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## COLLEX: Solving Collective Action Problems in Development Contexts

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### Abstract

In developing country contexts, government services often cannot be taken for granted. Such services may be unreliable, demand illicit payment to function, or simply be unavailable when needed most. If locals were better empowered to work towards solving problems in their own communities, the impact of governance deficits could be reduced in importance, leading to significant improvements in quality of life.

This paper lays the foundation for an open-source software package, COLLEX, intended to help people take the management of collective action problems into their own hands, leading to the generation of public goods that may otherwise never arise.

COLLEX advances psychologically-sound principles for communicating and structuring projects, handles rewards and failure, and addresses funding and maintenance concerns.

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### 1. Introduction

In developing country contexts, government services often cannot be taken for granted. Such services may be unreliable, demand illicit payment to function, or simply be unavailable when needed most. If locals were better empowered to work towards solving problems in their own communities, the impact of governance deficits could be reduced in importance, leading to significant improvements in quality of life. [1] Scholars and development agencies alike highlight the important contribution that decentralized governance can make towards the facilitation of human welfare. [2, 3]

This paper lays out core principles for an open-source software package, COLLEX, intended to help people take the management of collective action problems into their own hands, thereby generating public goods that might otherwise never arise. The paper identifies the scope of such a project and lays out solutions for potential problems. It advances psychologically-sound principles for communicating and structuring

projects, handles rewards and failure, and addresses funding and maintenance concerns. Along the lines laid out by UNDP in [3], the paper also details a myriad of roles the international development community can play in helping this vision become a reality.

## 2. Problem Description

Most meaningful real-world projects require significant collaboration and cooperation in order to be successful (that is, collective action [4]). Communities often have trouble arranging such projects, however; despite the fact that all members may ultimately benefit in aggregate should the project succeed, the costs of action by any one individual are often prohibitive, especially when payoffs are unclear (that is, the usual case).

Beyond this, projects often fail to be successfully organized (even when many or most would benefit) in cases where community members:

1. Do not know if others will contribute, and don't wish to be the only one, or to be taken advantage of.
2. Do not feel like their contribution will make a difference.
3. Fear being lost in a crowd and not highlighted for their efforts.
4. Fear proposing projects because they won't be heard.
5. Don't know that other people want the same things they do (when communication is difficult and expensive to organize), depriving the community of organically-generated critical masses which would otherwise have been present.
6. Suffer when decision makers are unaccountable or act as bottlenecks, rejecting projects wanted by many, causing projects to fail through mismanagement, or starting projects that the community does not want.
7. Are concerned that others may act as free riders, thus abstaining from participation in order to avoid this uncomfortable reality (a form of pre-emptive punishment).
8. Feel overwhelmed at the enormity of a problem, which in turn acts as a barrier to participation.

COLLEX is intended to help local community members decide which projects they wish to see undertaken in their communities, determine who will participate in these projects and how, and help structure the funding of these projects when necessary, generally helping reduce the need for central authorities to play key roles in solving collective action problems.

COLLEX's incentive structure and internal governance mechanisms draw deeply on psychological research (cf. [5, 6]) and are expressly designed to maximize the potential contributions of technology to governance. In areas where knowledge is likely to be disputed, the system facilitates trusted arbitration. Where information must be managed, COLLEX does so autonomously, guiding contributors towards making themselves heard in the most useful way possible.

## 3. The COLLEX Software Package

COLLEX is envisioned as a software package, installed on a single community-wide server with very basic specifications (and basic physical security).

### 3.1. Core Aspects of the COLLEX System

In general, anyone may propose or design a COLLEX project. Projects are structured via *mini-roles*, intended to represent contributions small enough to be tractable yet significant enough to make a difference.

### 3.1.1. Core Values

COLLEX proposes, broadly, the following core values:

1. Money should not be required in order to participate in projects; votes must be obtainable regardless of whether or not one possesses money or fame.
2. Funding can be accomplished collectively or in large groups; each person can contribute a certain amount of money as part of a mini-role, though the value of pure money payments will be discounted slightly vis-a-vis the contributions of those who perform hands-on work.
3. *No Nepotism*: People may not vote on projects they themselves submitted or worked on. People may not vote on projects submitted or worked on by those that other people recognize as their family members or close friends. The software tool will help maintain knowledge of who is related to whom and how, and the community has an inherent incentive to use voting to determine the accuracy of the data. The more accurate the lists, the less likely it is that entrenched patterns of influence will affect outcomes.
4. A key goal is *egalitarianism* and *openness*: *no bottlenecks* and *no single person* required for approval. COLLEX proposes the following '*Anyones*':
  - (a) *Anyone* can make a claim to join a community.
  - (b) *Anyone* can propose a project.
  - (c) *Anyone* can propose mini-roles for a project.
  - (d) *Anyone* can perform a mini-role.
  - (e) *Anyone* can verify that a mini-role has been performed.
  - (f) *Anyone* can vote (anonymously) on mini-role-related questions, project completion checks, and any other issues. Personalized vote results will not be extractible after votes have been tallied.
5. Voting thresholds (minimum numbers of votes) are employed where needed, intended to better align vote results with general sentiment.
6. Those with strong conflicts of interest (as determined anonymously by the community) may continue to vote, but their votes will be discounted to a certain extent.
7. Rewards are used to increase participation, improve project execution quality, and make participation more engaging and worthwhile.

### 3.1.2. Proposing and Choosing Projects

Any *Community Member* (defined below) may put forth a project they would like to see developed. In this way, others in the community are able to see what their fellow members view as important, and are able to extend their voice (through their proposals and votes) regarding those projects they personally find most important. A monetary extension could be added such that proposing projects costs some token sum of money, such that people feel they have something 'on the line' when proposing projects and are thus likely to value those projects more (things that come at a cost increase in value psychologically).

The software allows sorting through and ranking of possible projects, allowing community members to 1) register their interest, 2) determine *how much and how likely* they would contribute, and 3) determine *in what ways* they would be likely to participate if a project goes forward.

The system maintains a *Priority List* allowing potential collaborators to allocate their time to the most popular projects, but the list is not binding and anyone may seek to participate in any project regardless of where it is placed.

Communities may opt for an alternative model for certain projects, whereby only those who have contributed in the past may vote and/or suggest new projects, and/or such contributors may receive more votes. Under such a scheme, people who others recognize as members of the community may receive a certain number of votes without contributing, though after a short time they may need to begin contributing in order to retain the ability to vote.

### 3.1.3. Project Design

Collective project design is accomplished by *Proposers* and *Structurers*. A Proposer is someone who puts forth an initial idea, and Structurers contribute to the community by organizing larger projects into tasks and mini-roles. Anyone may perform either role.

Projects may be of two kinds: *Integral* or *Piecework*. Integral projects, by their nature, require a minimal set of mini-roles to be filled before they become feasible. Such projects could include the erection of buildings or other projects involving significant capital and labor inputs. Such projects are automatically accepted by the system when the number of mini-roles specified by the project designer have been filled and the minimum amount of capital has been raised (see below for more information on the funding model).

Piecework projects (such as building a garden), on the other hand, can be undertaken mini-role by mini-role, because once a mini-role has been proposed and filled, that part of the project may be carried out without necessary direct reference to the other parts. Piecework projects are automatically accepted by the system once a *single* mini-role has been filled.

### 3.1.4. Mini-Roles

The idea behind mini-roles is to break projects up into task components which are small and tractable in scope, thus incurring few costs, yet capable of providing psychological gains and meaningfully contributing to project success.

Anyone may serve as a Structurer who helps organize a project into mini-roles; the system does not depend on one designated person to segment a project into roles (as such an arrangement would generate a bottleneck).

The system maintains a database of various numerical *Factor* scores (described below) for each user, intended to keep track of how much and how well each community member has been participating in the mini-roles they have agreed to take on within the COLLEX system.

To provide an incentive to do good work as well as in order to determine participation-related user scores, work performed under each mini-role is checked by two or more other members of the community (counted in turn towards their own participation scores). A minimal measure of participation credit is granted whether or not work is ultimately approved (though significantly less credit is granted in cases where the work is not up to standard).

Anyone may participate in a mini-role. Each community member possesses a Mini-Role Preference Factor, calculated based on his expertise and past conduct. For example, if a roof needs to be placed on a schoolhouse, those who have specific expertise and/or whose similar work has been well-reviewed in the past would receive a higher value for this Factor.

As an incentive for successful participation, the Preference Factor multiplies other factors; someone with a high Preference Factor may be rewarded slightly more for his contribution than someone else.

If a person has been Banned (see below) from a particular mini-role in the past, a majority vote of the community will be required before that person may undertake the same role in future. If a person wishes to undertake a mini-role he has not been banned from but has at some point been banned from *any aspect of participation* in the past, a submajority vote will be required in order to participate, and the required number of votes will decrease over time.

### 3.1.5. Funding

Projects that depend on funding or capital inputs use a 'micro-funding model' wherein each person fulfilling a mini-role is permitted to specify what resources they need, and community members then vote on whether or not to allocate those resources and/or to adjust them.

Smaller projects may be handled via a minimal budget allocated to the person filling particular mini-roles, disbursed purchase-by-purchase in small amounts. After each purchase, the next budget installment may generally only be obtained after successful submission and validation of receipts. Any irregularities will increase scrutiny and may lead to banning.

Larger purchases will require majority votes for both the purchases themselves and consensus regarding the identity of personnel tasked with ensuring that purchase funds are properly handled and purchases are properly maintained.

Trusted third parties and/or people supportive of the overall system act as *Treasurers*, responsible for making purchases with collected monies and ensuring that funds are spent only as approved.

Once purchase decisions are made, as many community members as possible contribute small amounts to a payment system controlled by the COLLEX server, which maintains a tally of who has contributed. Purchased items belong to the common Treasury and may only be deployed on future projects for the community that paid for them unless they are sold, in which case the proceeds remain in the Treasury for future projects.

Such sale funds should not generally be used to defray COLLEX maintenance costs, as this may create a conflict of interest and lead to excessive purchasing and salvage.

### 3.1.6. Vote Allocation

Many aspects of COLLEX depend on votes. The general principle is that each member of an *Affected Community* (as defined below) possesses one vote, with the *weight* of that vote subject to a combination of the Factor scores possessed by a voting individual.

An Affected Community is the set of people who are likely to be affected, positively, or negatively, by a COLLEX project.

Anyone may register their claim to be part of a community, and their claim will be accepted automatically unless they are rejected by a significant number of other members. Thus, membership in an Affected Community depends on the votes of others; potential community members collectively decide who is a member. In order to encourage community members to make participation available to whoever is interested, each member who votes for someone else to be considered as part of the community obtains an increased *Openness Factor*. A community member who is significantly more or less open than the rest will find their Openness Factor adjusted accordingly, as an incentive towards increasing participation.

As COLLEX user accounts are tied to votes, it may be necessary to ensure that individuals do not open multiple accounts. Development agencies may be able to play a role in user account database maintenance by helping to check identification documents or other means of validation in order to ensure that the 'one person, one vote' rule applies within COLLEX projects.

There may also be a quota set aside for non-community members to participate, providing access to new points of view, important resources, and/or important expertise. Collaborative projects represent opportunities to build bridges between communities and create friendships across existing divides.

### 3.1.7. Participation of the Development Community

Development agencies are likely to have presence in communities where COLLEX is likely to be deployed, and they may be able to play unique roles in such deployment.

Beyond the suggestions given in previous sections, agencies may assist in the setup and hosting of the COLLEX platform and may act as trusted third parties, filling Treasurer and dispute resolution roles. It may be politically difficult for development agencies to act as dispute resolvers (as such agencies normally require goodwill from multiple sides in order to be effective) but if practicable, they may contribute significantly in this way.

Development agencies may act as arbiters of excessive influence (during votes on conflict of interest), assist in judging expertise relative to mini-role performance, and provide other mediating influences.

### 3.1.8. Factor Scores

Factors represent numerical quantities assigned to individual community members within the COLLEX system, serving both to reward and dissuade community members from taking certain actions.

Whenever possible, individual desire for positive rewards is used to increase motivation and shape trends towards prosocial behavior.

To avoid over-reliance on a single person, there is a cap placed on the total amount of various Factors that may be accumulated.

Potential factors include the following:

#### **Community Membership Control Factor (CMCF)**

Allows heightened access to decision making regarding who is and is not a member of the local community. Community members vote for other community members with respect to this Factor; the more votes received, the higher the Factor value.

Communities may vote to designate certain community members as *Notaries* based on their reliability and knowledge of the community, who receive maximum CMCF Factors.

#### **Contribution Factor**

This factor tracks contribution, in terms of mini-roles accepted, completed, and successfully Approved.

The factor is reduced in the case of community members who sign up for mini-roles and don't perform the work they promised to, or who do bad work. It is significantly increased for those who contribute significantly more than others.

#### **Conflict of Interest Factor**

This factor is calculated based on how much the success or failure of a particular project is anticipated to directly enhance financial returns to a particular set of parties. If community members (through anonymous vote) register their concern that a particular person or set of people may be purchasing votes, those votes may be discounted accordingly via this factor. Development agencies may be able to assist community members in creating appropriate values for this factor.

#### **Openness Factor**

This factor is calculated by reference to how willing community members are to let others join the community. The factor is intended to provide an incentive for enhanced openness and work against inherent incentives to gain benefits by keeping others out.

#### **Reward Factor**

This factor is calculated based on other factors. Community members with high levels of this factor may obtain more reward credit for their contributions, be displayed more prominently on the COLLEX public Website, or have the priority of their projects enhanced during selection. The factor implements a 'snowball' effect in that those who participate more get exponentially more reward than those who participate less.

#### **Selection Factor**

This factor rewards contributors who most often propose projects that are eventually undertaken (if Integral) or participated in (if Piecework). The factor supports high quality project proposals, creating an incentive for creative proposals that are of value and that are presented in ways that enhance participation. Projects suggested by those with high Selection Factors will receive further elevation within the Priority List.

#### **Approver Factor**

Those who Approve work that is not later Reversed (within a reasonable time) receive increases in this factor, generating an incentive to undertake this kind of work.

In cases where work acceptance is Reversed by other community members because improper work was approved of when it should not have been, that Approver's Approver Factor level will be reduced in turn.

#### **Mini-Role Preference Factor**

This factor (the only factor which varies per mini-role) increases when there is a strong Contributor ↔ Mini-Role match (in terms of capabilities and/or past experience) and decreases (or is neutral or negative) otherwise. This factor helps find a strong fit between community interests, needs, and abilities.

### 3.2. Control Processes

COLLEX defines the following Control Processes, intended to assist in correcting the operation of the system when necessary. All Control Processes are generally intended to be carried out via anonymous vote through the COLLEX platform, which ensures that votes are properly recorded and securely stored.

#### **Ban (from participation or from specific mini-roles)**

If a specific participant consistently has difficulties participating or is disruptive, they may be banned from participation or from a specific set of mini-roles for some period of time. As described earlier, majority or submajority votes are required in order to end a ban.

#### **Project Stops / Reverse Approval**

If a project has begun and some sector of the community develops an intense opposition to it, a vote may be taken in order to determine whether the project needs to be stopped or modified. Development agencies may be able to act as mediators in cases where significant conflicts develop that are not readily resolved.

#### **Approvers**

Each mini-role is examined by two other community members or other examiners who determine if it has been accomplished appropriately. If so, relevant factors are adjusted accordingly. If not, the person originally tasked with the mini-role at issue may be asked to redo the work. If they are unsuccessful or cannot do so, the mini-role will be reopened so that another community member may attempt it.

Contributors who have been shown to do good work may eventually be subject to reduced Approver requirements as a reward.

#### **Structurer Approvers**

The work of Structurers (project designers/mini-role assigners) should also be subject to Approval; at least one other person should offer feedback, and if desired, alternative structures which can be voted on.

### 3.3. Maintenance

COLLEX projects may require maintenance, defined as ongoing efforts required after project completion. This can be handled through allocation of a set of maintenance mini-roles. Development agencies may wish to contribute small sums as compensation for performance of maintenance work and also as incentives to complete projects.

### 3.4. Practical Benefits

Practical benefits of the COLLEX system include the solving of information and coordination problems involved in knowing what others want, who can and would contribute, funding projects, and determining how contributions could take place.

COLLEX helps make parties aware of how small contributions can contribute to the whole. It makes contribution details crystal clear for all to see, and fairly assigns rewards after contributions are complete.

### 3.5. Psychological Benefits

Psychological benefits include empowering community members to achieve projects of their own design within their own communities. COLLEX allows for the public checking and tracking of past contributions, thus better ensuring honesty and cutting down on fears of free riding. COLLEX tracks progress so that those who have committed to contributing but ultimately fail to do so can be held accountable.

COLLEX provides community members with a 'window' through which they may see progress being made, enabling them to feel that their goals are attainable. The system generates a 'virtuous snowball' effect when contributions have begun and minimal thresholds have been publically reached, allowing people to begin to change their beliefs about what is *possible*.

COLLEX helps community members take projects seriously and its emphasis on explicit shared costs and rewards helps the community better value (and maintain) those projects once they are completed.

COLLEX rewards community members for participating (more when more participation is undertaken), helping to build a sense of community and inculcate pride, dedication, and other positive emotions. Because financial compensation is not often practicable in the contexts in which COLLEX is anticipated to be used, emotional, social, and psychic rewards ultimately serve as compensation for efforts undertaken and as motivational influences.

Community members are likely to participate because it feels good to do something useful, to be part of a team, and to do something of worth to the community. They may also participate because of the practical, tangible benefits of the projects they contribute to and the social benefits of being involved in meaningful work with others. They may work out of a sense of obligation to their communities and/or to individuals and to groups that are important to them.

#### **4. The Path Forward**

Initial support will likely be required from agencies and NGOs in order to help further develop the concept in the minds of users and build trust in the safety and practicality of the technology. Development actors may also play continuing roles around the area of trust management (acting as ‘Notaries’), which will further enhance relationships between organizations and the communities they serve.

While a basic level of physical security is required for the server hosting the COLLEX system, it is likely that existing, off-the-shelf technologies will prove sufficient.

#### **5. Conclusion**

COLLEX holds great potential to empower people to engage in work that furthers their own destiny in environments where collaboration is otherwise difficult.

Future steps to implement this vision include: 1) further development of COLLEX theoretical aspects, including Factor application equations and algorithms and further attention to control mechanisms and ‘loopholes’ in COLLEX procedures, 2) development of an open-source software package, 3) marketing of the tool to those who would be likely to use it, 4) resolution of concerns once the tool is in use, and 5) followup and study regarding how the tool is used.

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