Organizational Structure for Mass Collaboration and Learning

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Abstract. The rapid emergence of collaborative communities supported by Internet has led to unprecedented waves of novelty in the ways people create and share knowledge. In this framework, the notion of mass collaboration has opened new windows of opportunity for collective learning. Mass collaborative learning is a new paradigm, through which large numbers of people engage in collaborative initiatives to learn from each other and alter the nature of formal education. Even though mass collaboration opens up an apparently limitless field for promoting social inclusion in effective learning, not all aspects, features, and characteristics of this phenomenon such as the organizational structures are quite clear at present. Therefore, this study is conducted to review the organizational structures of 14 real examples of mass collaboration. Through the analysis of the most suitable features of those structures we expect to be able to propose a general organizational structure for mass collaborative learning purpose. It is expected that such organizational structure could help developing a better insight into this field of study.

Keywords: Mass collaboration and learning ·
Knowledge creation and sharing · Community · Innovation

1 Introduction

Advances in information and communication technologies (ICT) and the emergence of IoT (Internet of Thing) have enabled people to redefine the boundaries of collaboration. This trend provides the possibility for large scale groups of distributed humans to join into mass collective projects and harness their potential joint power to deal with multi-faceted problems in social, economic, and environmental contexts. The emergence of the mass collaboration paradigm and its application to different domains is now reshaping the landscape of a wide variety of tasks, both locally and globally. Evidences clearly show that mass collaboration, by exploiting the capabilities of thousands of people, can create a kind of agile problem-solving system which is almost superior to any type of intelligent artefact that is made to serve similar purpose [1].

Mass collaboration brings together multitudes of individuals that may have not had the opportunity to work together before and may remain anonymous. It brings the opportunity to utilize the brainpower of participants in a collective effort and orchestrate their attempts in order to reach a common goal. In this context, Internet and ICT

have a facilitating role to play. In such collective action participants can efficiently and quickly contribute in developing an idea, plan, action, process, project, or artefact, to help solving a grand challenge [2].

There are many interesting applications of mass collaboration. For instance, its application in social learning occurs at a wider scale than the individual or group learning. In this case a large number of interested people capitalize on one another's resources, skills, and knowledge aiming to learn something new, and create lasting impact together. Mass collaborative learning, indeed, refers to a method of learning that can take place at community level where thousands of participants collectively and proactively engage in the process of knowledge acquisition, building, sharing, and developing, and where they can add their own contributions or even revise others' contributions. As opposed to traditional and formal learning methods delivered by instructors and utilizing systematic learning approaches within educational settings, mass collaborative learning stands upon the contribution of decentralized and self-directed participants who produce knowledge in an informal way [3].

In this case, knowledge creation and sharing can be considered as the core of learning that relies on the participation of a variety of people in learning networks helping to reach the community objectives. In addition, the ability to manage such knowledge is key to community success, which secures its competitive advantage and capability to achieve a sustainable superior performance. In this regard, it is significant to promote knowledge building and sharing that drives communities to create and/or add more value, thus engaging in effective innovation [4].

There are a number of factors that differentiate small organizations and communities from large entities, such as the type of organizational structure. An organizational structure determines how power, roles, and duties can be defined, controlled, and coordinated toward reaching community goals. It also specifies the way in which knowledge, information or data flow across different layers of the organization. Every organization or community certainly needs a structure (even if self-organizing) in order to survive, take actions, and grow [5]. Every community should select its structure based on its requirements and priorities. The type of organizational structure implicitly indicates in which ways internal works can be carried out.

In the past, the structures of communities were mostly designed for effectiveness and efficiency although they are nowadays designed for agility, speed, and adaptability to be able to compete and win in today's global competitive environments. As organizations or communities are becoming more and more digital-based and there is a transformation towards performing projects collaboratively, they are also facing with an imperative to redesign their structures in order to learn more rapidly, quickly respond to demands, and adapt to the characteristics of new workforces and workplaces. While the business environment, customer needs, technology capabilities and the nature of work in organizations and communities are likely to change, the organizational structure needs to reshape as well in a deliberate and strategic way. As such, the design of structures for adaptability is a shift away from traditional organizational structures like the hierarchical, centralized and bureaucratic models, towards unconventional models where projects are fulfilled collectively by network participants [6].

However, thus far there have been very few attempts to report on the role of organizational structures in the context of mass collaboration and learning. Furthermore, there are no clear evidences in the literature that show how mass collaborative projects can define, design, implement, and develop appropriate structures. Therefore, gaining some insight on what kinds of organizational structures have more chances for being adopted in mass collaborative learning projects is the foremost motivation for conducting this research work. Thus, a key research question that emerges is:

What kind of organizational structure within a community should be established to help developing learning through mass collaboration?

The proposed hypothesis to address this research question is:

Community learning through mass collaboration could be helped if existing models of organizational structures for long-term strategic networks are extended to allow more fluid borders and new roles, incentives and internal subgroups are defined to focus on learning and knowledge generation.

For this study, in order to search, choose, and review relevant papers, databases such as, SCOPUS, IEEE Xplore, Web of Science and Google scholar were used, being the goal to identify relevant examples and evaluate their organizational structures.

2   Relationship to Innovation in Industrial and Service Systems

From an organizational perspective, knowledge communities can speed knowledge creation, transfer, and utilization on an ongoing basis, as well as facilitate knowledge mobilization (for example, through providing suitable spaces for discussion in order to narrow the gaps between research and practice) [7].

Knowledge communities are often found to introduce changes to a system, and promote the culture of innovation. Such kind of communities can be called communities of innovation which are dedicated to support innovation. Communities of innovation are creative and dynamic entities that pursue innovative solutions to societal challenges. Communities of innovation are not only responsible for a growing number of innovations, but can also provide a common ground for learning. In this subject, they can freely and efficiently impart information and knowledge to the wider public. The literature shows that some examples of communities of innovation [8, 9] have successfully influenced the learning process.

Furthermore, "*online innovation communities have an ability to learn in a dispersed setting without any formal involvement, their learning capability is actually very remarkable, making it even more striking that we lack academic insight how these learning competences come about*" [9]. Mass collaboration through a large online community can be applied in various domains and fields of study. For instance, it can foster learning and optimization of the innovation portfolio through:

- Increasing the flow of new ideas, knowledge, or information generation,
- Boosting the chance of association between ideas, knowledge, or information,
- Improving the quality of ideas, knowledge, or information,

- Speeding up the collaborative feedbacks,
- Developing connection between members,
- Reaping the power of collective intelligence,
- Etc.

However, it is vital in this new context to be able to evaluate how much trustworthy the acquired knowledge is, because knowledge is power, and it serves as a basis for making choices and decisions in communities. One fundamental step in the process of learning, particularly in an online environment, is to ensure that the created and shared knowledge or information is reliable, as well as the accuracy and credibility of the materials that people encounter with, are high.

It is largely evidenced that in World Wide Web, and specifically in networked-collaborative activities neither all delivered materials are reliable nor will all stay stable. In addition, on one hand, the quality and value of various types of Internet sources (that are available in different formats) are not all high, and on the other hand not all Internet users are able to accurately evaluate the appropriateness of all types of online sources [10]. Thus, along with informal learning in such communities, it is essential to assess the quality and reliability of knowledge or information created in whatever format, particularly in mass collaborative projects. To cope with this challenge, approaches such as machine learning [11], digital audio and video output [12], BS detector [13], and linguistic and network-based approaches [14] can play a relevant role.

3 Analysis of Selected Cases

In this study, in order to gain a clear understanding of the organizational structure of mass collaboration, and propose an appropriate structure for mass collaborative learning projects, 14 relevant examples of mass collaboration in different domains were selected from the literature including, (1) *Wikipedia* (a well-known case of a web-based encyclopedia that is written collaboratively by its users), (2) *Digg* (a social networking website that aggregates interesting online news, pictures, and videos), (3) *Yahoo! Answer* (a community-driven question-and-answer website that allows users to ask questions and answer questions), (4) S*ETI@home* (a computing project and scientific experiment that benefits of Internet-connected computers in the search for signs of Extraterrestrial Intelligence), (5) *Scratch* (an online community that enables children to program and share interactive media with other people), (6) *Galaxyzoo* (a crowd-sourced and on-line astronomy project which classifies the morphology of galaxies, and then analyze their pictures and rate them), (7) *Foldit* (an online puzzle video game that uses the power of distributed computing to create and design the primary structure of chosen proteins), (8) *Applications of the Delphi method* (a structured communication technique based on the results of several rounds of questionnaires sent to a panel of experts), (9) *Climate Colab* (an open problem-solving platform where a community of experts on climate change evaluate plans to reach global climate change goals), (10) *Assignment Zero* (an experiment in crowd-sourced journalism, allowing collaboration between lots of people to work on a publishable story, with many parts), (11) *DonationCoder* (a community of programmers who develop and finance their own

free software), (12) *Experts Exchange* (a trusted global online community offering millions of verified solutions from industry experts), (13) *Waze* (a navigation app that runs on smartphones and tablet computers, through which users help each other to find directions and avoid traffic jams), and (14) *Makerspaces* (which are physical or digital spaces for open collaboration, where people have access to resources for developing projects with the aim of creating products or services).

In Tables 1 and 2, the organizational structure and main characteristics of two of the above-mentioned examples are summarized as an instance.

Table 1. Organizational structure of Wikipedia

What is Wikipedia: it is a web-based, free and open content encyclopedia based on a model of openly editable content - a wiki. As a general reference, it has been the most popular on the World Wide Web. It is written collaboratively by the people that use it. Many people from around the world are willingly contributing in Wikipedia development.	
Wikipedia Organizational Structure	
Wikipedia Membership Method	
• Wikipedia is open to public to use, read, write, edit, and make changes in articles. – People from any age group, gender, race, culture, and background can participate in. • Wikipedia community includes all anonymous editors, supporters, current and potential readers. • Wikipedia contributors consist of two main groups, those who create an identity, and those who communicate with other contributors.	
Wikipedia Roles	
Wikipedians (or editors) are the volunteer who write and edit Wikipedia's articles. Anyone can become a Wikipedian. Wikipedians do a wide variety of tasks, being free to pick and complete their tasks anytime anywhere. Wikipedians through collaboration and discussion can gain a sense of collective purpose and connectedness. While there are disagreements about an issue, a consensus can be reached through open and friendly discussion. While unresolved disputes or conflict arise, no matter the reason, it can be pursued in related talk page, either through comprehensive dispute resolution process of Wikipedia or, requesting comments from other Wikipedians.	

No	Roles	Descriptions
1	Account creator	Gets access to a tool that allows trusted Wikipedians to create a high number of accounts for other people who request them.
2	Editor (from expert scholar to casual reader)	A volunteer who writes and edits Wikipedia's articles.
3	Bureaucrat	Permitted to perform particular actions on Wikipedians' accounts.
4	Volunteer Response Team	Group of volunteers who answer most email sent to Wikipedia.
5	Event coordinator	For a short time, can add new created accounts to verified user groups, hence such accounts could write new articles.

Table 1. (*continued*)

6	Edit filter manager	Can make, change, enable, disable, and omit edit filters. Moreover, can check private filters and also their related logs.
7	Arbitration Committee	Handles those conflicts which remain unresolved while all the efforts in dispute resolution have failed.
8	Steward	Can give and revoke any authority to or from any Wikipedian on any wiki operated by the Foundation of Wikimedia that permits creating open account.
9	Oversight	Authorized to delete pages and revisions, and block function pages that it makes possible to hide logs or modify pages from any form of usual access by other Wikipedians.
10	CheckUser	Permitted to check the list of all IP addresses, the list of all edits, and all user accounts.
11	Administrator	A volunteer editor who is granted some technical authority to make particular decision and actions about blocking and unblocking user accounts and IP addresses; editing, modifying, and removing the protected pages, deleting and undeleting pages, protecting and unprotecting pages from editing; and etc.
12	Interface administrator	The only local user group who authorized to edit Cascading Style Sheets, JavaScript, and Javascript Object Notation pages.

Relationship Between Roles in Wikipedia

- The community of Wikipedia is divided into large number of "spheres" which categories members based on their area of interest, expertise, background, age, etc.
- The conversations and debates among members will be facilitated by means of Discussion Pages.
- There is possibility for members to nominate each other for awards of Wikipedia.
- Neither the quantity or frequency of contributions can be controlled, nor will members be fired.
- There are additional administrative responsibilities that can be taken to serve the community better.
- It has been attempted to Wikipedians be treated equally with no "power structure" although a hierarchy of positions and permissions is there (from simple editor to Jimmy Wales, the founder of Wikipedia).

Wikipedia Content Management

- Wikipedia is a free online encyclopedia and its entire contents are written by unpaid volunteers.
- Wikipedia is continually developed and updated. Its articles are intended to be realistic, reliable, and verifiable with cited external sources.
- Wikipedia has variety of procedures (e.g., peer review, good article assessment, and the featured article process) for continual article review and improvement.
- Feedback about articles, in the first instance, raise on the related discussion pages.
- Quality constantly improves via removing or repairing the misinformation and other errors.

Table 2. Organizational structure of Digg

What is Digg: it is a website that aggregates interesting online news, pictures, and videos through compiling links to the relevant webpages. Users submit stories for promotion, and they are subsequently either voted for (digged) or against (buried). The most popular contents are posted to the front page for making it easier to identify and consume the most important stories, videos, and trends of the day.
Digg Organizational Structure
Digg Membership Method
• Digg is a social networking and user-driven website that anybody can participate. • In Digg, nothing is written by paid editors. Contents are made by hundreds of thousands of users. • All users need to create a Digg user account to access the features of the website. They should play active role in both presenting and Digging stories. Log in is mandatory to get to the website. It provides kind of security assurance for each visit. • After registration, it is possible for users to give comment and vote on others contribution. • All users' information (e.g., past Diggs, friends, feedbacks) will be stored in their Digg profile. • Users can submit their stories and also benefit of all provided features in the website. Bad stories will be ignored, and good ones promoted. Thus, the stories that got positive votes and selected as the best will be cross-pollinated across other channels. • Users can customize their own news feeds.
Digg Roles
All Digg users are volunteers. The Digg community is made up of users who play different, often overlapping roles.

No	Roles	Descriptions
1	Casual reviewer	Looks for interesting stuff.
2	Reader	Makes up the majority of Digg user who reads and reaps the benefits of provided materials.
3	Submitter	Posts news and stories that s/he finds in different blogs, websites and random postings from around the Web.
4	Dedicated reviewer	Spends several hours each to check the stories, promote good ones, and report those are not good.

Relationship Between Roles in Digg
• Digg provides a place for lively conversation, discussion, inquiry, and debate. Digg community can discuss the topics that they're passionate about. • Users can add friends and develop their relationships. • A user can block another user if doesn't like his submissions or comments. The blocked user may get banned from Digg if he is blocked by enough number of Digg users. • Users can create or develop a "Digg game" by submitting stories and digging them.

Table 2. (*continued*)

Digg Content Management

- All the content-related decisions are made by site's users.
- When a user submits a story, its validity will be checked by the system.
- When a submitted article is up for promotion to a category homepage or the front page, the system (karma) checks it to make sure the Diggs are valid.
- Digg does not have editorial control on submissions, promotions, or burying.
- Digg manages all things with a proprietary algorithm (de-promotion algorithm). When a story is Digged by certain number of users (at least 40 persons), the Digg system automatically will move it to the front page of the website.
- The most popular stories of Digg are placed in the "Top News" section of the website.
- The top news can be anything (e.g., fun content or serious news).
- Digg is classified into different groups based on topics (e.g., business, technology, videos, and entertainment news).
- Digg has tabs that let users filter or sort contents into news stories, videos, images and podcasts.

In summary, elements for a typical organizational structure for mass collaborative learning projects, as derived from the 14 studied examples, are displayed in Fig. 1.
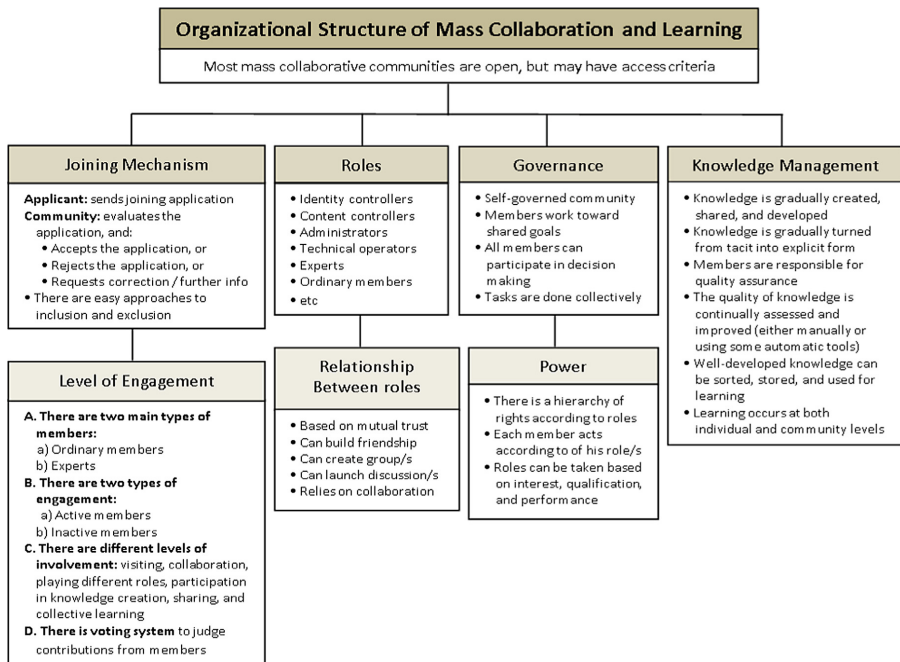

Fig. 1. Elements for an organizational structure for mass collaborative learning

Having critically analyzed the organizational structure of 14 studied examples of mass collaboration and also reviewed related papers, it is concluded that each organizational structure stands upon some building blocks and fundamental elements. In this sense, it is therefore suggested that the organizational structure of mass collaborative learning (for creating, developing, and servicing) should take into account at least four core elements and three supplementary elements. Core elements including, (A) the required mechanism for members to join the community, (B) the roles that can be taken and played by members, (C) the methods of governing the community, and (D) the way that possessed knowledge or information can be managed properly and efficiently. Supplementary element consists of, (a) the ways and levels that members can engage in different activities, (b) the ways that different roles can built and involved in interrelationships, and (c) the power, rights, and responsibilities that members can take. In this structure the role of supplementary elements is augmenting, clarifying, and facilitating core elements. This organizational structure depends on the specific situations and conditions of application. It is expected that the proposed structure in this work can contribute to the development of this field of study, and enrich the understanding of the complex organizational structures for mass collaboration and learning.

4   Conclusions and Future Work

Mass collaborative learning provides greater opportunities for distributed contributors to engage in virtual global learning and take advantage of powerful social communities of experts and peers to develop innovative solutions to major challenges. Despite of successful outcomes that mass collaborative learning already gained, we still need to clarify our understanding about the required organizational structures for this emerging phenomenon.

Evidences demonstrate that collaboration and innovation are not mutually exclusive; on the contrary, they feed and build upon each other. That is, collaboration brings and drives innovation, and innovation happens through collaboration [15–18]. Considering that fact, in this study, in order to identify appropriate organizational structures for mass collaborative learning projects, the organizational structure of 14 real examples of mass collaboration are reviewed.

This work is still ongoing, but it is expected that the preliminary findings of this review and the proposed organizational structure can provide communities and learners with helpful guidelines and directions for achieving effective mass collaborative learning.

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