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Optimizing Contract Flow: A Simulation-Based Approach to Efficiency Improvement

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ABSTRACT

This paper explores the efficiency and performance of business processes involved in contract flow. We leverage simulation techniques to analyze various parameters that impact contract flow, extending beyond just efficiency. The simulation model encompasses the entire contract lifecycle, allowing us to identify bottlenecks and assess the impact of different process configurations. Our investigation examines a range of performance indicators, including efficiency, cost, and cycle time. The results provide valuable insights for organizations seeking to optimize their contract flow processes and achieve improved performance.

Keywords: Human-computer interaction, Simulation, Workflow, Business process simulation, LCDP, Low-code development platform, Aurea BPM, Contract management

INTRODUCTION

Optimizing contract flow processes is crucial for organizational efficiency and performance. Traditional approaches often focus solely on improving efficiency, neglecting other critical factors such as cost and cycle time. This paper presents a novel approach for analyzing contract flow by leveraging simulation techniques. Our research goes beyond traditional methods by examining a range of performance indicators.

The contract flow process under investigation involves several key steps. Initially, an employee drafts a contract based on a request. This contract then undergoes a multi-level approval process, involving various stakeholders like task managers, plan managers, legal counsel, and potentially public procurement departments. Additionally, the deputy director, chief accountant, and ultimately the director need to sign off. Revisions might be necessary based on feedback received during the approval stages.

Following the approval process, relevant departments like finance and payroll verify the contract's data accuracy. The delivery method, either physical or electronic, is then chosen by the employee. Depending on the chosen method, the contract is either printed and delivered or generated and sent electronically. Upon receiving the signed contract from the contractor, it is attached and scanned for record-keeping purposes. Finally, the system automatically generates a metric signifying the completion of the contract process. It is important to note that the contract can be rejected at any point during the approval stages.

This paper utilizes a simulation model encompassing the entire contract lifecycle implemented with the help of the Aurea Low-code Development Platform (Adrian, 2020; Martinez, 2023; Overeem, 2022; Rokis and Kirikova, 2022; Sanchis et al., 2019; Waszkowski, 2019; Waszkowski, 2022; Waszkowski and Bocewicz, 2022). This allows us to identify bottlenecks within the process and assess the impact of different configurations on overall performance. By analyzing a broader range of performance indicators, including efficiency, cost, and cycle time, we aim to provide valuable insights for organizations seeking to optimize their contract flow processes (Worwa et al., 2017; Waszkowski et al., 2018; Waszkowski and Nowicki, 2020, Waszkowski et al., 2017, Waszkowski et al., 2020).

CONTRACT FLOW BUSINESS PROCESS

The business process starts with an employee creating a new contract based on a request. This contract then undergoes a multi-step approval process involving the task manager, plan manager, lawyer, and potentially public procurement, the deputy director, chief accountant, and finally the director. If revisions are needed, the employee amends the contract based on feedback (Waszkowski et al., 2018; Waszkowski et al., 2017a; Waszkowski et al., 2017b).

Following this, the Economic and Financial Department and Payroll Department verify the contract's data accuracy within their respective areas. The employee then chooses between delivering the contract electronically or physically to the contractor. Depending on the chosen method, the employee either prints and delivers the physical copy or generates and sends the electronic version.

Upon receiving the signed contract from the contractor, the employee attaches it for record-keeping. The signed document is then scanned. Finally, the system automatically generates a metric, likely a record or confirmation, signifying the completion of the contract process. It's important to note that the contract can be rejected at any point during the approval stage (Dudek and Patalas-Maliszewska, 2026; Jasiulewicz-Kaczmarek et al., 2017; Kiedrowicz et al., 2016; Kiedrowicz et al., 2017; Antosz et al., 2022).

In details the business process of contract flow works as follows (Fig. 1 and Fig. 2):

1. Creation of a Contract - Creation of a new contract based on demand.
2. Executor: Employee
3. Acceptance by the Task Manager. Executor: Task Manager
4. Acceptance by the Plan Manager. Executor: Plan Manager
5. Acceptance by the Lawyer. Executor: Lawyer
6. Acceptance by Public Procurement. Executor: Public Procurement
7. Acceptance by the Deputy Director. Executor: Deputy Director
8. Acceptance by the Chief Accountant. Executor: Chief Accountant
9. Acceptance by the Director. Executor: Director
10. Contract Amendment - Amendment of the contract documentation. Executor: Employee
11. Approval by the Economic and Financial Department - Verification of the correctness of the entered data of the Contract. Executor: Employee - Economic and Financial Department

12. Approval by the Payroll Department - Verification of the correctness of the entered data concerning the civil law contract. Executor: Employee - Payroll Department
13. Selection of the Delivery Method to the Contractor - Selection of whether the contract will be delivered digitally or physically to the Contractor. Executor: Employee
14. Printing and Delivering the Contract to the Contractor. Executor: Employee
15. Generating the Contract and Sending it to the Contractor - Generating the contract and sending it electronically to the Contractor. Executor: Employee
16. Attaching the Contract Signed by the Contractor. Executor: Employee
17. Scanning the Contract Signed by the Contractor. Executor: Employee
18. Generating a Metric. Executor: System
19. Optionally – Rejected - The contract was rejected at the acceptance stage. Executor: System

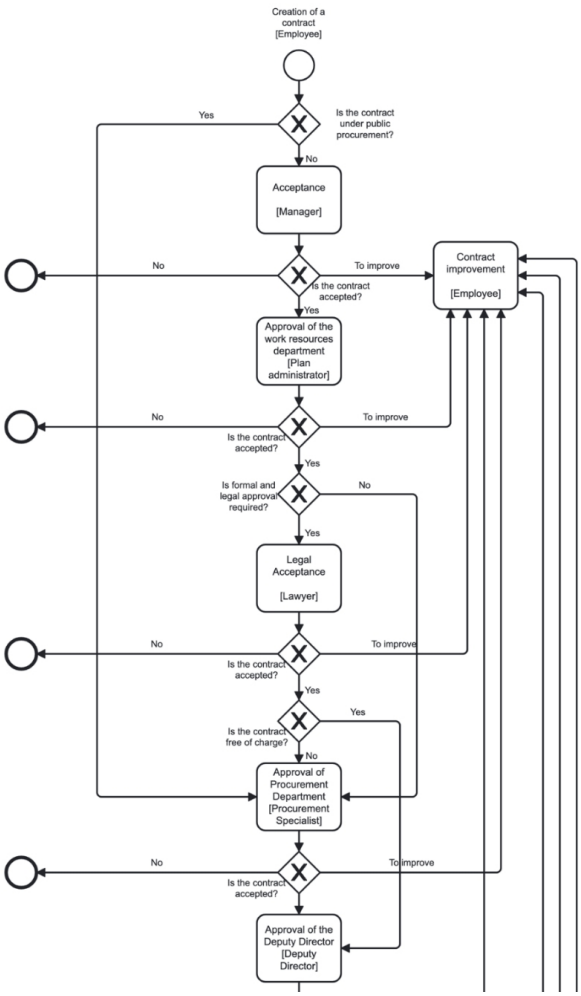

Figure 1: Contract management business process – part 1 (own evaluation).

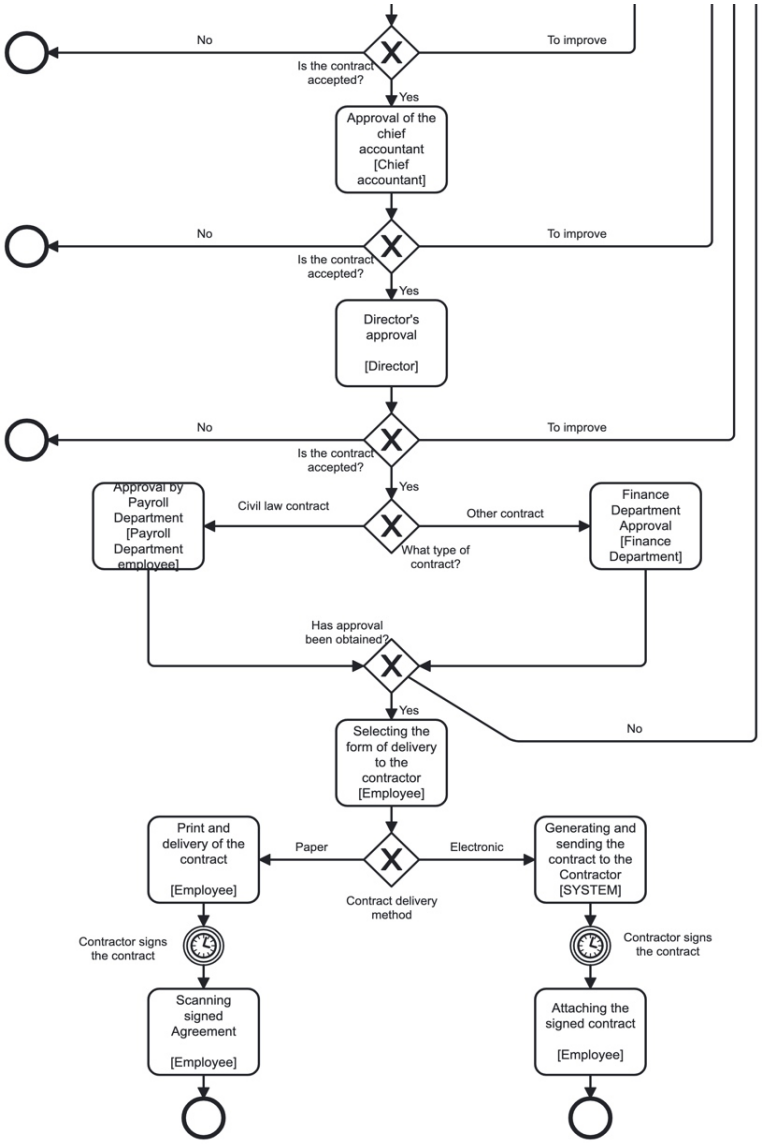

Figure 2: Contract management business process – part 2 (own evaluation).

RESULTS OF SIMULATION EXPERIMENTS

In the iGrafx business process modeling and simulation support environment, a simulation model of contract flow will be presented. Simulation experiments will be designed to study the properties of the process of contract flow. The characteristics of both the process itself and the execution environment implementing the contract flow will be examined. To simulate the functioning of the business process relating to contract flow in given organization, this process was implemented in the iGrafx environment, which is the equivalent of the Low-code systems class. This process is shown in Figure 3.

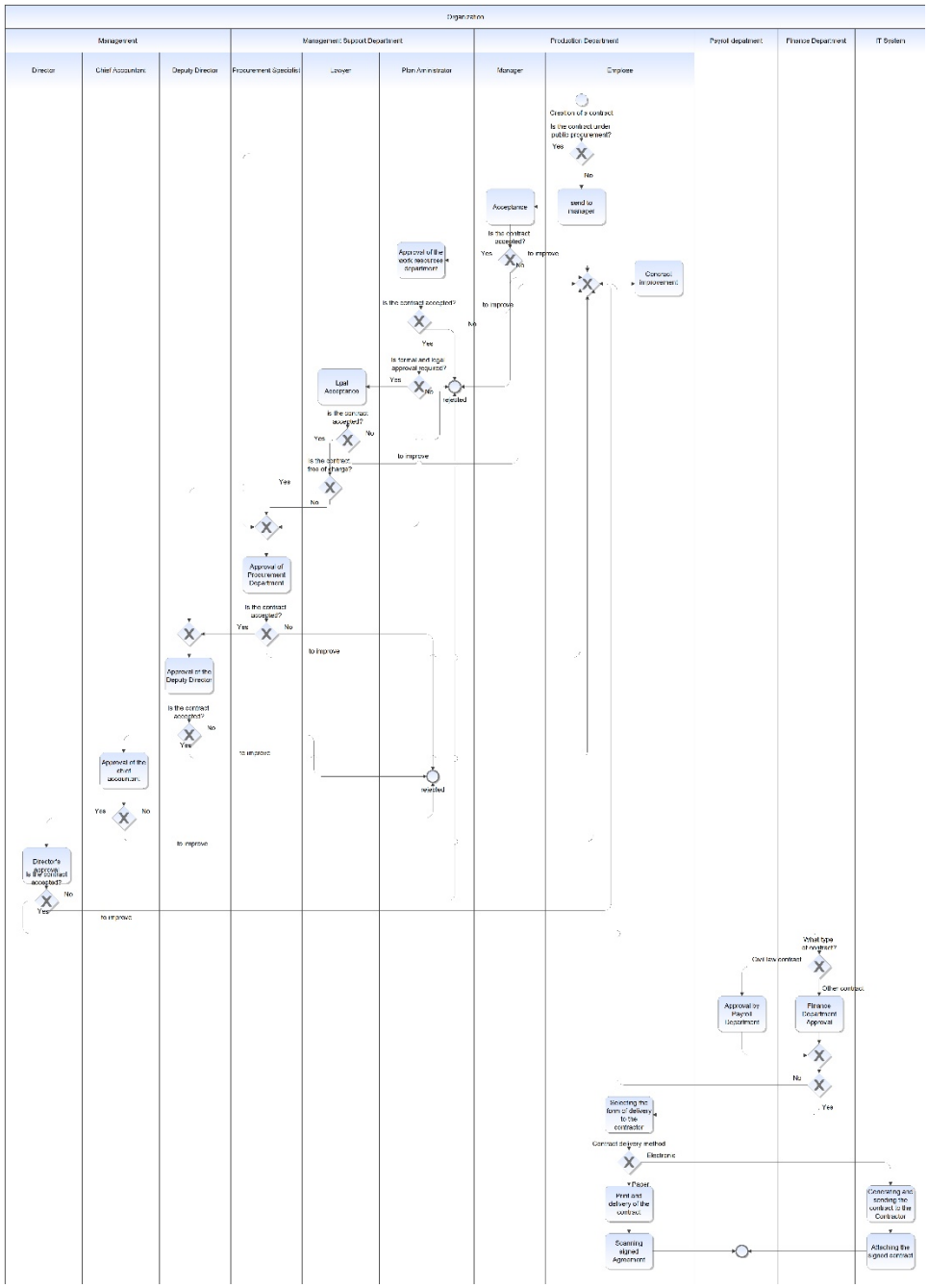

Figure 3: Contract flow business process made in iGrafx environment (own evaluation).

For the process implemented in the iGrafx environment, a number of data necessary to run a computer simulation of the process functioning were introduced. The structure of a part of the organization corresponding to the flow of documents in the organization was established. This structure is shown in Figure 4.

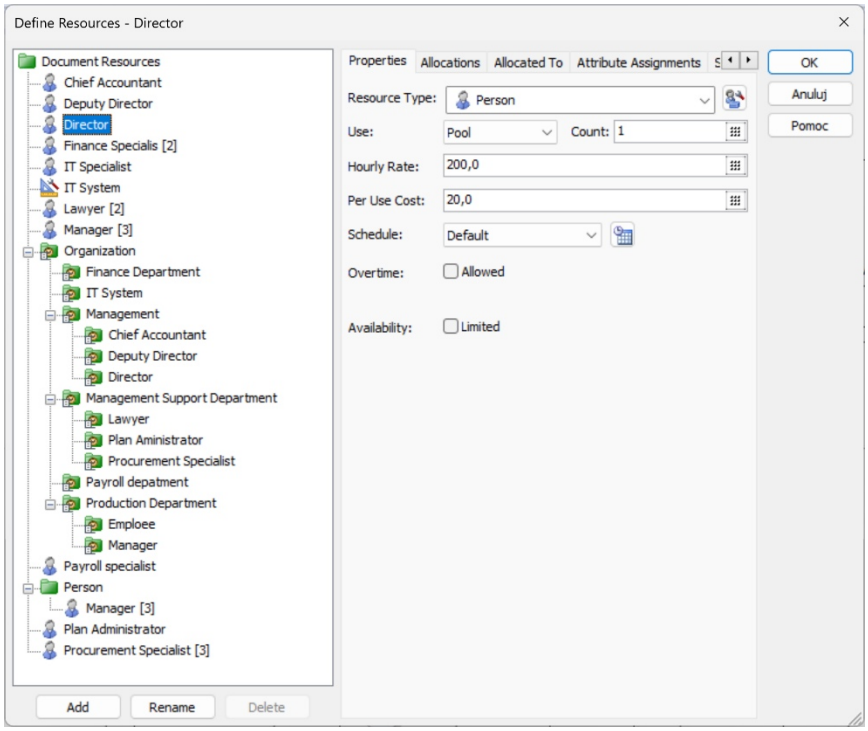

Figure 4: Organization structure corresponding to the contract flow business process made in iGrafx environment (own evaluation).

Each of the people shown in the organization structure has a fixed work schedule in the organization. It is shown in Figure 5.

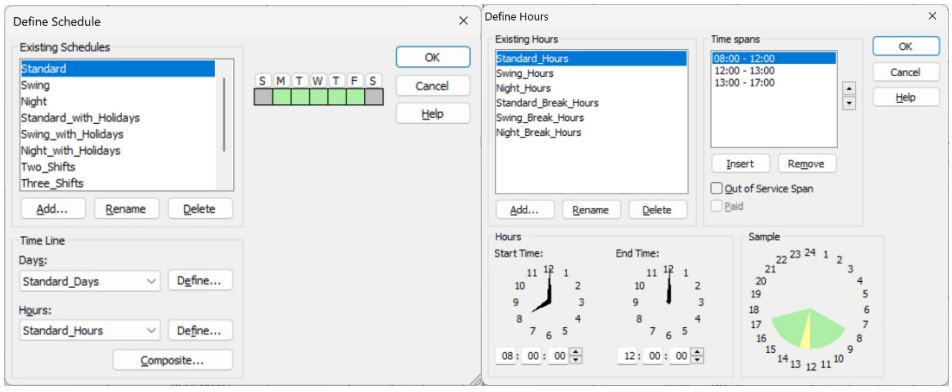

Figure 5: Fixed work schedule for people in the organization in the iGrafx environment (own evaluation).

The characteristics of document inflow streams to be handled in the contract flow process must also be determined (Waszkowski and Nowicki, 2023). The parameters of the document inflow generator for the contract flow are shown in Figure 6.

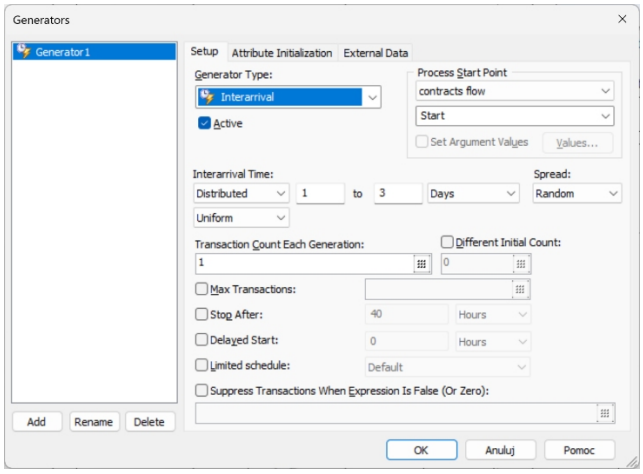

Figure 6: Parameters of generator for contract flow in the iGrafx environment (own evaluation).

As a result of a number of simulation experiments, a number of interesting combinations relating to the process of contract flow were obtained. You can show statistics relating to the execution times of various types of activities (Figure 7).

Transaction Statistics (Hours)								
	Count	Avg Cycle	Avg Work	Avg Wait	Avg Res Wa	Avg Block	Avg Inact	Avg Serv
Organization/Finance Department	3	25,43	3,76	21,67	0	0	21,67	3,76
Organization/IT System	1	0,29	0,29	0	0	0	0	0,29
Organization/Management Support Department/Lawyer	6	0,76	0,76	0	0	0	0	0,76
Organization/Management Support Department/Plan Aministrator	19	0,34	0,29	0,05	0	0	0,05	0,29
Organization/Management Support Department/Procurement Specialist	14	20,65	0,43	20,22	0	0	20,22	0,43
Organization/Management/Chief Accountant	9	0,57	0,57	0	0	0	0	0,57
Organization/Management/Deputy Director	11	0,65	0,65	0	0	0	0	0,65
Organization/Management/Director	4	0	0	0	0	0	0	0
Organization/Payroll depatment	3	0,15	0,15	0	0	0	0	0,15
Organization/Production Department/Emploee	26	69,54	15,48	54,06	0,43	0	53,63	15,91
Organization/Production Department/Manager	18	0,3	0,25	0,06	0	0	0,06	0,25

Figure 7: Aggregate characteristics for various activities in the iGrafx environment (own evaluation).

It is also important to show the characteristics related to individual resources in the model. A number of properties of the processes of using these resources in the process of electronic circulation of documents can be shown (Figure 8).

Resource Statistics (Days)											
Labor/Person											
	Count	Tavg Util	Avg Busy	Avg Idle	Avg Inact	Avg OOS	Avg OT	Avg Res Wa	Tavg NW Util	Avg Cost	Tot Cost
Organization/Finance Department	2	1,6	0,24	14,43	43,5	1,83	0	0	1,6	17605,00 $	35210,00 $
Organization/IT System	1	0,08	0,01	14,65	43,5	1,83	0	0	0,08	0,00 $	0,00 $
Organization/Management Support Department/Lawyer	2	0,65	0,1	14,57	43,5	1,83	0	0	0,65	3550,00 $	7100,00 $
Organization/Management Support Department/Plan Aministrator	1	1,57	0,23	14,44	43,5	1,83	0	0	1,57	24770,00 $	24770,00 $
Organization/Management Support Department/Procurement Specialist	3	0,57	0,08	14,58	43,5	1,83	0	0	0,57	17625,00 $	52875,00 $
Organization/Management/Chief Accountant	1	1,45	0,21	14,45	43,5	1,83	0	0	1,45	17690,00 $	17690,00 $
Organization/Management/Deputy Director	1	2,03	0,3	14,37	43,5	1,83	0	0	2,03	35310,00 $	35310,00 $
Organization/Management/Director	1	0	0	14,67	43,5	1,83	0	0	0	70480,00 $	70480,00 $
Organization/Payroll depatment	1	0,13	0,02	14,65	43,5	1,83	0	0	0,13	0,00 $	0,00 $
Organization/Production Department/Emploee	3	40,36	5,92	8,75	43,5	1,83	0	0	40,36	0,00 $	0,00 $
Organization/Production Department/Manager	3	0,46	0,07	14,6	43,5	1,83	0	0	0,46	35263,33 $	105790,00 $

Figure 8: The degree of resource utilization in the process in the iGrafx environment (own evaluation).

We can also show a number of aggregate statistics relating to the activities carried out in the process of electronic correspondence circulation in the organization (Nowicki et al., 2017; Nowicki et al., 2013, Nowicki et al., 2018). Such a summary in the form of a bar chart is shown in Figure 9.

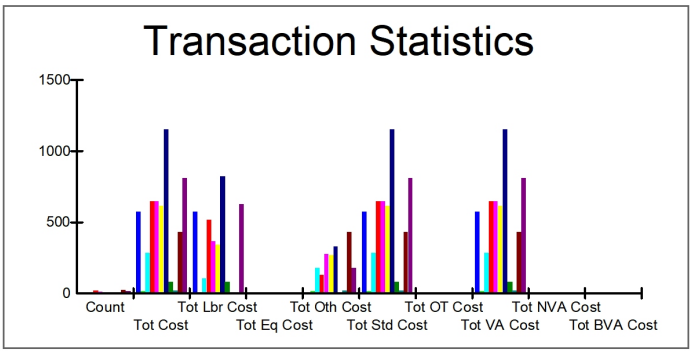

Figure 9: Aggregate statistics relating to the activities performed in the process in the iGrafx environment (own evaluation).

Many other interesting characteristics can be demonstrated by performing numerous simulation experiments (Patalas-Maliszewska and Krebs, 2015; Patalas_Maliszewska and Łosyk, 2020; Pazera et al., 2020). Analysis of the dynamics of functioning of a certain part of the organization is extremely interesting and necessary to assess the quality of this organization's operation.

CONCLUSION

This paper demonstrates a method for modeling and simulating a business process representing contract flow within an organization. The process was translated into a low-code equivalent, enabling efficient simulation of its functionality and analysis of various model parameters. This approach facilitates the examination of inherent properties of the electronic contract flow process, allowing for identification of bottlenecks, resource deficiencies, and other improvement opportunities.

Furthermore, the application of business process modeling and computer simulation in a low-code environment presents a valuable tool for understanding and optimizing real-world processes. This methodology encourages continuous model development and iterative process modifications to achieve optimal efficiency within the organization.

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