly, involves the continuous monitoring and steering of such systems to make sure they continue to satisfy company-level objectives.

This goes beyond the capabilities of information system management solutions [7] because of two main reasons: networked communities do not simply consist of machines and software, but are also communities of people and human behaviours; additionally, social software creates networked social environments in which individuals self-select whether and how they participate. The challenge in this ecosystem is to understand and manage the bidirectional relations governing how interactions between community members influence the overall community dynamics and impact its health and performance.

Given that online communities (and social media in general) is a relatively new phenomenon that emerged on a large scale a couple of years ago, we are just beginning to understand that the maintenance of such complex information ecosystems requires active management effort realised by highly skilled experts that take on the role of community managers. Unfortunately, for many first-time social media 'integration' efforts the official community management staff is often non-existent or represented by a few non-dedicated volunteers [14]. Tom Humbarger (Marketing and Social Media Strategy manager at AppleOne) is one of the few people who has done an analysis of community activity with and without a community manager. His observations [15] show that in the absence of community management, the activity (whilst not immediately terminal) slows significantly in a fairly short amount of time. The industry's reaction focused on the human aspect by allocating more community staff. For example, in the case of BASF, the active management has led to the involvement of a number of full-time community managers and part time involvement of staff (for governance) and solution stakeholders/owners. In addition, BASF utilises the power of numerous advocates who volunteer time to spread awareness and best practices across the company, as well as users who build and help facilitate communities of practice.

As social media adoption continues and thousands of online communities emerge, the role of community management matures and is perceived not only as a risk mitigator but also as a way to ensure that participation takes place, ROI is measured and business goals are being met [7], [10], [11]. Sophisticated data mining tools for sentiment and topic analysis are becoming essential in the monitoring platforms in order to provide more insights about the community [16], [17], [18]. However, these tools did not change the management methodology that is centered around monitoring the current state of the community, for instance, by looking at the daily growth rate of new members, calculating churn rates, identifying topics and sentiments, etc. Whilst this approach provides valuable information about the community's current or past state, it offers little support to the community manager in their endeavour to analyse the monitoring information and infer conclusions about the community's future. For example, it is hard for the community manager to predict the likelihood of a user developing negative sentiments or quantify the impact on the community caused by loss of key community members or a decrease in their activity. As a consequence, the correct choice of management actions is a mere trial and error process.

To address these limitations, this paper presents a novel risk-based approach for online community management in which decisions of community manager are supported by a suite of automated tools that constitute a community management platform. The goal of such a platform is not only to assist in the performance of tedious and time consuming routine tasks, such as monitoring of the current community state but, more importantly, to support pro-active community management involving the detection of risks and opportunities that may happen within the community in the near future. The key concepts behind the proposed solution along with its design architecture are presented in the remainder of this paper.

III. Risk Management

Many risk management methodologies can be found in the literature ranging from the generic [19] to the domain-specific [20] . The aim of this section is to shed light on the definitions of risk and risk management viewed by some of the highly acclaimed standards rather than offer an exhaustive list of them.

Management of Risk (M_o_R) [21] is a methodology published by the OGC (Office of Government Commerce). It defines risk as *"an uncertain event or set of events that, should it occur, will have an effect on the achievement of objectives. A risk is measured by a combination of the probability of a perceived threat or opportunity occurring and the magnitude of its impact on objectives"*. M_o_R considers threats to be the events with negative impact whereas opportunities are interpreted to have a positive impact.

The Risk Management standard [22] adopted by FERMA defines risk as *"the combination of the probability of an event and its consequences"*. It also notes the potential for events

and consequences that constitute opportunities for benefit (upside) or threats to success (downside).

ISO 31000 "Risk Management Principles and Guidelines" [19] defines risk as the *"effect of uncertainty on objectives ... An effect is a deviation from the expected — positive or negative"*. This definition agrees with the above descriptions on the uncertainty element of risk and its positive/negative relation to the objectives. However this controversial definition defines the risk as the impact (effect) of the uncertain event. ISO 31000 still refers to the traditional view of the risk being *"characterized by reference to potential events and consequences, or a combination of these"*. This ISO standard also indicates that *"risk is often expressed in terms of a combination of the consequences of an event and the associated likelihood of occurrence"*.

In ROBUST we specify a 'risk' in terms of an uncertain event (or set of events), which, if it occurs, affects the objectives of the community owner negatively; we reserve the 'opportunity' term for events that affect the objectives positively. It is possible for an event to affect multiple objectives negatively and positively at the same time. The boundary between risk and opportunity can get blurry, however, we argue that the community owner's decision on how to deal with the event ultimately classifies it as a risk or opportunity. This can be based on an implicit or explicit hierarchy of prioritised objectives.

The above standards have similar definitions of risk management being mainly the set of activities systematically applied to direct and control an organisation with regard to risk (identification, assessment and treatment). Risk management process, according to ISO 31000, consists of phases establishing the context, risk assessment (identification, analysis, and evaluation), risk treatment, communication and consultation, and monitoring and review - see Fig. 1.

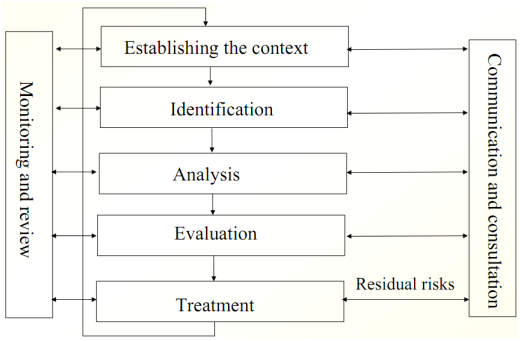

Figure 1. ISO 31000 risk management process

In the first phase, the context is specified, including the objectives and scope of the analysed system (online community in this case). Risk identification deals with the identification and specification of the risks and their attributes (e.g., events as well as their causes and potential consequences). Risk analysis involves developing a detailed understanding of the risk and determining the likelihood and consequences (i.e., level of risk) . A risk evaluation process classifies the risks according to acceptable risk criteria in order to make decisions about which risks need treatment and the priority for treatment implementation. The treatment options could be to avoid the activity that gives rise to the risk, modifying the risk likelihood or consequence (enforcing countermeasures), retaining/accepting the risk or sharing it with another party. ISO 31000 does not distinguish treatment actions for a risk from those of an opportunity. However, M_o_R offers more specific options shown in Table I, below:

Table I
RISK AND OPPORTUNITY RESPONSES

Risk response	Opportunity response
Avoid	Exploit (ensure that event occurs and impact realised)
Reduce (likelihood or impact) Fallback (reduce impact) Transfer to 3rd party (e.g., insurance)	Enhance (likelihood or impact)
Share	
Accept	Reject (no action)

The ROBUST framework supports an organisation's risk and opportunity management activities by providing tools that assist in risk identification, expression, analysis, evaluation and decision making in the treatment process. The tools do not mandate the adoption of any specific risk management process. The details of the framework are presented in the following sections focusing on how ROBUST addresses each of these phases.

IV. ONLINE COMMUNITY RISK SPECIFICATION

A. Risk Components

As per the definitions in Section III, risks and opportunities are defined within the context of the organisation and its objectives. These objectives may be strategic, tactical or operational. The scope can be the whole organisation, a department or a sub-system such as the online community. The online community can have its own objectives (e.g., knowledge transfer between users, improved quality of experience, increase the number of community members) or inherit the organisations objectives (e.g., reduce operational costs).

The objectives can then be used in order to identify the uncertain events that may affect them positively or negatively. The objectives can be viewed as the scope for the process of identification of risks and opportunities. An event is the (one or more) occurrences or non-occurrences of a change of a particular set of circumstances. An event can lead to a range of (certain or uncertain) impacts on objectives. The impact level or severity may not be static and may vary according to different factors (time, life-cycle phase, community features, etc.). An impact scale is usually produced in order to quantify the risk impact (e.g., high, medium, low). The scale should be specified in terms of impact criteria in line with the

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objectives (e.g., in terms of activity level drop, content quality deterioration or financial loss).

B. Event Specification

In ROBUST we classify risk/opportunity events based on their source being either internal or external. The external events are those that originate from external actors whom are not part of the community. Examples of external events include the introduction of new legislation affecting the online community or the launch of a competitor's community leading to the churn of users.

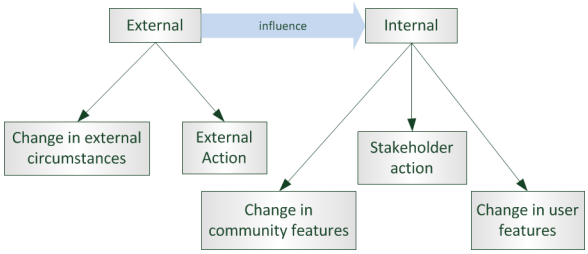

Figure 2. Event categories

The internal event category comprises those events that originate from within the community, such as a modification of its structure or a change of an individual user's attributes (see Fig. 2). The events can be deliberate, accidental or the result of the normal evolution of the community. The internal events can be decomposed into three categories:

1) Community features: This includes any changes related to the community attributes like content, structure, users, performance, etc (e.g., drop in community members or new joiners)
2) User features: This includes any changes related to the user attributes including role, connections, position (e.g., change of role, network centrality or activity level)
3) Stakeholder(s) actions: this includes deliberate or accidental actions performed by the community managers or users (e.g., delete or block user, user flaming others)

Note that the three events categories are inter-dependent since actions by stakeholders influence community features as well as user features. The same applies to the external events that can influence the internal changes. Moreover, within the same category e.g., community features category, changes in the number of community users may influence the community activity level. In ROBUST, we focus on the internal events mined from community data logs that contains users' activities time series. Given the event definitions we have established, events can then be formulated as: Variable(s) attaining a certain value (i.e., threshold if numeric) or Variable(s) changing from one value to another (i.e., states).

An example of the former is 'the drop in community members exceeding 50%', and for the latter, 'a user X changing their role in the community from *contributor* to *lurker*'. Although these are examples of risks formed by a single event, there can also be compositions of multiple variables to produce more complex events. For instance the community owner may be interested in the joint event of an "expert user change of role from contributor to lurker" and "increase in community new joiners" in order to anticipate the load.

With risks/opportunities specified in such a measurable manner, it is possible to automatically perform monitoring and assessment in order to compute the likelihood of the events, analyse them and later decide on a treatment strategy. In the following Section, we introduce the ROBUST Risk Management Framework and how it supports the risk management cycle.

V. The ROBUST Risk Management Framework Implementation

The risk management framework that is presented here takes a central role in a platform that is produced in the ROBUST project. It is designed to be flexible, extensible and to allow the integration of new modules to address a multitude of risks and opportunities in different communities. An overview of the framework is given in Section V-A, followed by sections describing how the framework can be used in the risk management process discussed in Section III for managing online communities. For this, a examples based on the SAP Community Network will be given [23].

A. Overview

An overview of the main components in the framework is given below in Fig. 3, comprising three layers: *presentation*, *core* and *support* layers.

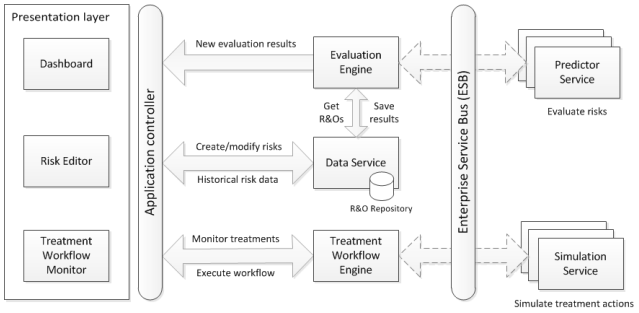

Figure 3. Risk management framework components

The *presentation* layer mainly includes the interfaces available to the community manager to interact with the system capabilities. It consists of a Risk Editor, a Dashboard that incorporates the results of the risk analysis and visualisation tools, and treatment workflow monitor to manage the management response to risks and opportunities.

The *core* layer consists of a Risk Registry, a Workflow Engine that enacts the treatment workflows and an Evaluation Engine that orchestrates support layer services in order to evaluate the risk and opportunity events.

In the *support* layer, different services may be made available that can perform analytical tasks. We distinguish between two types of services:

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- Predictor Service: provides event prediction capabilities based on the community data (could be done via batch processing of historical data or real-time stream processing).
- Simulation Service: allows simulating the community evolution under a variety of "what if" scenarios and, thus, enabling the assessment of the impact of the different events and actions.

As illustrated in Fig. 3, above, the support services are connected to the core system via an Enterprise Service Bus (ESB) to improve the robustness and extensibility of the framework. This means any number of services can be made available for bespoke communities, exposing different functionalities to address any risks or opportunities identified for the respective community. To validate the ideas described in this paper, we developed a prototype of the proposed risk management framework based on Java technologies using Apache ServiceMix ESB as a backbone. The prototype was applied on one of the ROBUST use cases: the SAP Community Network (SCN) [23]. This is an online platform of multiple communities for customers seeking support about SAP products. Community members (whether SAP employees or not) are encouraged to contribute to the community by being awarded points for answering other users' questions. The following sections describe the implemented functionality and interactions supporting the main risk management phases discussed in Section III taking as example the risk of missing a performance target: solving any customer query within 3 days.

B. Establishing the Context

The framework provides plugins to visualise and analyse online communities as part of establishing the context (roles, topics, network). The manager provides the system with details of the sources of community data, as data batches or real-time streams, and specifies the community objectives. In our case, this included, *inter alia*, quality of experience and performance, fostering sharing and healthy community growth [24].

C. Identification and Specification

The identification phase is based on the community objectives and manager's knowledge of their own community events and impacts. ROBUST tries to minimise the latter dependency via Simulation Services that allow exploring the future state of the community in various "what if" scenarios. The manager can then identify the relevant events and can proceed with the specification using the Risk Editor.

The specification includes the risk (opportunity) title, owner (who is responsible for this risk management), scope (one user, group of users or community) as well as the risk event(s) and impacts (on the objectives specified above). In our scenario, the event "not providing customer support within a reasonable time" was identified as a risk. This is expressed in a measurable form of a ROBUST risk as "thread response time exceeds a threshold t".

The information about supported events originates from the Predictor Services, each of which supports one or more event prediction capabilities. We have developed a Predictor Service that can estimate the likelihood of the above event using agent-based modelling (details are out of scope in this paper). Advanced tools developed in the ROBUST project are being integrated to address events based on topics, sentiment and quality of the content [25], as well as the roles and behaviour of users [26].

D. Assessment

This phase entails design-time as well as run-time activities. In the design-time, the community manager needs to develop the understanding of the event by quantifying any variables like the above threshold, t. This can be guided by the manager's own observations/knowledge, existing online communities' best practices or inherited from the organisation's policy as it was in our example (3 days). Moreover, the event impact on the objectives is also defined in this phase by indicating the relative potential impact (positive or negative) the event may cause, should it occur. In our example, we can estimate a negative impact on all objectives specified above, particularly on high performance and quality of experience objectives [24].

The above specification is stored in the Risk Repository and used at run-time by the Evaluation Engine (EE). The EE orchestrates the associated Predictor Service to evaluate the event likelihood within a future time window, such as the next week or month. The future time window predictions can be made for depends on the capabilities of the respective Predictor Service. Prediction capabilities of the system can always be extended by implementing a Predictor Service API, which includes a generic way of describing the supported events and any required configuration parameters.

The results of the Predictor Services are returned asynchronously to the EE, which stores the results in the Risk Repository and notifies the Risk Dashboard to give real-time updates to the risk manager. An example of a visualisation provided in the Dashboard is a risk/opportunity matrix, which shows the likelihood of the risk on the vertical axis and its impact (positive or negative) on the horizontal axis. The manager can then evaluate the risk and opportunity levels and proceed with the treatment phase if required.

E. Treatment

The Risk Editor allows the manager to assign a treatment workflow as a response (mitigate, fallback or exploit) for the risk or opportunity during design-time and enacting it during run-time. Treatments are workflow based plans that address one or more risks (or opportunities). Each treatment plan includes a linear or parallel series of actions that can (some could be optional) be carried out by the risk/opportunity owner. Whilst some of these actions may require direct and manual intervention in the community, such as blocking a malicious user, others may dictate community exploration using other ROBUST tools, for instance, using a Simulation Service to explore and evaluate the potential outcomes of planned

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actions. The Treatment Workflow Monitor implemented in our framework allows storing, retrieving and enacting BPMN 2.0 based workflows to support semi-automated responses based on the open source Activiti API [27]. In our example a simple treatment workflow can be based on "allocating additional internal resources, or attracting external resources by providing double points for answering questions during the next period". The impact of these actions can be evaluated, before actual enactment, using our "what-if" Simulation Service by adding more agents or changing the agents' behaviour.

VI. Conclusions and Further Work

This paper has reviewed the current practices of community management and showed the need for a new generation of tools focusing on proactive risk management. We have presented a framework that goes beyond analysing the current state of the community; focusing on predicting whether risks or opportunities are likely to occur in the future and what their impacts may be on the community.

ROBUST supports online community risk and opportunity identification, specification, assessment, monitoring, visualisation and treatment. To our knowledge, such a risk-based approach has not been directly exploited for online community management. In our initial evaluation with SAP and IBM community owners, it was pointed out that risk management expertise can be an obstacle for the approach acceptance. However, the promising capabilities provided by this approach justifies the minimal effort of acquiring the expertise. Though scalability of the framework was addressed by design (modular, loosely coupled services), the accuracy of predictions depend on the predictor services of which we developed Gibbs Sampler, Compartment Model, and Agent-Based Simulation Service [9]. The loosely coupled design guarantees that other statistical approaches can be integrated if needed.

The prototype framework currently implemented does not model the interdependencies between risks. This is not a trivial problem that we are intending to tackle in our future work.

Portability of the system is crucial and requires supporting different online community data sources and models. In ROBUST, a common community data model based on SIOC [28] is being developed for this purpose. We are in the process of updating our prototype to support the new community data model thus allowing any community to use the framework by simply mapping their data schema to SIOC.

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