Enterprise Architecture as a Public Goods Dilemma

An Experimental Approach

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Abstract. Enterprise architecture management (EAM) in organizations often requires coping with conflicts between long-term enterprise-wide goals and short-term goals of local decision-makers. We argue that these goal conflicts are similar to the goal conflicts that occur in public goods dilemmas: people are faced with a choice between an option (a) with a high collective benefit for a group of people and a low individual benefit, and another option (b) with a low collective benefit and a high individual benefit. Building on institutional theory, we hypothesize how different combinations of institutional pressures (coercive, normative, and mimetic) affect decision makers' behavior in such conflictive situations. We conduct a set of experiments for testing our hypotheses on cooperative behavior in a delayed-reward public goods dilemma. As preliminary results, we find that normative and mimetic pressures enhance cooperative behavior. Coercive pressure, however, may have detrimental effects in settings that normative and mimetic pressures are disregarded. In future work, we plan to transfer the abstract experimental design to the context of EAM and to subsequently test whether the preliminary results also hold in the EAM context.

Keywords: Enterprise Architecture, Experiment, Institutional Theory, Public Goods Dilemma.

1 Introduction

Organizations are considered as complex sociotechnical systems, in which humans interact with IT resources to achieve both personal and collective benefits [1]. In large organizations, guiding people and IT resources in the pursuit of multiple, often conflicting goals is a multifaceted endeavor that bears the potential of coordination failures (e.g., free-riding or a lack of trust) [2]. Consequently, large organizations require norms, rules, and conventions that enable to resolve goal conflicts between personal, group, and organizational interests, thereby promoting collective welfare [3]. Institutional theory postulates how such norms, rules, and conventions arise and consequently shape organizations [4]. Institutional theory explains how formal and informal institutions define the "rules of the game" [5] that guide the behavior of actors in organizations. In particular, institutional theory allows explaining human behavior in complex and conflicting situations [2, 6].

Within the information systems (IS) discipline, Enterprise Architecture Management (EAM) is a prevalent approach to create collective benefits in organizations through architectural coordination i.e., through creating short-term, local benefits in line with long-term, enterprise-wide goals. To this end, EAM needs to not only consider both IT- and business-related components [7], but also the values, norms, and culture that promote cooperative behavior and thus leverage collective benefits [8]. Consequently, there have been several efforts to investigate the institutionalization of EAM in different organizational contexts [9-12]. In general, these studies conclude that the presence of adequate institutional pressures is a prerequisite for achieving desirable EAM outcomes [10, 12, 13]. Considering that real-world institutional environments are highly diverse and conflicted [14], we propose an experiment to directly observe how institutional pressures impact cooperative behavior and the achievement of collective benefits in typical EAM scenarios.

In the experiment we thereby focus on goal conflicts between long-term, shared organizational goals and short-term goals of local decision-makers, which is a common issue in institutionalizing EAM [15]. We argue that these EAM-related goal conflicts are similar to abstract public goods dilemmas, in which participants are faced with a choice between two options: (a) a high collective benefit and a low personal benefit, and (b) a low collective benefit and a high personal benefit [2]. As a first step, this paper proposes a specific public goods dilemma, termed delayed-reward public goods dilemma that reflects the challenges observed in the institutionalization of EAM in organizations (i.e., shared long-term benefits vs. local short-term benefits). We then present the results of a pilot experiment, relying on Amazon MTurk [16] to recruit participants. This pilot experiment investigates how different institutional pressures impact cooperative behavior in the abstract delayed-reward public goods dilemma. Thus, we seek to answer the following research question:

RQ: What is the relative effect of different combinations of institutional pressures on cooperative behavior in a delayed-reward public goods dilemma?

In future work, we plan to transfer this public goods dilemma experiment to a more specific EAM context to test the applicability of our results to EAM. However, we already obtain interesting preliminary results from the pilot experiment. In particular, we confirm that institutional pressures do not act in isolation, rather there is an interplay among them in affecting human behavior [4]. Specifically, our preliminary results show that normative and mimetic pressures generally enhance cooperation. Coercive pressure, however, needs to be employed with care, as it may have devastating effects in settings without adequate normative and mimetic pressures. In such settings, people tend to spend significant resources to sanction the behavior of others without observable benefits, even at the cost of decreasing their own welfare, in addition to decreasing overall group welfare.

2 Theoretical Background and Research Model

In this section, we introduce the theoretical foundation of our research. First, we briefly discuss institutional theory. Then, we argue that many issues in EAM and architectural coordination in organizations may be conceptualized as public goods dilemmas. Finally, we describe the conceptual model that is the basis for our experimental design.

2.1 Institutional Theory

Institutional theory is one of the dominantly used theoretical lenses in examining various IS phenomena [17]. Institutional theory assumes that organizations are social constructions that constantly seek to gain legitimacy in their social context i.e., in order to survive, organizations must adhere to the rules and belief systems prevailing in their environment [5, 18].

Institutional theory distinguishes coercive, normative, and mimetic pressures as the central elements that shape behavior in institutions [5]. Each of these pressures delineate distinct mechanisms that, in turn, define the processes by which specific rules, norms, and beliefs gain legitimacy in organizations [14]. Coercive pressure represents a set of mechanisms through which organizations constrain and regularize behavior. It encompasses formally enforced rules and corresponding enforcement mechanisms, such as sanctions for not following the rules. Normative pressure represents social norms, values, and beliefs [19]. The presence of social structure in organizations may range from closely-knit social frameworks that prioritize group welfare, to individualistic environments that emphasize personal interests and achievements [20]. Finally, mimetic pressure reflects the shared conceptions that an organization's actors have about their social reality [19]. Once such shared conceptions have formed in an organization, they determine the frame of reference through which things are perceived [5]. That is, once people have accepted a certain type of behavior to be the default, all other options are compared to this "taken-for-granted" behavior [19]. Therefore, mimetic pressure is evident when actors encounter uncertain situations, in which they unconsciously model themselves on the other actors [14].

In a nutshell, institutional theory posits that coercive, normative, and mimetic pressures constitute the fundamental elements that shape and constrain behavior in organizations [5].

2.2 Architectural Coordination as a Public Goods Dilemma

EAM is concerned with organizing a company's business processes and corresponding technology infrastructure [8, 21]. Common activities include, for example, standardization activities that aim at the enterprise-wide reuse of applications for given business tasks, rather than allowing custom developments within single local units (e.g., departments), which incur unnecessary overhead costs and compatibility issues [21]. The problem in such cases is that, there is often an immediate and direct benefit for an individual local unit to disregard architectural coordination and to make a unilateral IT decision. In contrast, the benefits of EAM are only apparent in the long-term and shared

throughout the organization. As an illustration, consider the following excerpt from an EAM case study conducted by Cram et al. [21]:

"Interviewees indicated that some business and project leaders were fundamentally at odds with the objectives of the EA process and were unwilling to make financial sacrifices on individual initiatives in order to reap longer-term architectural benefits."

Thus, major issues in EAM institutionalization may be considered as goal conflicts between long-term, enterprise-wide goals and short-term goals of local units [15].

Behavioral scientists studied similar goal conflicts in abstract public goods dilemmas [2, 6]. In a public goods dilemma, a group of participants is faced with the following scenario: each individual may either contribute to a public good with a high payoff that is shared between group members (receiving less personally but increasing group welfare) or contribute to a private good with a lower payoff (receiving more personally but decreasing group welfare). In the context of EAM and architectural coordination, the benefit from contributing to the public good is not only shared, but also *delayed* (as it takes time to manifest). Consequently, we first test this specific delayed-rewards public goods dilemma in a pilot experiment before attempting to transfer extant theoretical knowledge to the EAM context.

For this purpose, we build on research that connects public goods dilemma experiments with institutional theory [e.g., 2, 6]. Regarding the basic public goods dilemma, previous research has repeatedly established that humans behave significantly more cooperative than game theory would rationally predict. Thus, there needs to be something more than pure rationality to explain human behavior. Consequently, behavioral social scientists have tested several variations of the public goods dilemma that correspond to varying institutional pressures. We build on these experiments to develop a conceptual model for our own experiments on the *delayed*-rewards public goods dilemma (see **Fig. 1**).

Regarding *coercive pressure*, researchers tested the effect of different sanctioning mechanisms on cooperative behavior and thus on collective benefits [22]. A common experiment design gives participants the option to use a part of their own payoff to sanction non-cooperative behavior of other players [23]. Researchers found that this option is frequently used, with the specific frequency depending on the associated costs and the fee-to-fine ratio [22]. Results regarding the collective benefits are mixed, with some studies finding increased collective group welfare [e.g., 6] whereas others find no such benefits or even worse outcomes at the group level [e.g., 24, 25]. Considering these mixed results, we hypothesize an impact, but no specific direction:

H1: *Coercive pressure impacts cooperative behavior in a delayed-rewards public goods dilemma.*

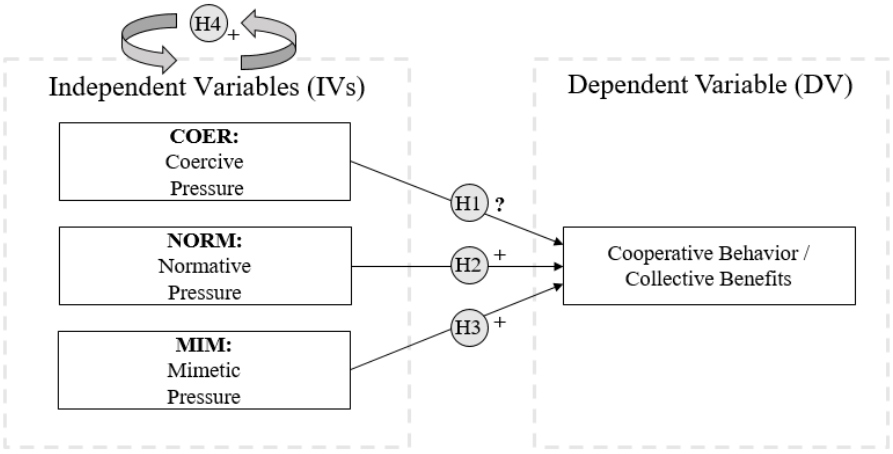

Fig. 1. Overview of the Conceptual Model

Concerning normative pressure, studies generally find that enhancing communication will increase cooperation [6]. In these experiments, the behavior of participants was tested in settings where people were easily enabled to communicate with one another, compared to settings where communication was difficult or impossible. Introducing normative pressure facilitates the enactment of social structure in public goods dilemmas, which dramatically improves the outcomes of the experiments [6]. Even in settings where all actual choices were completely anonymous, simply enabling people to discuss the optimal strategy, to raise expectations and to voice their frustration in the group, significantly increases cooperation [2]. Therefore, we hypothesize

H2: *Normative pressure increases cooperative behavior in a delayed-rewards public goods dilemma.*

Regarding mimetic pressure, several experiments conclude that providing transparency about the individual contributions to the public good increases observed cooperative behavior [2]. Enabling participants to observe the actions of the other members of their group was found to significantly decrease the percentage of individuals that acted completely egoistic and that never contribute to the public good [26]. Consequently, we hypothesize

H3: *Mimetic pressure increases cooperative behavior in a delayed-rewards public goods dilemma.*

Finally, we expect interaction effects in our setting. For example, existing research found that sanctioning mechanisms are more effective when participants could clearly see that these sanctions were consistently applied to those who did not cooperate or did not contribute to the public good [27, 28]. Similarly, if participants were able to develop their own sanctioning mechanisms (thereby creating a clear frame of reference for

expected behavior), these mechanisms were found to be more effective [25]. Thus, we hypothesize

H4: *There are positively reinforcing interaction effects between all institutional pressures.*

3 Methodology

Our primary interest lies in understanding human behavior in a delayed-reward public goods dilemma, which provides a promising basis for theorizing the institutionalization of architectural rules, norms, and beliefs in organizations [10, 12]. Experimental research helps to understand the theoretical foundations of such questions by enabling researchers to test different variations of variables in a controlled setting [6]. Thus, an experimental approach is suitable to test our hypothesized conceptual model, since we can control for the multitude of other potentially confounding variables that may influence behavior in real-world organizations [3]. In line with our theoretical discussion, we treat the three institutional pressures as independent variables and cooperative behavior, measured in terms of collective benefits, as the dependent variable. In the experiments, we thus purposefully vary the presence of the institutional pressures and then, after randomly assigning participants to such a combination of institutional pressures, observe whether participants show increasingly cooperative or non-cooperative behavior.

We employ a baseline public goods dilemma design similar to Amir [29]. Following this design, participants are split into groups of four players (labelled $i = 1 \dots 4$) and each player receives an initial endowment $e_{i,1}$ of 50 points. We then conduct an iterative game over ten rounds ($t = 1 \dots 10$). During each round *t*, players simultaneously choose an amount $x_{i,t}$ to invest in the public good; the remainder $y_{i,t} = e_{i,t} - x_{i,t}$ is invested in the private good. The investment in the private good $y_{i,t}$ offers an immediate return of 10%, so that player i will receive $1.1 \cdot y_{i,t}$ in the next round $t + 1$. The investment in the public good, however, is paid out over six rounds (5% return each round; total return of 30%) and split evenly among all players. Furthermore, we deduct six points from each player every round to instill a sense of urgency on the players. We measure cooperation via the overall collective benefits of the group. Since more contributions to the public good will lead to a higher collective benefit, this is indicative of cooperative behavior. The presence of coercive pressure is operationalized by giving players the option to spend some of their own payoff to sanction the behavior of other players [6, 24]. We operationalize normative pressure by giving players the option to communicate with each other via a shared chat window that is displayed throughout the experiment [30]. Mimetic pressure is operationalized by making players' choices, payoffs, and punishments visible to all participants, thereby enabling mimetic behavior [2]. **Table 1** provides an overview of our construct operationalization for institutional pressures.

We recruited 136 participants (40 participants for the initial baseline experiment and 96 participants to test different combinations of institutional pressures) via Amazon's Mechanical Turk (MTurk) platform, an online labor market that is often employed for

behavioral research [16]. Each participant was informed beforehand that they are going to participate in a cooperative decision-making experiment and that their payoff (50¢ plus 1¢ per point above 50 at the end of the experiment) will depend on their own decisions as well as on the decisions of the other participants. Since some participants dropped out during an experiment, we needed to recollect roughly 15% of our data to reach 136 usable data sets.

Table 1. Operationalization of Institutional Structures

	Coercive	**Normative**	**Mimetic**
Not present	No punishment for not contributing to the public good	No communication between participants	Choices and payoffs are anonymous
Present	Participants may sanction other players for their actions	Participants may communicate by chat throughout the experiment	Choices and payoffs/punishments are visible to anyone
Reason	Forced behavior through sanctions and emphasis on direct consequences	Morally governed behavior through communicated expectations	Mimetic behavior through shared logics of action

4 Results of the Pilot Study

Theoretically, the ideal cooperative strategy in any setup is that all players invest everything into the public good from round 1 up until round 8 and invest everything into the private good in rounds 9 and 10. This will yield 90.89 points for each player in the final round. If all players always cooperate (i.e., invest everything into the public good), this will yield 86.69 points at the end, and if all players act purely egoistically (i.e., invest everything into the private good), this will yield 36.42 points. If players always split their investments evenly between the private and the public good, it will yield 61.65 points at the end. **Fig. 2** shows the calculated results of these strategies.

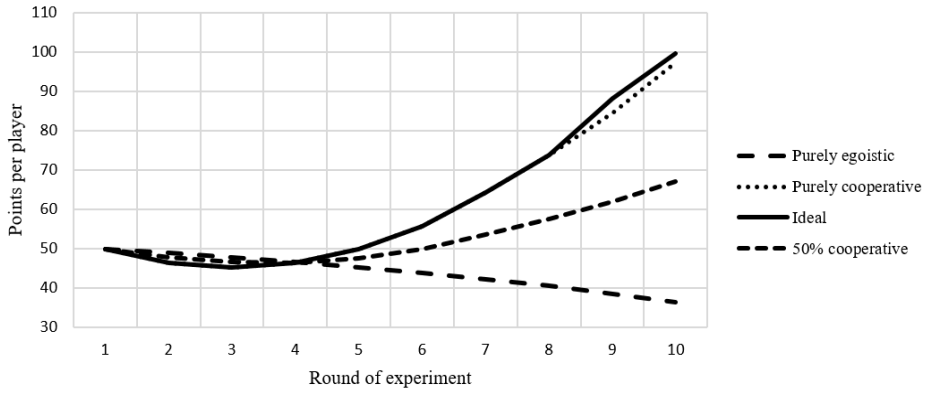

Fig. 2. Overview of Calculated Payoffs for Different Cooperative Players Strategies

We find that the actual behavior of participants in the experiments differs significantly from the game-theoretic prediction. To compare the observed behavior of humans to the theoretical setting, we first tested the baseline experiment (no coercive, normative, and mimetic pressures) with 10 groups (i.e., 40 people). **Fig. 3** shows the progress of this baseline experiment over ten rounds, displaying the average points per player, the average contribution of a player to the public good, and the standard deviation of the contributions of the players in each round and group.

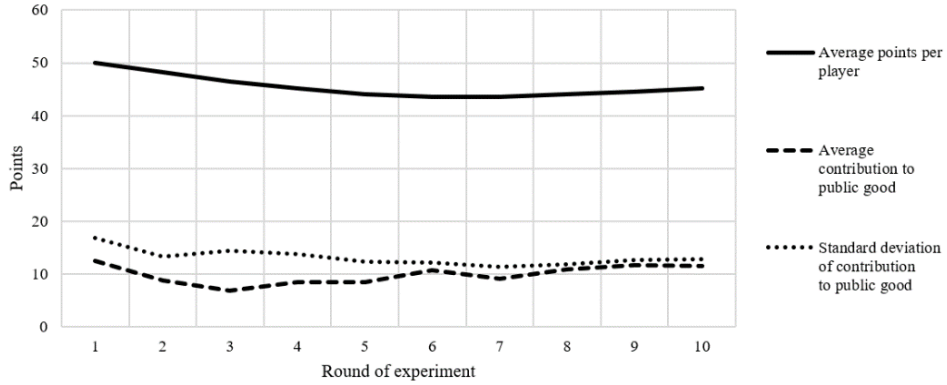

Fig. 3. Progress of the Baseline Experiment

At the end of the baseline experiment, players had 45.19 points on average, which is significantly less than the ideal collective benefits of 90.89 points, but also significantly more than the purely egoistic outcome of 36.42 points, predicted by game theory. This observation is in line with previous studies that find people contributing to collective benefits, even if no individual incentives are provided [6].

Comparing **Fig. 2** and **Fig. 3**, we further analyzed the dynamic effects over time in more detail by looking at (i) the average contributions to the public good (indicating cooperation between players) and the standard deviation of contributions to the public

good within a group of players (indicating how "unfair" contributions and rewards are spread; see the dotted lines in Figure 3). At first (rounds 1-3), the overall contribution to the public good decreases. This is not surprising, as early investments only pay off later and due to the 6-point deduction, there is a pressure to keep the points above 50 and the private investment brings an immediate reward. Only after a while, the cumulative benefit of investing in the public good becomes apparent (approximately round 3 to round 6 in Figure 3), and the investment to the public good slightly increases. Furthermore, the lack of transparency and communication is hindering cooperation in this setting [2]. As one participant wrote in the experiment feedback:

"The workers on Amazon Mechanical Turk are mostly here to make money. In these tests of decision-making, all of us almost always choose to keep the points and to NOT share. But, you set up the test so that we lose 6 points on every round, forcing us to share or else go completely bankrupt. I cannot see what the other three are sharing. This is a drawback. I was only able to judge my contribution after the round was finished and all the points were toted up. I tried being very generous; I tried being very stingy. My total points continued dropping. I seemed to benefit the most when I shared 0 points."

After piloting the baseline experiment, we tested what happens when we add different combinations of the three institutional pressures to the experiment, by conducting an experiment with 3 groups (12 people) per combination of institutional pressures. Tables 2-5 show the results of this experiment.

For our analysis, we distinguish the experimental data by the presence of coercive pressure (Table 2 and Table 3 without coercive pressure; Table 4 and Table 5 with coercive pressure) and we separately consider average final points (Table 2 and Table 4, indicating how successfully participants cooperated) and average contributions to the public good (Table 3 and Table 5). Within each table, we display the results for normative (NORM) and mimetic (MIM) pressures being present (= 1) or not (= 0).

First, we find that coercive pressure is indeed used to sanction others, leading to overall less collective benefits for groups in these settings (compare Table 2 and Table 4). This is particularly true in settings without mimetic pressure (top right in Table 4), without normative pressure (bottom left in Table 5), and with neither normative nor mimetic pressures (top left in Table 4). A better result is only achieved if all three institutional pressures are present (bottom right in Table 4).

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Table 2. Final Points; no Coercive Pressure

	NORM = 0	NORM = 1
MIM = 0	43.96	50.18
MIM = 1	45.90	49.60

Table 3. Contribution; no Coercive Pressure

	NORM = 0	NORM = 1
MIM = 0	10.37	14.28
MIM = 1	11.73	12.85

Table 4. Final Points; with Coercive Pressure

	NORM = 0	NORM = 1
MIM = 0	26.83	23.30
MIM = 1	21.16	41.37

Table 5. Contribution; with Coercive Pressure

	NORM = 0	NORM = 1
MIM = 0	5.93	8.21
MIM = 1	1.27	9.63

On the other hand, if no coercive pressure is present, the difference between the (NORM = 0, MIM = 0)-scenario (43.96 final points, top left in Table 2) and the (NORM = 1, MIM = 1)-scenario (49.60 final points, bottom right in Table 2) is comparatively minor. In this setting (Table 2), there is a benefit both from providing normative pressure (NORM = 0 to NORM = 1) and from providing mimetic pressure (MIM = 0 to MIM = 1), but the relative effect is smaller than in Table 4 (i.e., with coercive pressure).

5 Discussion and Outlook

Using an experimental approach, we can isolate pressures, outlined by institutional theory, that affect cooperative behavior in the institutionalization of EAM in organizations [2]. In sum, we find major differences in cooperative behavior in delayed-reward public goods dilemmas for different combinations of institutional pressures. Furthermore, the received feedback from MTurk participants is similar to issues observed in EAM practice: similar to decisions in the experiment, the desirable EAM outcomes are often delayed, and local decision-makers are often under pressure to solve immediate problems for which they prioritize their own benefits over enterprise-wide benefits [9, 10, 15].

Specifically, we observe that normative and mimetic pressures enhance cooperative behavior (H2 and H3). Coercive pressure, however, needs to be employed with care (H1): emphasizing coercive control is only successful, if people can clearly communicate their actions and intentions, and if the consequences of their actions are transparent (H4). Otherwise, people spent significant resources to sanction the behavior of others without observable benefits, thereby decreasing both their own and the overall groups' welfare. The experimental setting enables us to analyze how group interactions unfold over time and to understand how participants perceive their situation. A brief analysis of the chat logs clearly indicated that some experiments in settings with coercive pressure derailed: participants sanctioned other players in their group almost randomly. This

happened primarily when the actions of the participants were anonymous. On the other hand, groups that could communicate showed more positive interactions, often starting with simple messages such as “Hi! We need to share to profit from this!”.

While the experimental setup with MTurk enabled us to pilot test the design of our experiment and to collect initial data on our hypotheses, it is unclear, whether it allows to transfer these results directly to the EAM context. For example, in most organizations face-to-face communication is easily possible, which has been shown to have stronger effects than electronically mediated communication [6, 30]. Similarly, the intrinsic motivation of people in a typical organization differs from the average MTurker [31], which is expected to affect cooperative behavior in an experiment. Consequently, we plan to conduct a follow-up experiment that transfers the basic idea in the delayed-reward public goods dilemma to the EAM context. This experiment will then be conducted with enterprise architects and IT decision-makers, so that we can employ actual EAM case descriptions [10, 32] to derive more realistic goal conflicts and scenarios. Still, these initial experiments are a valuable contribution because they confirm the anticipated effects in an abstract setting, which is the precondition for entering much more critical experiments with rather scarce domain experts.

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