Social Farm : Making Social Networks Work for Profit

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ABSTRACT

We present the Social Farm architecture for encouraging user contribution through the profit motive. Our solution leverages the connectivity and trust relationships available in online social networks to create and operate businesses using the programming interface provided by existing online social networks. Social Farm automates the tasks of finding partners, implementing the business workflow, managing profits and reputation, and managing the day-to-day operations of the business. It encourages contribution and engagement by providing an automatic mechanism for transparent and fair distribution of profits to contributors.

1. INTRODUCTION

The world wide web is evolving from a publisher generated content model to a user generated content model. A number of important websites and online communities derive majority of their content from ordinary web users. These contributions are typically made without any economic returns. Having a user generated content model brings into fore the problem of incentivizing user contributions. Similarly, the viability of online communities depends critically on their ability to incentivize user participation.

The problem of incentivizing user contribution is becoming increasingly important with the rise of user generated content. As the value of user generated content has increased in terms of online advertising revenues, so has the importance of incentivizing content creation. The problem of incentivizing user participation is closely related to well studied classical problems. The problem of social loafing in social psychology addresses the factors that encourage or discourage individual efforts when done as a part of group activity [16]. Similarly, economics addresses the problem of free riding where consumers of public goods consume without paying the cost of production. Both of these traditional problems place important limits on feasible solutions for user engagement. The engagement problem is an important traditional problem that has been encountered in a number of fields and has required significant infrastructure for solution.

Traditional solutions from social psychology have focused on the factors that encourage or discourage social loafing. These factors tend to focus on the composition of groups and how participants feel about the groups and their position within them. In an online setting, it is not easy to directly apply these factors to influence user engagement [6]. In the field of economics, public goods are those goods that are hard to trade. Once they have been produced, anybody may consume them freely. Because of this special characteristic of public goods, they are normally funded with an infrastructural approach through taxes or tolls [15, 29]. User generated content on the web is known to have the characteristics of a public good [4, 30]. Since it is produced through group activity, it is also prone to social loafing. It is therefore difficult to incentivize user contributions on the web.

Solving the problem of public goods requires an infrastructure for compensating the producers of public goods. No existing infrastructure supports this functionality on the web. Solving the problem of social loafing requires users to have adequate motivation for contributing to the community good. Building on the empirically established factors influencing social loafing, existing online approaches have focused on specific interest areas where users are motivated to contribute, on structuring the tasks in a manner that makes it easier for users to contribute or have feedback, or by grouping users in a particular way so that they have a greater incentive to contribute [6, 27]. None of these methods is applicable in all areas of user engagement. Further, the existing encouragement methods can be complimented through an economic incentive based approach for motivating user contributions.

1.1 Our Solution

In this paper, we propose the *Social Farm* architecture for incentivizing user contribution with the profit motive. Social farm provides an online platform for the creation of long term business relationships. It is able to motivate user engagement or content creation by supporting profit distribution and task routing (i.e. assigning tasks to users). Users can aggregate their efforts as well as share the profits generated from their efforts in an automatic manner. This makes our solution attractive for encouraging engagement through transparent fair sharing of online efforts and profits.

The Social Farm is an infrastructure for creating and oper-

ating businesses on top of online social networks. It provides a structured framework for people to form businesses, invite or hire suitable people as members of their businesses, define automated workflows, advertise the goods and services of their businesses, disclose and verify their business' consumer reputations, regulate consumer-business transactions, and distribute business profits to members.

Online social networks possess a number of attractive properties that make them a good platform for business formation and execution: they are large collections of people, they can identify well established trust relationships between those people, and they can efficiently aggregate large numbers of people for various endeavors based upon specific interests. Finally, as well-known entities themselves, online social networks posses their own reputations similar to online marketplaces. This can add to the credibility of businesses operating on the social farm [19].

Permitting users to form profit oriented businesses online allows us to solve the user engagement problem through profit sharing. In summary, this paper makes the following contributions:

- Introduces the Social Farm model for building businesses utilizing online social networks as a foundation.
- Provides a general framework for business creation, operation, growth, and management built on the online social networks programming interface.
- Develops a novel technique for work-flow specification, monitoring, and execution for Social Farm businesses.
- Describes how the Social Farm can be applied to online communities in order to encourage engagement through the profit motive.

2. THE SOCIAL FARM BUSINESS MODEL

Economic activity is traditionally carried out in an organized manner. Typically, businesses are collections of individuals performing specialized functions to produce goods and services. Economists have investigated why certain economic activities are carried out within businesses instead of being traded in a free market. The traditional explanation for the existence of businesses, first provided by Coase, claimed that business organizations allow the efficient allocation of resources by avoiding the transaction costs of acquiring these resources in the free market [9, 33].

Online social networks allow the Social Farm businesses to access resources in an automatic manner. This is enabled by the pre-existing social ties and the programmable API provided by online social networks. Having a social network based automatic resource discovery process is likely to provide a transaction cost advantage by making it cheaper and faster to search for resources [3] and to co-ordinate tasks [10]. The social farm proposal also enables businesses to gather the required resources from a wider pool of potential candidates. This allows Social Farm businesses to select better resources or to operate with reduced cost.

Traditional business organizations are also evolving towards loosely coupled organizational forms [28]. Operating businesses on the social farm allows for a similar setup, except that the business organization is built from the bottom up. The challenge is to create, operate, and grow businesses on the Social Farm by faithfully mapping traditional business activities onto online social networks to produce identical products or services.

2.1 Business Components

In this section, we define the Social Farm business model in terms of its main components. These components are the business members, the reputation assigned to both the business and its members by consumers, and the business workflow, which defines the business execution.

DEFINITION 1 (MEMBER). *A member is an online social network user who participates in the activities of the business.*

In context of the movie rental service, online social network users, who wish to rent movies to others, can join the business as members. Observe that members correspond to workers, partners, and managers in traditional businesses. Members have resources and skills which can be used for business activities.

DEFINITION 2 (REPUTATION). *The reputation R is an integer encoding the expertise of a member m in a given skill s:*

$$R : (m, s) \mapsto \{0, 1, 2, \ldots\}$$

Members have reputations, one for each area of contribution to the business. For example, members of the movie rental service may have skills like *quick delivery*, *high definition DVDs*, or *failure rate*. Each member has reputation values representing their performance and skills.

Operating a business requires its members to perform a series of actions in order to produce a productive outcome. In context of our Social Farm proposal, a task is a command to a given member to perform a specific action. Tasks are interpreted by the members skilled in performing them. Performing an action not only results in the corresponding business action being done, but also allows a consumer to update the business' (and indirectly) the members' reputations. Combining these concepts, we can now define a business on the Social Farm as follows:

DEFINITION 3 (BUSINESS). *A business $\mathcal{B}$ consists of:*

- *A set of members $M = \{m_1, \ldots, m_k\}$, who have the skills or resources required to support the activities of the business.*
- *A set of states Q representing the various stages in the activities of the business.*
- *A task function $\mathcal{T}$ defined for each state $q \in Q$ of the business:*

  $$\mathcal{T}(q) = \langle p, T, S, D_r, D_p \rangle$$

  where

- $p \in Q$ *is the next state of the business after the task* T *is performed by a member* $m \in M$ *with skills* $S^\star \supset S$.
- S *is the set of skills required to perform the task* T.
- D_r *is a distribution function specifying how the reputation earned after performing the task shall be distributed among the members in* M.
- D_p *is a payment function specifying how the profit earned after performing the task shall be distributed among the members in* M.

- *A start state* $q_0 \in Q$ *where orders can be accepted for payment, and an end state* $q_f \in Q$ *where orders are completed.*

In the movie rental service, the initial state of the business is the "accepting movie request" state. The business state also contains information about the movies available for rent. Consumers use this information to place a movie rental order. Upon receiving a credit card payment and shipping address A, the business moves into the state: "processing movie request X". In this state, a member willing to rent the requested movie X is selected by the business logic for performing the action: "ship movie X to consumer at address A". The state associated with the movie rental business will now change to reflect that one less copy of the movie X is now available for rent. The business then moves into the initial accepting state, once again.[1]

2.2 Business Lifecycle Phases

The Social Farm is responsible for the creation, execution, and management of businesses. In this section, we describe each of these business lifecycle phases. We also carry forward the running example of a movie rental business to illustrate the various business phases.

2.2.1 Business Creation

Businesses on the Social Farm are created by a chairman. Every business has a member performing this role. The role of the chairman can also be transferred from one social network member to another. The chairman performs a number of actions as part of business creation. These actions include posting a business charter, inviting members to join the business, and specifying the skills and resources required by the business. Distribution of profits and reputation is also specified up front in the business charter.

The chairman also nominates the initial Board Members, whose role is to perform administrative actions for the business. Finally, the workflow logic for executing the business has to be defined. Upon completion of these steps, the business becomes operational.

In our example movie rental business, Joe decides to rent out his large collections of DVDs, as a service. He first creates the new business using the Social Farm business framework. In his new role as business chairman, he advertises within his social network for like-minded individuals to join his business as contributors.

[1]Throughout the remainder of the paper, we use italicized text to represent our running business example, as in this passage.

2.2.2 Business Execution

Operational businesses process transactions from consumers according to the business workflow. The business workflow logic translates each consumer request into a set of tasks, which are then assigned to members. Members complete the tasks, which ultimately changes the task status. The consumer transaction is complete once all the related tasks complete successfully.

Transaction completion results in the allocation of payments and impacts the reputation of members in the business. The consumer makes a payment while placing the transaction and rates the transaction experience by providing a reputation score on completion of the transaction. The consumer supplied reputation is used to update the reputations of members and businesses.

Reputation management: Businesses maintain reputations for a number of reasons. Consumers like to interact with highly rated businesses while members want to take credit for their work. Reputations are managed by having a number of business domains. Each business domain maps to a set of reputation categories. The business charter defines how reputations are distributed among business members.

Payment management: Payments are processed for each consumer transaction. While the allocation of payments can be done in a simple manner for successful orders, handling failed orders and returns requires special treatment.

Once Joe has recruited enough contributors to work in his business, he again uses the Social Farm application to specify the workflow logic of the business, and sets the reputation and payment distribution parameters. Once completed, he opens the business to start accepting consumer requests.

2.2.3 Business Management

Business management must be handled by the Board Members and consists of maintaining the business charter, changing the workflow logic, and performing membership maintenance.

As the Netflix-like business continues to accept and process consumer requests, Joe spends his days handling his tasks, as assigned to him by the Social Farm workflow scheduler, based upon the current business workflow logic. He also manages contributors by adding new people from his social network to join the business, and at times removing poorly performing contributors (through the Social Farm application). He is able to determine contributor performance by utilizing the Social Farm workflow monitoring tool.

3. THE SOCIAL FARM ARCHITECTURE

In this section, we present the Social Farm architecture and the relevant details of the key Social Farm system components. Our primary design goal is to reduce the cost of business creation, management, and growth. The approach to meeting this goal is to identify those tasks common to all the businesses and provide tools and support for these.

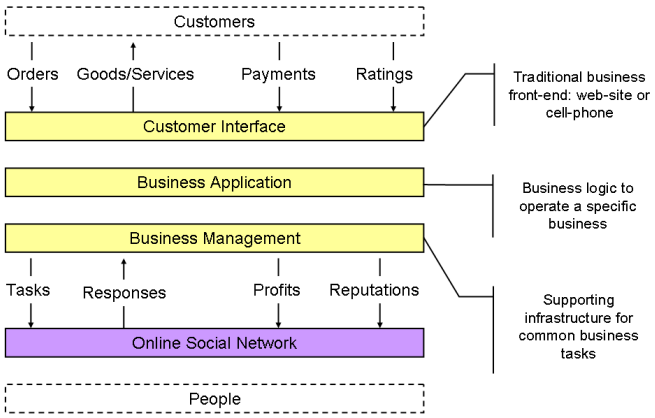

Figure 1: The Social Farm Architecture.

As shown in Figure 1, the Social Farm architecture overlays a social network and is divided into three layers: *(i)* the Business Support layer, *(ii)* the Business Workflow layer, and *(iii)* the Customer Interface layer. Here, we describe the system components (see Figure 2) that compose each layer, including the component interfaces and the interactions that occur between components.

3.1 Business Support Layer

The role of the Business Support layer is to make it easy for users to create, operate, and grow their businesses. The system components of this layer represent functional extensions to the underlying online social network and provide extended support for: *(i)* business formation, *(ii)* execution, and monitoring of business workflow, *(iii)* calculation and verification of business reputation, and *(iv)* collection and distribution of payment for product or service[2].

3.1.1 Business Formation

A user who wishes to form a new business starts by installing the Social Farm application into her online social network profile. This provides both the Business Management Interface (BMI) and the Task Manager (TM) graphical interfaces. Through the BMI, the user initiates the creation of her new business, specifying the high-level business plan and the criteria that other potential members must meet to join the business.

Once created, the business is offered for other members to join based upon the invitation model and the member offer criteria. Once a potential member accepts the invitation, the business' Board Members will review the application to verify that all join criteria have been met and respond with acceptance or denial.

We envisage four invitation models to control how invitations are propagated through the online social network. The Friend-to-Friend (F2F) and Friend-to-Friend with Forwarding (FFF) models are similar in that a user may only forward invitations to her first degree friends in the online social network. They differ in that FFF allows a received invitation to be forwarded by a user who declines membership herself, while the F2F model only allows accepted business members to invite their friends. The General Public Advertisement (GPA) and Limited Public Advertisement with Link Validation (LPA) models both make use of a business formation message board, provided by the Social Farm. Under GPA, all users may view the announcement. This approach could face significant delays in gathering members because of the way public information travels in social networks [8]. LPA limits the announcement to those people who are linked to a business member in the social graph within N degrees (N being specified during formation). The purpose of this is to leverage the fact that short paths imply stronger trust relationships in the graph and to limit the propagation of invitations to within a certain "radius of trust" in the social graph. Since closer social relationships have also been shown to lead to more effective interactions [18], the LPA approach is likely to provide the most effective results.

Joe, the chairman of our running Netflix-like business example, utilizes the BMI to perform the initial business creation. In the interface, he specifies the details of the Business Charter and advertises his new business within his social network via the FFF model. He chooses this model, since he is not sure any of his directly linked "friends" will be interested in joining his business, but he believes that the friends of his friends may want to join. He also wants to be able to trace the social network path between himself and potential contributors, as a means of generating a referral path.

3.1.2 Business Execution and Monitoring

Once the Board Members have completed the formulation of the business execution workflow (see Section 3.2), the business is ready to be formally opened and to start processing customer requests. The business workflow is executed by the Business Runtime component which performs the business task scheduling, routing, and monitoring within the Social Farm. Tasks represent the smallest unit of work that can be assigned to a business member to process. They are created in response to either a consumer request or periodically by the runtime as specified in the Business Workflow Logic. Once created, tasks are scheduled according to the workflow and ultimately assigned to one or more members for processing. Once a task has been processed, its status is updated and it is removed from the workflow by the runtime. Tasks may also include a deadline and the runtime prioritizes such tasks according to their deadlines.

As stated earlier, each business member has a Task Manager installed in her online social network profile. Through the TM she can access, accept, update, or reassign any tasks assigned to her, as well as, inspect the currently running workflow and review the status of any active task in the workflow.

Within the confines of our movie rental example, the contributors all utilize their own instances of the Task Manager (TM) interface to view the pending tasks that have been as-

[2]We stress that these are functional extensions. We would not require modifications to an underlying online social network, which provides an application developers environment, e.g. Facebook. In that case, our system can be implemented through the online social network's application development kit.

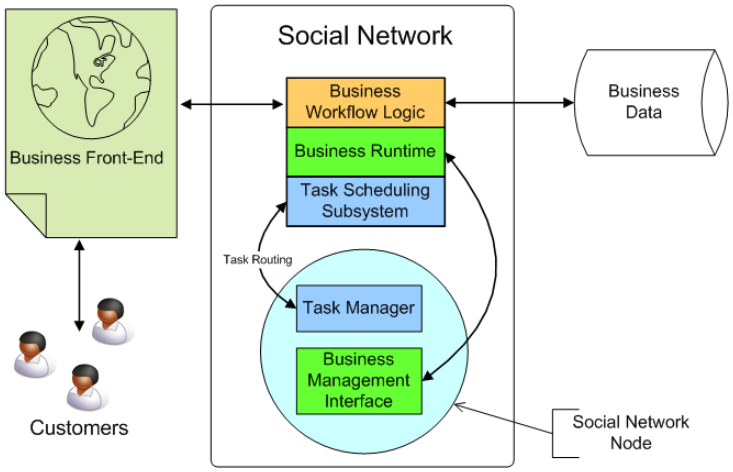

Figure 2: The Social Farm System.

signed to them, and to signal back to the workflow system when these tasks have been completed. Those with the proper authority to view the entire workflow, can also monitor the progress of tasks within the workflow using the TM. This provides a way to determine the real-time status of tasks and to view performance statistics for individual contributors. Joe keeps a close eye on how tasks are handled within the business, to ensure high customer satisfaction to continue to grow the business and its reputation.

3.1.3 Reputation Verification and Distribution

As for any customer-focused activity, the reputation of a business carries substantial weight and must be handled carefully by the system in order to ensure the integrity of the reputation metric. We leverage the reputation of the online social network as a foundation of trust for the businesses that are operated within its confines. Therefore, it is the online social network, through the extended support provided by the Social Farm system, that is responsible for verifying a business' reputation.

All reputation is created by customers. This means that any customer who has completed a transaction with a business may rate that business with a transaction score (as described in Section 2.1). Reputation flows from customers to individual business members according to the established distribution function for the business. Each business specifies how the assigned ratings change the reputation of Key Contributors, Board Members, and other members.

The following functions describe the general case for all stages in the business lifecycle. When a new business is formed, we initially calculate the business reputation as:

$$R_{Business} = avg\{R_{BoardMember}\}$$

Thereafter, we use the following formula to calculate the business reputation, each day:

$$R_{Business} = max\{R_{Business}, avg\{R_{Member}\}\}$$

Should a board member decide to leave while the condition $R_{Business} < avg\{R_{BoardMember}\}$ holds, we reset the business reputation to:

$$R_{Business} = max\{avg\{R_{BoardMember}\}, avg\{R_{Member}\}\}$$

The reason for making this choice is that in the initial stages of business formation, new members may not have high enough reputation to result in fair business reputation. The appropriate reputation aggregation method is selected automatically by the business management layer. Note that we are tentatively using average based formula to calculate business reputation as a compromise between median based and min-max based formulas.

3.1.4 Payment Distribution

Payment distribution is handled similar to reputation, but does not require any historical information to be kept by the system. The Board specifies the per-transaction payment distribution percentages to be paid to Key Contributors, Board Members, and others. For each transaction, the Social Network verifies the transaction, possibly through an agreement with a third party payment vendor [24], and distributes the funds as per the payment distribution specification.

One difference between the reputation system and the payment system is that it is possible for a customer to request a refund. To handle this case, the online social network holds all payments in escrow for a period of time specified by the business as the *refund period*, beyond which a refund for a given transaction will no longer be granted. This guarantees both transparency of the refund terms prior to the transaction and availability verification of funds to cover the refund during the refund period for a customer by the online social network.

3.2 Business Workflow Layer

Business workflows have traditionally been modeled through a variety of techniques. These have been used to analyze business workflows to improve efficiency or control. While there exist a number of business workflow modeling techniques (see Table 1), they differ by stressing particular aspects of business workflows [5]. Since these techniques have been used to model a large number of real world activi-

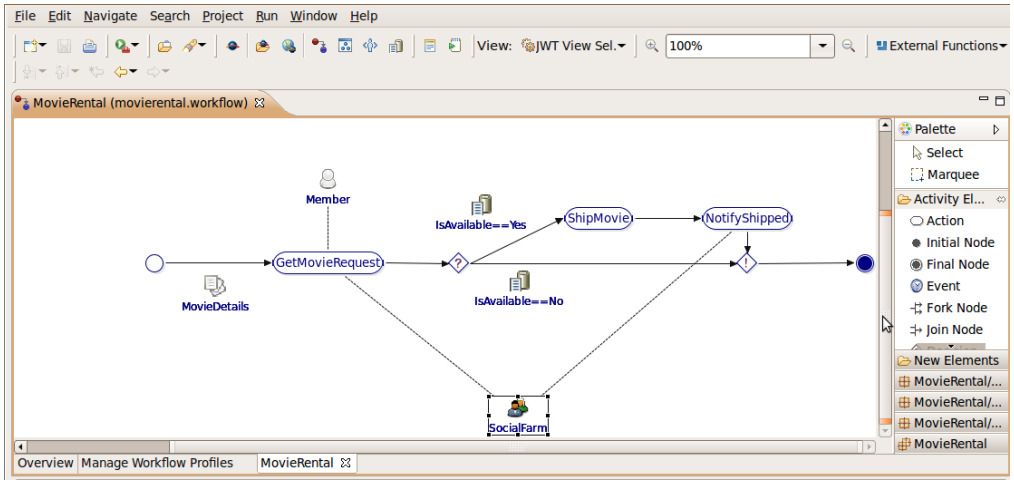

Figure 3: Graphical tool for creating work flows specifying businesses on the Social Farm.

Modeling Technique	Salient Features
Flow chart	Relationship between tasks.
Gantt chart	Performance and progress of tasks assigned to contributors.
Workflow	Flow of tasks between contributors in specific roles.
PERT/CPM	Workflow completion analysis based on the critical paths within a set of dependent tasks.

Table 1: Business Workflow Description Methods.

ties, they represent a suitable template for defining arbitrary businesses.

All business workflow modeling methods associate a set of attributes with each task, and a contributor responsible for performing it. Tasks also have completion status, expected and actual durations, start and finish times, and possibly a set of pre-requisites. These pre-requisites can function as a starting or completion criteria for the task. Pre-requisites include any resources needed to complete the task, as well as, the status of predecessor tasks upon which this task may depend. Since some of the modeling techniques prohibit loops, we require each task in the business to be specified in terms of pre-requisite tasks and resources. This allows designers to create task templates with pre-requisite relationships. Particular aspects of tasks, e.g., start/finish times, contributing member assignments, resource status, and predecessor task status will be assigned by the business application layer at execution time. The Social Farm allows business Board Members to specify the workflow in one of these methods (Table 1) and translated into a program to be executed by the Workflow Runtime.

3.3 Customer Interface

To the external world, the Social Farm provides a web-based portal through which customers may search or browse for businesses that provide the service or product of interest. This default interface is provided by the Social Farm and is available to any Social Farm business. A business may also choose to construct its own web-based business front-end external to the Social Farm, which interacts with the other Social Farm layers for all interactions between customers and the business.

A customer decides to rent a movie from Joe's Netflix-like business. She pays for her selection through the Social Farm payment interface, and the funds are held in escrow until the transaction has been completed. A task is created by the workflow system and routed to a contributor based upon the business workflow logic. Remember, Joe specified this logic prior to opening the business. In this example, the logic dictates that the task be routed to a contributor that has an available copy of the selected movie. That contributor accepts the task, ships the movie to the customer, and signals that the movie has shipped. Once the customer returns the movie, the contributor signals completion of the transaction. At this point, the Social Farm asks for customer feedback and updates contributor reputation. It also delivers the escrowed payment to the contributor.

4. THE SOCIAL FARM PROTOTYPE

We are currently implementing a prototype Social Farm business as a Facebook application [13, 14]. We are using the Django [12] web framework and the Python [26] programming language. Since we cannot directly extend the service provided by Facebook, we are implementing the various components as application logic external to, but accessible within Facebook. Our components use the standard Facebook application development kit. We chose to implement the prototype Social Farm within Facebook simply due to the fact that it provides a rich application development environment. Social Farm is not restricted to Facebook and can be implemented on top of any online social network that provides a similar application development capability.

The prototype allows users to graphically create social farm businesses. This is done by using the Java Workflow Tooklit (JWT) from the Eclipse development environment [1]. As shown in Figure 3, its workflow editor can be used to graphically define Social farm workflows. Workflows are exported from JWT into the XML based standard XPDL process def-

inition language for execution. Our prototype enhances the workflow specification by noting the tasks to be delegated to the social network.

The social farm prototype executes the workflow described in process definition language. This is done by instrumenting the open source Scarbo workflow execution engine to execute the specified workflow [31]. The workflow engine is modified to use the social network for task assignment. This allows the business to operate on the social farm. We also provide a graphical monitoring and management console for social farm businesses. It is based on Bonita monitoring and management console available with the workflow engine. The console allows monitoring and management of specific tasks as well as entire workflows.

5. DISCUSSION

The social farm allows us to engage users through the profit motive. Existing web sites and communities relying on user generated content separate the issue of financial viability from the issue of user engagement. For example, Facebook allows users to publish content for free, but displays advertisements to pay for its operations. Applying social farm for encouraging engagement allows us to bridge this gap. Social farm users would be able to organize their efforts and have a transparent way of sharing the profits earned from their contribution. We believe that using the profit motive can support enhanced levels of engagement in online communities in diverse interest areas.

Recently, open business models [2] have been proposed. The key idea is to allow innovation in to occur in an open fashion, similar to the open-source software movement. The Social Farm provides a well-placed venue to support such open business models. Since the business definition in social farm is based on a process definition language, and operates on an open source platform, users can better deduce the scrupulousness of particular businesses. Having this assurance would reduce the risk of participation, thereby further encouraging engagement.

6. RELATED WORK

The problem of designing engaging communities and web sites has received research attention from the computer human interaction point of view. O'Brien and Toms developed an operational definition of engagement and identified its key components [23]. Millen and Patterson investigated the determinants of social interaction in a community network. Their analysis focused on informational issues like interactivity, event notification, and topic selection to encourage participation [22].

The impact of social and psychological factors on user contributions has also received considerable research attention. The effects of group similarity have been observed by Ludford et.al. [20]. They find that user contributions increase in groups with diverse perspectives. The influence of displaying the value of contribution and other group related metrics is also well documented [6, 27].

The ease of finding suitable tasks has been identified as an important factor limiting user engagement. Cosley et. al. use link relationships, text analysis, and collaboration relationships to route tasks to editors on Wikipedia [11]. Results show a significant improvement in editor productivity. This approach of helping members find appropriate volunteer work can be thought of as a community-specific nonprofit counterpart of our solution.

Our approach of using the profit motive to incentivize participation complements the existing user engagement approaches. It is also related to prior research in terms of the primitives used for creating the Social Farm.

Business process modeling is an established area of research. It has traditionally been investigated from the business information systems point of view with the goal of improving existing businesses. The evolution and contribution of business process modeling techniques is traced in the survey papers [5, 32]. On the industrial front, a number of popular business process management systems are in the market. The major ones being SAP, Baan, PeopleSoft, and Oracle. The role of business process models and business process management systems is to help analyze and monitor existing business processes. In contrast to the work done in the business process area, our Social Farm model is designed to foster the creation of new businesses on online social networks instead of analyzing or improving existing businesses.

The rise of organizations working through electronic hierarchies (complementary to electronic markets) has been predicted by Malone [21]. The social farm also realizes the electronic commerce research goal identified by Kauffman and Walden [17] that transformation of business processes within the firm should reduce the overall costs of doing business, and possibly replace the physical infrastructure of an organization with a virtual infrastructure. Such a move is expected to improve the firm's immediacy and responsiveness while broadening its coverage in the marketplace. Constructing the social farm on top of the online social network continues the longer term trend towards highly networked organizations [25].

The open source movement allows co-operating users to aggregate their volunteer work into free software and content (e.g., GNU software and Wikipedia). The rise of the open source software movement, where unorganized volunteers can create better software than powerful corporations, is an instance where digital connectivity trumps the advantage of traditional business organizations [7]. Our proposal takes this trend a step further by allowing co-operative social network users to create, operate, and grow businesses on the Social Farm.

7. CONCLUSIONS AND FUTURE WORK

In this paper, we have presented the Social Farm architecture for encouraging user engagement through the profit motive. Social farm provides a novel way to create, manage, and grow businesses on top of online social networks. It uses the trust implicit in social relationships and the social network programming interface to create and operate businesses on top of existing online social networks.

We have described our work-in-progress prototype implementation of the Social Farm as a Facebook application. We plan to complete the prototype and build a number of busi-

nesses as feasibility studies. We will use the businesses for conducting user studies as well as to assess the effectiveness of the Social Farm.

8. ACKNOWLEDGMENTS

This work was supported in part by the NSF under grant CNS-0831268.

9. REFERENCES

[1] Eclipse - Java Workflow Tooling Project (JWT). `http://www.eclipse.org/jwt/`.

[2] Open business models. Center for Open Innovation, Haas School of Business, UC Berkeley.

[3] L. Adamic and E. Adar. How to search a social network. *Social Networks*, 27(3):187 – 203, 2005.

[4] E. Adar and B. Huberman. Free riding on gnutella. *First Monday*, 5(10):2–13, 2000.

[5] R. S. Aguilar-Saven. Business process modelling: Review and framework. *International Journal of Production Economics*, 90(2):129–149, July 2004.

[6] G. Beenen, K. Ling, X. Wang, K. Chang, D. Frankowski, P. Resnick, and R. Kraut. Using social psychology to motivate contributions to online communities. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work*, pages 212–221. ACM, 2004.

[7] Y. Benkler. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press, November 2007.

[8] M. Cha, A. Mislove, and K. P. Gummadi. A measurement-driven analysis of information propagation in the flickr social network. In *WWW '09: Proceedings of the 18th international conference on World wide web*, pages 721–730, New York, NY, USA, 2009. ACM.

[9] R. H. Coase. The Nature of the Firm. *Economica*, 4(16):386–405, November 1937.

[10] A. Cordella and K. A. Simon. The Impact of Information Technology on Transaction and Coordination Cost. *Information Systems Research*, 1997.

[11] D. Cosley, D. Frankowski, L. Terveen, and J. Riedl. SuggestBot: using intelligent task routing to help people find work in wikipedia. In *Proceedings of the 12th international conference on Intelligent user interfaces*, pages 32–41. ACM, 2007.

[12] Django web framework. `http://www.djangoproject.com`.

[13] Facebook.com. `http://www.facebook.com`.

[14] Facebook developers platform. `http://developers.facebook.com`.

[15] G. Hardin. The tragedy of the commons. The population problem has no technical solution; it requires a fundamental extension in morality. *Science (New York, NY)*, 162(859):1243, 1968.

[16] S. Karau and K. Williams. Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology*, 65(4):681, 1993.

[17] R. J. Kauffman and E. A. Walden. Economics and electronic commerce: Survey and directions for research. *Int. J. Electron. Commerce*, 5(4):5–116, 2001.

[18] G. Kossinets and D. J. Watts. Empirical Analysis of an Evolving Social Network. *Science*, 311(5757):88–90, 2006.

[19] H. Y. Lee, H. Ahn, and I. Han. Analysis of trust in the e-commerce adoption. In *HICSS '06: Proceedings of the 39th Annual Hawaii International Conference on System Sciences*, page 113.3, Washington, DC, USA, 2006. IEEE Computer Society.

[20] P. Ludford, D. Cosley, D. Frankowski, and L. Terveen. Think different: increasing online community participation using uniqueness and group dissimilarity. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 631–638. ACM, 2004.

[21] T. W. Malone, J. Yates, and R. I. Benjamin. Electronic markets and electronic hierarchies. *Commun. ACM*, 30(6):484–497, 1987.

[22] D. R. Millen and J. F. Patterson. Stimulating social engagement in a community network. In *Proceedings of the 2002 ACM conference on Computer supported cooperative work*, CSCW '02, pages 306–313, New York, NY, USA, 2002. ACM.

[23] H. L. O'Brien and E. G. Toms. What is user engagement? a conceptual framework for defining user engagement with technology. *JASIST*, 59(6):938–955, 2008.

[24] Paypal.com. `http://www.paypal.com`.

[25] W. W. Powell. *Neither market nor hierarchy: Network forms of organization*, volume 12, pages 295–336. JAI Press, Greenwich, CT, 1990.

[26] Python programming language. `http://www.python.org`.

[27] A. Rashid, K. Ling, R. Tassone, P. Resnick, R. Kraut, and J. Riedl. Motivating participation by displaying the value of contribution. In *Proceedings of the SIGCHI conference on Human Factors in computing systems*, pages 955–958. ACM, 2006.

[28] A. Sahaym, H. K. Steensma, and M. A. Schilling. The influence of information technology on the use of loosely coupled organizational forms: An industry-level analysis. *Organization Science*, 18(5):865–880, 2007.

[29] P. A. Samuelson. The pure theory of public expenditure. *The Review of Economics and Statistics*, 36(4):pp. 387–389, 1954.

[30] S. Saroiu, P. Gummadi, S. Gribble, et al. A measurement study of peer-to-peer file sharing systems. In *proceedings of Multimedia Computing and Networking*, volume 2002, page 152. Citeseer, 2002.

[31] The OW2 Consortium. Scarbo project. `http://wiki.scarbo.ow2.org/xwiki/bin/view/Main/`.

[32] W. M. P. van der Aalst, A. H. M. ter Hofstede, and M. Weske. Business process management: A survey. In W. M. P. van der Aalst, A. H. M. ter Hofstede, and M. Weske, editors, *Business Process Management*, volume 2678 of *Lecture Notes in Computer Science*, pages 1–12. Springer, 2003.

[33] O. E. Williamson. The economics of organization: The transaction cost approach. *The American Journal of Sociology*, 87(3):548–577, 1981.