

Exploring the Application of Blockchain Technology to Combat the Effects of Social Loafing in Cross Functional Group Projects

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ABSTRACT

Today, many multi-national organisations operate in a dispersed geographical environment. Teams consisting of members from around the globe can be assembled on an as-needed basis. However, this can prove to be a complex managerial task. Individuals, who believe that their efforts are not being effectively monitored by upper management, lose their motivation to fully contribute to the best of their abilities as they do not believe there is any correlation between the effort they exert and the reward they receive. With low levels of intrinsic involvement among employees, a lack of task visibility from upper management and limited social interaction among group members, many organisations struggle to combat the issue of social loafing in cross functional working groups. Blockchain technology, widely acknowledged as enabling openness, can facilitate the development of an immutable, transparent, secure and verifiable application for capturing individuals Intellectual Property as they work. This would motivate employees to more openly contribute to group work, safe in the knowledge that their contribution will be recognised, enabling management to maintain a high level of task visibility over their employees work without requiring their physical presence.

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INTRODUCTION

The objective of this research is to explore if Blockchain technology can be utilized to more effectively track employee’s contributions and efficiently record an individual’s contribution to group endeavours, potentially facilitating increased transparency, leading to improved productivity and rewards.

This research focuses on the issue of social loafing in cross functional dispersed teams and explores the potential of a Blockchain based system to address this problem and garner an understanding as to the effectiveness of such a system to potentially increase individuals IP contributions, which are defined as ‘creations of the mind: inventions; literary and artistic works; and symbols, names and images used in commerce’[28]. Blockchain technology is potentially applicable in this setting as it acts as a distributed mechanism to capture data in an immutable, verifiable and independently auditable fashion [23].

The potential application of Blockchain technology for capturing IP contributions has been discussed in the literature in an inter-organisational setting. A report published by the UK Government’s Chief Scientific Advisor in 2016 advocated the potential that distributed ledger technology could have in the IP domain; “Enabling companies to register their Intellectual Property (IP) within a distributed ledger, rather than through traditional patent applications, may reduce the overall number of contract disputes” [27].

An analysis of the literature on organizational behavior and forms of motivation reveals that many organisations experience the issue of being unable to effectively manage their employees to work productively, the problem being magnified when it comes to group projects due to 'The Free Rider Problem' or 'Social Loafing' phenomenon. Low levels of task visibility and low levels of intrinsic motivation result in employees feeling that their work was undervalued and unimportant to the organization [11]. In the global environment in which we operate today, many organisations consist of teams containing group members from dispersed geographic locations. Although dispersed teams offer many advantages to an organization, they lack the level of social comparison found in collocated groups which can contribute to increased levels of social loafing [24]. Social comparison is defined as 'comparing our behaviours and opinions with those of others in order to establish the correct or socially approved way of thinking' [13].

In order to complete this research we adopted a design science approach which is outlined in detail later in the paper. In brief, first we identified the problem of social loafing in distributed teams which will be outlined in the literature review. The literature review also details our analysis of Blockchain technology as a potential tool for combatting this problem. We then designed and developed a blockchain enabled proof of concept application to track individual contributions to a group project and demonstrated this to a number of organisations in order to evaluate its potential and take suggestions for future applications of the system. Details of the application will also be outlined later in the paper.

LITERATURE REVIEW

Employee Motivation and Social Loafing

Ryan and Deci's paper on Intrinsic and Extrinsic motivation and 'Self-Determination Theory' described the ability to motivate somebody to perform tasks which are not inherently interesting or enjoyable as an essential strategy for successful teaching [22]. Intrinsic motivation refers to when people perform an activity because they are interested in the activity itself and performing the activity gives them a sense of satisfaction, on the other hand, extrinsic motivation does not involve satisfaction coming from the activity itself but rather satisfaction from separable outcomes that come because of performing an activity such as rewards [10]. One form of extrinsic motivation under the umbrella of 'Organismic Integration Theory' is 'identification', this occurs where an individual partakes in an activity out of choice because they can see the benefit in doing so. Although they perform an activity to achieve 'separable outcomes' as described above, their behavior is self-determined, for instance athletes who are involved in sport as they believe it contributes to their personal development [21]. Organizations should focus their efforts on creating an environment which would enhance an

individual's level of identification in a task by rewarding everyone on their contribution to achieving the organizational objectives. This would help counteract what is known as the dilution effect whereby members of groups feel their contribution is marginal towards the overall goal [10].

Rational individuals have a desire to progress in their own careers. Behavioral economist, Dan Ariely, spoke to this point in his book entitled 'Predictably Irrational'. Rather than focusing on market norms where money is the primary motivator to work, Ariely suggests that social norms, i.e. showing recognition for the effort made by an individual can produce better output. He found that a lack of recognition for work completed is almost as bad as destroying one's work, however the slightest amount of recognition, was enough to motivate people to work harder as they felt their work was worthwhile [26]. If there was a system in place in an organization which would guarantee recognition for individual effort, each person would be able to identify with the importance of improving their productivity.

Regardless of an individual's level of identification, they may still be reluctant to participate in group activities as a result of the 'Free Rider Problem'. The term 'free rider' refers to a member of a group who obtains benefits from a group membership but does not bear a proportional share of the costs of providing the benefits [1]. This issue is particularly relevant in the case of group activities because regardless of how motivated an individual may be to perform well, often they will not trust that other members of the group are making the same effort. This can result in individuals losing that level of identification in the task they are working, which undermines any strategy for motivating employees that may be in place within an organization. Latane et al. found that in group activities 'lack of trust and the propensity to attribute laziness or ineptitude to others could have led people to work less hard themselves' [15]. Furthermore, Ringelmann found that members of a group feel that the responsibility for the success of the group does not rest on their shoulders to the same extent as the success of an individual task would [15], a problem referred to as 'diffusion of responsibility' which is defined by Bandura as 'when everyone is responsible, no one really feels responsible' [5].

Jennifer George explored the area of the 'Free Rider Problem', or as she refers to it, 'social loafing' which she defines as being 'the fact that individual contributions to a group product are often unidentifiable, when this is the case, motivation may be low since the perceived relationship between individual effort and sanctions or rewards is weak' [11]. George put forward the following hypotheses to explain the factors that influence social loafing;

- **Task visibility** is negatively related to social loafing

- An individual's **intrinsic involvement** in work is negatively associated with social loafing
- **Task visibility** will dominate intrinsic task involvement in terms of relative ability to predict social loafing in an ongoing organization
- **Intrinsic involvement** moderates the relationship between task visibility and social loafing such that the relationship is stronger when intrinsic involvement is low than when intrinsic involvement is high.

It is apparent from these hypotheses that the two main variables contributing to the factors that influence social loafing are task visibility and intrinsic involvement. George describes task visibility as; 'the belief that a supervisor is aware of individual effort on a job', and intrinsic involvement as; 'believes that the work being done is meaningful and significant and that one's own efforts are an important contribution to the employing organization' [11]. Therefore, an organization should focus on increasing task visibility and individual's intrinsic involvement to reduce social loafing and in turn improve productivity. Indeed, George purports that the reason individual productivity is not maximized is mainly because employees do not believe their work has a direct contribution to the entire organization, nor do they trust their employers to effectively record their work [11].

Further research into this area has found that social loafing is particularly a problem in technology supported, dispersed and knowledge teams [16]. One basic difference between global teams that work and those that don't lies in the level of social distance—the degree of emotional connection among team members [18].

In the case of traditional, collocated groups, Chidambaram and Tung cite social standards as key deterrents of social loafing; they argue that in a collocated environment, social pressure results in individuals being more productive as they can see their peers working around them, this acts as a form of motivation to other team members which is not present in a dispersed group [9].

Social pressure in groups is also highlighted by Suleiman and Watson as being integral to any effort to reduce free riding tendencies. Their research found that self-feedback; feedback given on an individual basis, did not result in a reduction in the levels of social loafing in a group. However, when feedback was given to all members of the group and member's feedback was visible to all other members, this acted as a comparative tool and decreased level of social loafing [24].

To summarize, social loafing is a significant issue in distributed teams, with a myriad of factors impacting upon group dynamics, project success and the ability to manage and motivate individuals to contribute and innovate. Can Blockchain technology, with its focus on openness and

transparency potentially play a part in reducing social loafing and increasing individual's contribution?

We suggest, and are keen to investigate, if Blockchain technology can combat an employee's feeling that they are merely an anonymous tool in a large organization through tracking individual contribution and recreating social presences in dispersed group settings. A Blockchain application which captures individual contribution to a group and ensures that individual intellectual property receives appropriate recognition may also potentially reduce perceptions of diffusion of responsibility, dehumanization and attribution of blame as illustrated by Alunani, Robert and Maruping[2].

As stated in the introduction, the objective of this research is to apply this concept to group projects and assess the potential the technology may have for recording individual contributions to a distributed team's towards improved performance.

UTILISING BLOCKCHAIN FOR CAPTURING IP AND REDUCING SOCIAL LOAFING IN DISTRIBUTED GROUP PROJECTS

This section reviews the state of the art in Blockchain technology and abstracts that; 1. the ability to store information on the Blockchain 2. The technologies record of being applied to capture IP and appropriate recognition 3. Blockchain's security and immutability characteristics and 4. The ability to leverage the technology to record verifiable contributions mean that it is a suitable technology to be applied for potentially improving the performance of geographically distributed teams.

Information Storage

Recording employees work can be facilitated by storing data on the Blockchain. This has already been successfully implemented by a few applications, most notably ProofOfExistence.com, a service which anonymously and securely stores an online distributed proof of existence for any document [3]. The service works in the following way: A user presents a document or file to the website. The file is never uploaded to the site but instead they create the cryptographic digest of the file and the user maintains the original copy 'off-chain' [19]. This adds security and privacy to the service because the original contents cannot be stolen from the service. The digest is then inserted into a transaction which is in turn mined into a block and is then registered forever on the Blockchain, regardless of whether the service is shut down. Should any conflict occur in the future over the ownership of the file, the user need only run the hash function over their off-chain copy of the file and the file will be verified if the digest produced is the same [26].

In fact, storing data and documents on the Blockchain is becoming an increasingly popular application for the technology. In October 2016 Dubai announced their objective to store all government documents on Blockchain by the year 2020, this is as part of Dubai's strategy to

become a leader in the Blockchain industry. Estimates from the Dubai government suggest that this initiative has the potential to save 25.1 million hours of economic productivity as well as being environmentally friendly [8].

Capturing IP and Recognition

An interesting example of where blockchain technology has already been implemented to secure IP rights and ensure that appropriate recognition is given to the creators of IP is in the music industry. Tapscott et al. credit Napster, the peer-to-peer music sharing platform, for casting a light on the music industry's distribution inefficiencies when the service was launched in 1999 [26]. This revolutionary innovation in the music industry caused musicians to rethink the role of record labels and opened their eyes to the unbalanced distribution of wealth. Today, musicians such as Imogen Heap are distributing their music via blockchain based services such as 'Ujonomic', this platform uses smart contracts to ensure that artists get to decide who can interact with their work and how much each interaction is worth. All contributors to the purchased product are automatically paid directly into their wallets after each transaction [12]. This research hopes to apply this logic to group work and ensure that each member of a group receives appropriate recognition for their work.

Security and Immutability

Blockchain uses Hashing and Secure Timestamping to conduct attestation services. Hashing is the process of compressing any document or file of any type into a string of alphanumeric characters which cannot be reverse computed into the original file [26]. The hash function is 'second pre-image resistant', meaning that it is impossible for a transaction to be recorded on the Blockchain before it is executed. Also because of pre-image resistance of hash functions, it is impossible to recreate an identical hash in the future with a different file [3]. This directly relates to the issue of recognition discussed earlier in this paper as put forward by Dan Ariely; when employees believe that their work is not being recognized their production levels begin to decline. The hashing of transactions on the blockchain can provide employees with a sense of security that all work they record on a blockchain enabled system will be securely recorded and in the event, that any other party tried to claim ownership of their work, the system would be able to efficiently verify the true ownership of the record.

Blockchain timestamps all transactions as outlined in Satoshi Nakamoto's White Paper, 'a timestamp server works by taking a hash of a block of items to be timestamped and widely publishing the hash. The timestamp proves that the data must have existed at the time, obviously, to get into the hash' [17]. Combining this with Public Key Infrastructure (PKI), the Blockchain not only prevents a double spend but also confirms ownership of each transaction, and each transaction is immutable and irrevocable. Bitfury define immutability by saying 'the Blockchain could not be retroactively changed by the

collusion of notaries' [6]. In summary, this means that Blockchain prevents us from claiming ownership of a transaction that is not our own, committing a transaction on behalf of another party or even preventing somebody's freedom to commit a transaction to the Blockchain. The Blockchain provides a means of proving ownership and preserving records without censorship [26].

Recording Verifiable Contributions

Organizations today are constantly striving to keep their employees motivated, particularly when individuals can identify with the benefits of working hard on a task [22], if they feel intrinsically involved in the task, or if they feel that management maintains a high level of visibility over their work [11] they will be more likely to be productive. However, this can be undermined if individuals feel that their efforts are not being effectively recorded, especially in the context of group endeavors [15].

This research hopes to illustrate that Blockchain technology can facilitate an application that would resolve these issues by creating a trustless, secure mechanism for recording any content produced by any individual. The technology is immutable meaning that no third party could prevent an individual from having their efforts recorded. Transactions are irrevocable so nobody could claim ownership of work they did not perform. Transactions are timestamped, allowing everyone to see when the work was completed. Finally, transactions are verifiable through hashing so that should conflict of ownership ever arise, it can be easily resolved.

STATEMENT OF THE RESEARCH PROBLEM

The focus of this research study is to explore the possible utility of a Blockchain enabled application to combat the problems of social loafing and increase individual contributions in cross functional, geographically dispersed group projects. In order to conduct this research, the following research questions will be answered;

- Does utilizing Blockchain technology in cross functional geographically dispersed group projects both increase individual contributions and reduce the potential for social loafing?
- What are the factors which determine the success of utilizing Blockchain technology to reduce social loafing and increase IP capture in cross functional geographically dispersed group projects?

RESEARCH METHODOLOGY: A DESIGN SCIENCE APPROACH

Given the nature of the research, and the necessity to design an artefact to answer the research questions outlined, design science is a suitable methodology to investigate this problem. 'The design science paradigm seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts' [13]. Traditionally in IS Research, Design Science is not a commonly used

approach; ‘While design, the act of creating an explicitly applicable solution to a problem, is an accepted research paradigm in other disciplines, such as engineering, it has been employed in just a small minority of research papers published in our best journals to produce artifacts that are applicable to research or practice’ [20]. Nevertheless, this research will adopt the Design Science framework outlined by Peffers.

The purpose of conducting IS Research is to create and evaluate IT artifacts which will solve problems faced by an organization. These ‘IT artifacts’ can be categorized as *constructs* (vocabulary and symbols), *models* (abstractions and representations) and *instantiations* (implemented and

prototype systems) [13]. Design is both a process and a product. The products of design are the constructs, models, methods and instantiations as outlined above whereas the processes of design are building and evaluating [13].

Table 1 below employs the Six Activities outlined in Peffers Design Science Methodology and a brief overview of each as they pertain to the stated research problem. Peffers model was chosen because his study involved analyzing all prior research into Design Science Frameworks and building on this groundwork to create a generalizable methodology.

Activity	Applicability
Problem Identification and Motivation	Due to low levels of task visibility and intrinsic task involvement, many organizations experience high levels of ‘social loafing’ among their employees which reduces levels of productivity in individual and group work [11]. This problem becomes more pronounced in cross functional groups because of low levels of social interaction between group members [9]. Also, work that individuals do complete is under threat of being stolen, international IP theft adds up to over \$7 trillion globally [27].
Define the objectives for a solution	To assess the ability of a Blockchain enabled system in improving overall group productivity by capturing individual productivity during cross functional group projects. Blockchain will create a secure and frictionless solution, aiming to improve productivity by increasing management’s visibility over everyone’s efforts, improve individual’s level of identification with their work and create a degree of social interaction between members of dispersed groups.
Design and Development	<i>Development of a prototype instantiation:</i> If the initial exploratory investigatory research reveals the utility of a solution a prototype will be built. This solution will be developed using Blockchain technology and will aim to demonstrate how the immutability, transparency, verifiability and timestamping features of Blockchain can be utilized to create a successful product.
Demonstration	Once an artefact of an acceptable standard (preferably a prototype system) has been produced it will be demonstrated during workshop sessions in organizations operating in a variety of industries. The workshops will be conducted for managers and project team members to gain an insight into the requirements of each type of user. In an ideal scenario, the prototype would be implemented for a trial period in each organization to fully assess its potential, however a simulated situation will suffice if necessary.
Evaluation	<i>Evaluation of the System Prototype:</i> Before any workshops, a full unit test will be carried out on the system to ensure that every method works correctly. During the workshops, the system will be evaluated in terms of general feedback as well as metrics gathered. User feedback will be important to gain insight into the user’s general interaction with the system, and any suggested improvements they may have, this will then be used to direct future iterations of the system. The workshops will look to suggest improvements to the aesthetics of the system but also whether a blockchain enabled system produced any significant benefits or drawbacks compared to a traditional system. Also, the system’s reporting capabilities will be assessed by the managers taking part in the workshops. The metrics gathered during workshops will include, time taken to record each task, time required for each transaction to be subsequently mined to the blockchain, the level of user engagement will be recorded by the quantity of tasks submitted to the system.
Communication	The results of this piece of IS Research will be documented and communicated in the form of an Empirical Research Paper which will then be submitted to a number of peer-reviewed outlets.

Table 1. Design Science Approach

BLOCKCHAIN INNOVATION TOOL: PROOF OF CONCEPT

(1) User adds and idea

(2) Users browse and vote on ideas

Idea Description:	Idea Creator Address:	Idea Number of Votes:	Idea Passed:	Idea No. Votes Req:
Example	0x50fc51e9055e636d4cf397a2010d0b7501a3c9c3	0	false	5

(3) Managers get a report of passed ideas

Idea Description:	Idea Creator Address:	Idea Number of Votes:	Idea Passed:	Idea No. Votes Requ
Test	0x4e3f9a9146b272ceec94b1c2b2054ea6e34d498	5	true	5

(4) Contributors rewarded for successful ideas

Table 2. Blockchain Innovation Tool

This proof of concept application has been developed considering the suggestions and recommendations of managers and distributed group members in Statestreet corporation. After conducting exploratory interviews with these parties, we decided to develop the application to tackle a specific use case, namely intra-organisational groups and the innovation process.

The system was built on the Ethereum blockchain network which allowed us to utilize smart contracts to implement a voting mechanism and an internal cryptocurrency.

The different activities and the associated Blockchain Innovation Tool GUI are outlined in Table 2. First, members of a group can login to the system to post an idea they may have (1); this idea will be immutably stored on the blockchain for all group members to see, towards increasing task visibility and intrinsic involvement of group members.

Next (2), individuals will have the ability to browse through all ideas which have been posted to the system and vote for ideas which they consider having potential. This feature combats the issues which contribute to social loafing, for example, social comparison is increased in groups as each member can see the ideas being put forward by their peers. Although Blockchain will not be able to create the level of social interaction found in a face-to-face setting, the technology will be able to increase levels of individual task monitoring so that each member will observe a similar level of social comparison that would be found in a collocated group. Feedback is provided to all members, by all members, thus harnessing the wisdom of the crowd, and this is broadcasted to everyone as the current vote count will be captured by the smart contract and displayed to all users.

The smart contract is designed and programmed so that each idea requires a certain number of votes before it is deemed valid. Once this quota is reached the idea will be flagged as 'passed' and presented to management (3), giving them a high-level report of popular ideas amongst their group. This increases transparency for management and by giving each member a say, the system can reduce the 'dilution effect' in group based innovation.

Finally, the system also utilizes smart contract technology to improve recognition and reward (4), once an idea is passed by the voting system, the smart contract will automatically reward the individual who contributed the idea with a predefined amount of internal coins. Potentially, these coins may have intra-organizational value, for example being redeemable for lunch in the cafeteria etc.

CONCLUSIONS

This research contributes to both theory and practice. From a theoretical stand point, this research illustrates that Blockchain technology has significant value beyond a transactional setting, revealing that it can be applied as part of an organisation's (1) innovation and (2) recognition and

reward process. Furthermore, it illustrates that Blockchain technology, through the transparency which it enables can address the problem of social loafing in dispersed, cross functional group terms.

Furthermore, from a practitioner perspective, the Blockchain enabled POC (Proof of Concept) would, if operationalized, allow individuals to record their contributions in a frictionless manner as they operate. An immutable, verifiable and transparent application for capturing individuals IP could potentially improve individual's contributions, particularly in group environments by combatting social loafing.

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