Application of the Organizational Dependence Ontology

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1 Introduction

In this document, we demonstrate the application of the Organizational Dependence Ontology to a practical scenario encountered during our case study investigating the integration challenges experienced by the City in its flood protection efforts. The Riverine Flooding Project (RFP), aimed at reducing riverine flooding risks in the neighbourhood, involves designing and implementing several pieces of infrastructure such as bridges and concrete channels. Concurrent with this, the City's Urban Flooding Program (UFP) is implementing sewage infrastructure improvements that must be coordinated with the RFP. There are also several planned capital works projects in the area that the RFP must consider in its design. As operating in this complex environment entails intense coordination across various organizations, stakeholders, and tasks, we had access to a wealth of coordination phenomena and challenges to model and help address.

2 Application

For the scenario of interest, we focus on three organizational units of the City: Riverine Flood Risk Mitigation (RM), Water Infrastructure Management (WIM), and Parks and Recreation (PR). The neighbourhood of interest is grappling with substantial flood risks due to both urban (sewer overflows) and riverine (watercourse overflows) sources. While RM is tasked with the implementation of the Riverine Flood Risk Mitigation Project (RFP) to combat riverine flood risks and aims to safeguard against a 350-year storm level through the construction of a concrete channel, WIM is simultaneously leading the Urban Flooding Program (UFP). This program aims to protect against a 100-year storm event by improving the sewer system. The City has consistently received numerous flooding incident reports and has the goal of reducing the total number of (reported) incidents.

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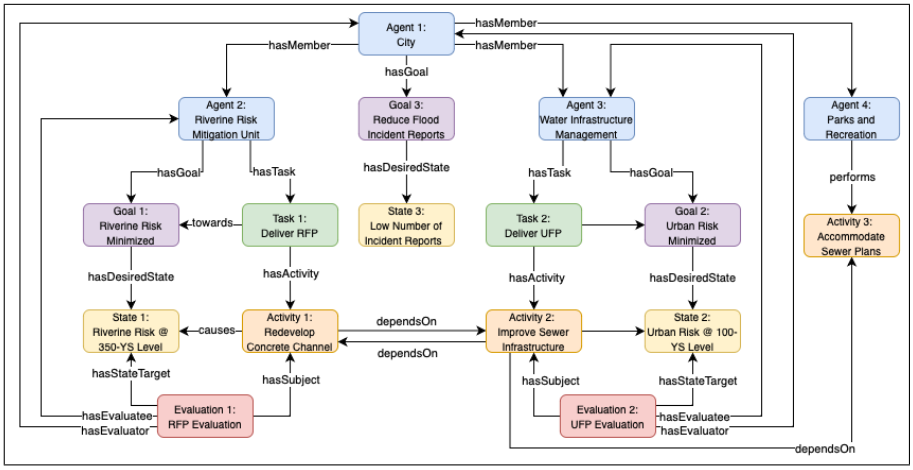

Figure 1: Partial representation of case study scenario.

Flooding is a complex issue due to riverine and urban flooding being interconnected sources. Enhancing the sewer system alone, for instance, while not addressing riverine flooding, still leaves the community exposed. Therefore, both the concrete channel development and sewer improvement activities are strategic complements with respect to the likelihood of a flooding incident occurring that would result in a report. More so, both activities depend on one another since the way in which either activity is designed and implemented imposes constraints on the other due to geographic overlap, funding constraints, and mutual impact on flood risk. Additionally, some sewer improvements must occur under recreational park space, which is under the jurisdiction of the PR unit. The PR unit performs the activity of reviewing and creating plans to accommodate the sewer improvement plans, which constrains the performance of WIM's sewer improvements. RT and WIM are independently evaluated by the City on their activities for the achievement of their respective goal states.

Based on a formal encoding of this scenario using our framework, depicted in Figure 1, several coordination needs and cooperation risks are inferred by the ontology. We briefly outline three:

- *Sub-goal optimization*: Since the activities of RT and WIM are strategic complements, yet both agents are only evaluated based on their individual targets, there is a cooperation risk between them since they have an incentive to prioritize that which they are directly answerable for, rather than the overall level of flood protection, which no one is evaluated on.

- *Shirking*: To perform their activity of improving the sewer, WIM is epistemically dependent on PR since PR's review and accommodation constrains the way in which sewer improvements can be made. However, since PR isn't being evaluated on their review activity, they are not incentivized to accommodate WIM's activities, especially because doing so would be

costly for them. In essence, WIM needs PR but since PR will not need to answer to anyone for their efforts, there is a cooperation risk between them.

- *Coordination risk*: Since the activities of both RT and WIM mutually constrain each other, and the incentives for both units is based on their respective activities, they are both epistemically dependent on one another, causing a coordination need between them. However, since no coordination mechanism was asserted to exist that would ensure they both have the necessary information to effectively execute their activities, there exists a coordination risk between them.

These inferences allow the City to detect that a mitigation strategy, e.g., a coordination mechanisms between RT and WIM, must be in place to ensure the successful integration of the concrete channel and the sewer improvements through the exchange of information necessary to manage their dependency. Additionally, the City is also made aware of the risk of cooperation failure between RT and WIM, which could be addressed by, for example, establishing evaluations and incentives to hold them collectively accountable for the overall flood risk in the neighborhood, rather than for their individual team goals. Finally, by surfacing the cooperation risk between PR and WIM, the City is afforded the opportunity to setup a process for evaluating PR's reviews that would promote a timely review and accommodation for the sewer improvements.