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SIMULATING THE IMPACT OF ARTIFICIAL INTELLIGENCE INNOVATIONS WITH A MODULAR FRAMEWORK AND DIGITAL TWIN

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ABSTRACT

U.S. federal government agencies oversee a wide array of citizen benefits, which affect millions of Americans. Federal benefits administration is a complex interaction of systems that can be approximated with a modular framework and digital twin. Rather than focusing on individual elements of the benefits administration operation, we aim to minimize interface issues between the elements by modeling the entire operation using a holistic modular framework. We also present a digital twin discrete event simulation of the benefits administration system to measure how much new Artificial Intelligence (AI) technologies improve government services.

1 INTRODUCTION

Federal agencies responsible for adjudicating health, food, financial and other benefits are increasingly asked to deliver services faster and cheaper with fewer resources. Inefficiencies within benefits administration can negatively impact vulnerable citizens in need of time-sensitive critical services. AI solutions are increasingly being used to meet this demand and have consistently been touted as bringing massive amounts of innovation to government. Modeling the benefits administration system as a collection of independent agents that execute behaviors for the system they represent allows agencies to customize and explore the dynamic interactions in the systems they manage with minimal business risk (Bonabeau 2002; Scala et al. 2019). Discrete event simulation has been used to reduce wait times and improve customer service in physical health care and other citizen service settings (Duguay and Chetouane 2007). A modular macroscopic-level framework with a benefits application system, application intake, decision-maker network and decision-maker processes was created to approximate benefits administration operations. In addition to developing the macroscopic framework, we quantified the impact of introducing an AI solution into the benefits application system with a digital twin.

2 BACKGROUND

A modular macroscopic framework for modeling the federal benefits administration system is presented. Our framework and digital twin can be used to model physical and / or virtual systems and has been adapted to approximate the interaction and impact of people, processes and new AI technology have in the benefits administration context. The framework comprises: the benefits administration system, application intake, a decision-maker network comprising any number of people that make benefits eligibility determination for incoming applications, and any number of steps in the decision-making process as shown in Figure 1. Customized variables could be presented in any component of the framework, depending on the specific federal agency's context. Benefits administration operations could be simulated and variability approximated with discrete event simulation using a general-purpose simulation software like Simio or other types of tools

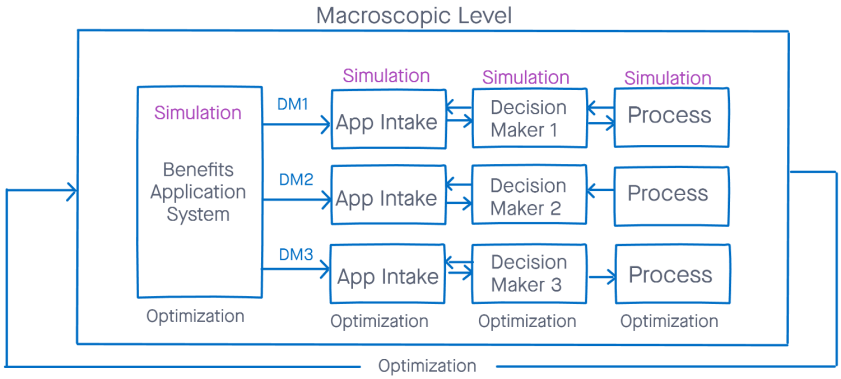

Figure 1: Macroscopic Model Framework in a Federal Benefits Context.

(Dennis and Sturrock 2011). The digital twin includes a Benefits Application System that contains simple and complex applications sources arriving into the system and routed to either NoAI or AI sources, which could include any type of new AI technology, a resource pool of Decision-Makers in a Decision-Maker network and a set of agency-defined processes that a Decision-Maker follows to arrive at a decision. The digital twin is adaptable to system changes as they occur and could be used as a general approach for improving efficiencies, operations, and customer service.

3 RESULTS

A baseline, 'current state' digital twin representing the benefits application system was simulated and permutations were performed to study their effects. Simple and complex benefits applications are the entities that arrive in the system independently of each other at one moment in time and indicate a change to the system. The simple and complex application entities move from to either a NoAI or AI source object, to any number of Decision Makers servers over a network of connectors and nodes and exits the system at the Decision sink, where a decision is made. Throughput and processing time efficiencies were measured and gained by the introduction of AI technologies.

4 DISCUSSION

Simulation methods serve as proxies to exploring and understanding 'what if' scenarios to benefits administration operations using a digital twin. By perturbing the digital twin in the microscopic model, federal agencies can understand how much changes in any part of the system affects the entire system, therefore improving the benefits administration system with minimal risk. The modular framework with a federal benefits context.

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