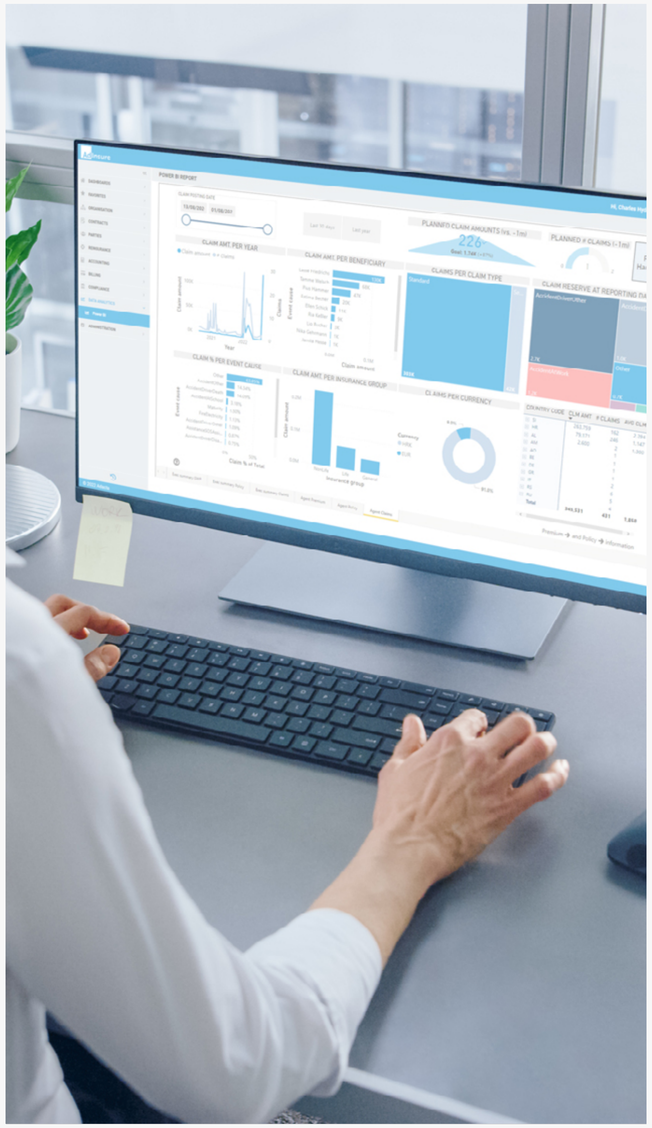
WHITEPAPER

Automated activity scheduling and allocation in AdInsure

ADACTA



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Introduction

The use of machine learning and artificial intelligence in the insurance business is taking off, but insurance processes still largely depend on human resources. Managing and planning people's work effort, availability, and capacity in such a dynamic environment can be quite demanding, especially when trying to take into account the employees' availability and other constraints.

This process could be significantly improved by the ability to automatically schedule and allocate tasks to employees in a way that would ensure their timely completion. This is a complex enough issue that decades of research have been devoted to solving the so-called Resource-Constrained Project Scheduling Problem (RCPSP). Ultimately, this research has produced a variety of optimization procedures that we have incorporated into AdInsure.

In this paper, we will take a closer look at resource-constrained project scheduling problem (RCPSP) and AdInsure activity scheduling solution.

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Resource-Constrained Project Scheduling Problem (RCPSP)

RCPSP is a well-known problem in project scheduling and optimization. It can help estimate the duration of the project and optimize the number of necessary resources. It is also one of the problems with high computational complexity making it difficult to solve. That is why multiple heuristic approaches were applied to solve the problem, including evolutionary optimization methods. As the basic RCPSP has significant limitations for modelling real-life projects, multiple extensions of the basic problem were proposed to align it closer with real business needs:

- Non-renewable resources - e.g., limited budget and expected costs.
- Multiple ways to perform an activity - e.g., resolving a common type of claim or handling a rare event that must be investigated.
- Stochastic activity durations - activities can take more or less time to complete due to uncertain risks.
- Pre-emptive activity splitting - some activities can be paused in the middle as work is focused on more important activities.
- Alternative objective functions - e.g., meeting deadlines or budget requirements, minimizing costs, optimizing for multiple objectives.

AdInsure activity scheduling solution

AdInsure enables users to create activities in the system either manually or automatically using configured rules. These activities are digital equivalents to various tasks performed by employees and must be planned and allocated effectively to meet deadlines and to be finished as soon as possible without unnecessary delays.

AdInsure activity scheduling can automatically calculate schedules to propose a mathematically optimal plan. Managers can then use these schedules to support their planning decisions or automatically allocate activities in the system.

SUPPORTS PLANNING DECISIONS

AUTOMATICALLY ALLOCATES ACTIVITIES

Finding an optimal schedule

To enable automated scheduling and allocation of activities in AdInsure, we designed a genetic algorithm that solves RCPSP with multiple extensions. This solution takes all activities that have been created in the system and finds a near-optimal schedule with the shortest total duration that focuses on minimizing deadline failures while using the resources defined in the system. All activities are then optimally assigned and scheduled to employees who are able and available to perform them.

One of the most important extensions we implemented is the ability to define a work calendar for every employee in the system. This calendar specifies the employee availability, including their working hours, working days, vacations, holidays, etc. When the employee is unavailable, their current activity is paused until they are available again, for example the next working day or after vacation.

OPTIMIZING TOTAL PROCESS DURATION

MINIMIZING DEADLINE FAILURES

How does it work?

As an example, 5 activities and 2 employees (Alice and Bernard) are defined in the system.
Every activity can be performed by either employee and their durations and deadlines are specified as follows:

ACTIVITY 1

DURATION	DEADLINE
5 workdays	12 days

ACTIVITY 2

DURATION	DEADLINE
10 workdays	15 days

ACTIVITY 3

DURATION		DEADLINE
3 workdays for Alice	4 workdays for Bernard	17 days

ACTIVITY 4

DURATION		DEADLINE
3 workdays for Alice	4 workdays for Bernard	X no deadline

ACTIVITY 5

DURATION		DEADLINE
3 workdays for Alice	4 workdays for Bernard	24 days

Alice has 3 days of vacation at the start of the second week, but otherwise is a full-time employee who works a 5-day workweek. Bernard is a part-time employee who only works the first three days of each week.

Activity	Resource	Effort	Week 1							Week 2							Week 3							Week 4						
			1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Activity 1	Bernard	5																												
Activity 2	Alice	10																												
Activity 3	Bernard	4																												
Activity 4	Alice	3																												
Activity 5	Alice	3																												

Optimal schedule prioritizing deadlines before total project duration. Because of Alice's vacation, the deadline for Activity 2 is not met even using this optimal schedule. Bernard is not occupied during week 4, so he would be able to start working on Activity 4 on Monday already. But if he did, he would finish it on Monday of week 5, because he only has 3 workdays in a week and this activity would take him 4 to complete.

Activity	Resource	Effort	Week 1							Week 2							Week 3							Week 4						
			1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Activity 1	Alice	5																												
Activity 2	Bernard	10																												
Activity 3	Alice	3																												
Activity 4	Alice	3																												
Activity 5	Alice	3																												

Optimal schedule prioritizing total project duration before deadlines. While the deadline for Activity 2 is missed by even more, the project ends 2 days earlier based on this schedule. Notice that the order of Activity 4 and Activity 5 can be interchanged in this schedule without having any effect on the duration or deadlines.

LEGEND

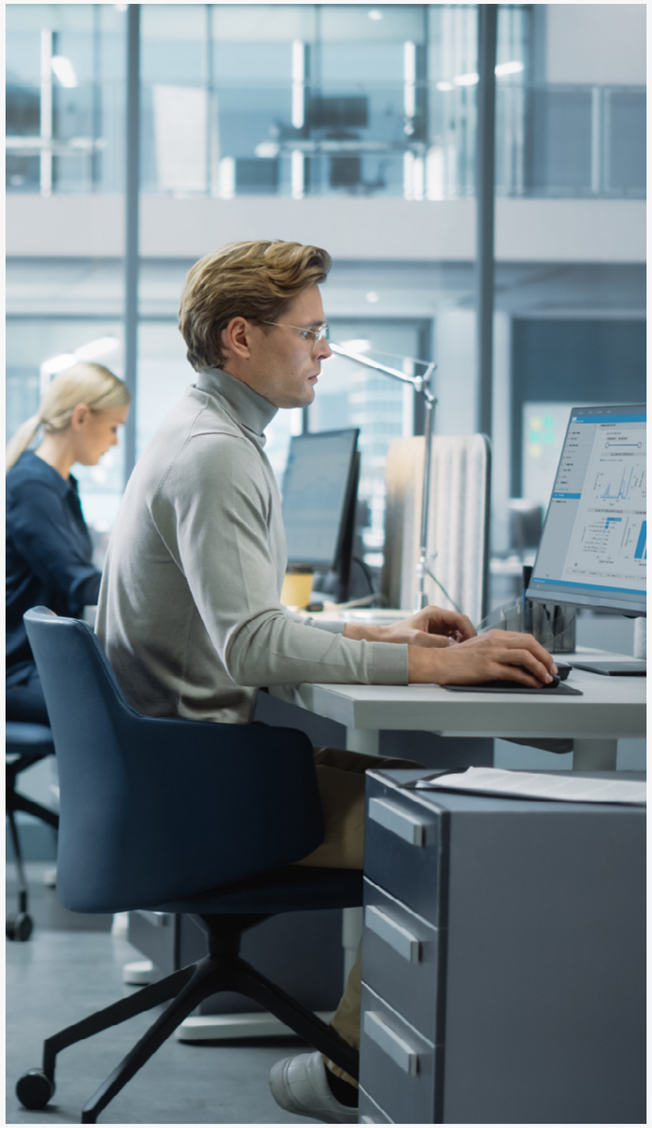
Activity is being performed

Activity is in progress, but worker is not available

Worker has a vacation

Non-working days (weekend)

Deadline



Activity Scheduling Features

Activity duration

To keep the previous example simple and to properly showcase the calendar availability extension, we used activities with longer durations. However, it is also possible to schedule shorter activities that only last a few minutes.

Prioritizing deadlines and total duration

As shown in the example above, the priority ratio between duration and meeting the deadlines can be configured based on the needs of each individual project.

Deadline severity

Aside from the deadline priority, it is also possible to specify the severity of individual deadlines. This means that one activity can, for example, have an earlier internal deadline and a hard deadline at a later date. Alternatively, one activity can have a more severe deadline than another, because there are bigger penalties for missing it.

Dynamic environment of insurance processes

Because many insurance processes are reactive (for example, claim notification and handling), AdInsure activity scheduling has to work with a dynamic environment where new activities can appear every day and have to be scheduled accordingly. This can be achieved by running the scheduling algorithm every day and recalculating the schedule based on the latest situation.

Activity Scheduling Features

Fixed activities and stable allocation

While the system is designed to be dynamic and responsive, changing the schedules too frequently can lead to chaos in the workplace by preventing employees from planning their work in advance. To prevent this, AdInsure activity scheduling introduces three important periods for schedules:

1. Scheduled activities over the shortest term (e.g., one day) will remain exactly as they were planned in the previous schedule, ensuring their stability.
2. Activities scheduled over the second shortest term (e.g., three days) will not be reassigned to different workers, allowing individual employees to plan proactively.
3. Activities scheduled over the longest term (e.g., seven days) will be assigned to optimal workers, but can still be reallocated in future runs, if it improves the quality of future schedules.

Activities scheduled after the longest term will not be assigned at all to avoid frequent reallocation.

Automatic activity progress tracking

The solution considers that ongoing activities are already in progress and automatically decreases their remaining duration in future scheduling runs. It also expects that some activities may take longer to finish, so it automatically extends incomplete activities based on their minimal duration.

Deadline failure notification

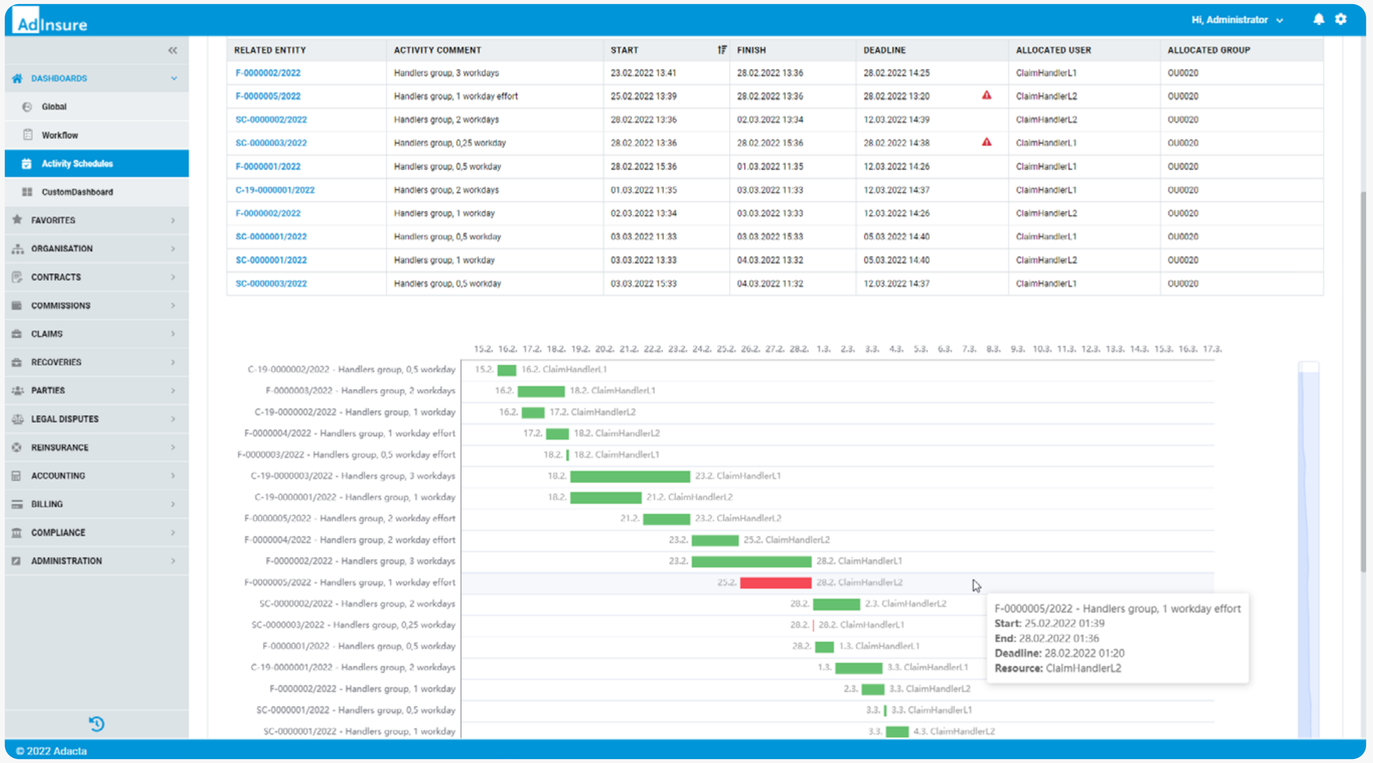
Because the scheduling solution is integrated with AdInsure's Organisation module, it is possible to send notifications to the relevant managers when a schedule predicts that some deadlines will not be met. This can support proactive decision-making when it comes to availability and capacity management processes, staffing and training decisions, and other human resource management processes.

Visualization

The scheduling process is fully automated, and activities can be optimally allocated to the employees in the process without the need for manual intervention. However, it is still useful to double-check the calculated schedules for:

- manual adjustments,
- auditing,
- process optimization opportunities,
- a better understanding of plans and work distribution over longer periods, etc.

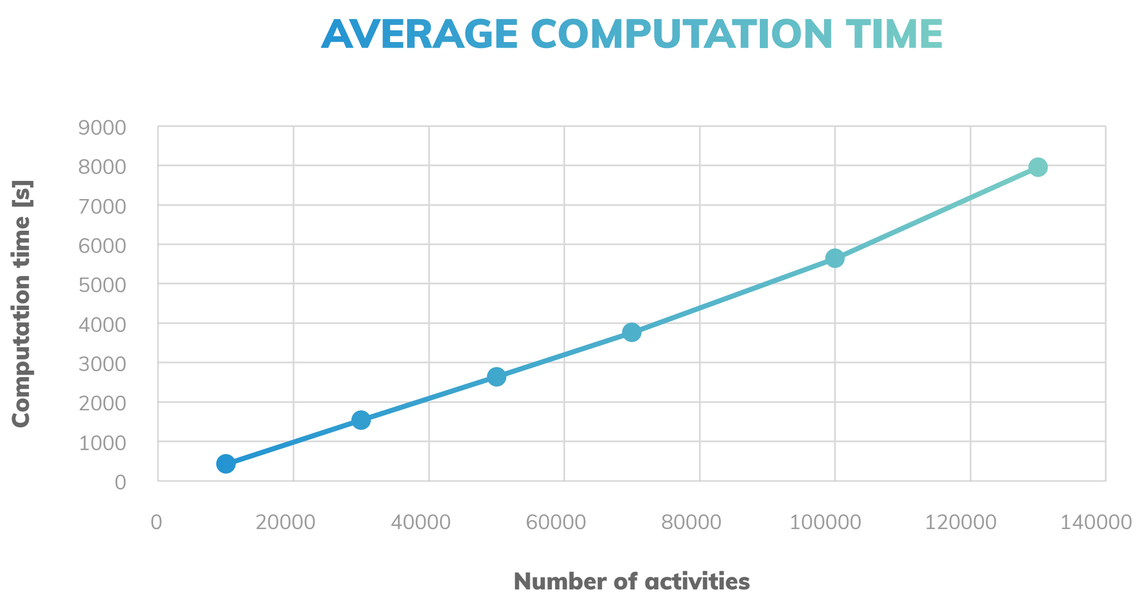
For these purposes, each calculated schedule can be displayed directly in the system in the form of a Gantt chart. Activities with missed deadlines are also highlighted for easier analysis.



Performance

We executed several performance experiments to see how many activities can we schedule at the same time on a generic reference Azure cloud node. We used the Standard_D16s_v5[1] Azure node with 16 vCPUs and 64 GB RAM for reference. This reference infrastructure was able to schedule a process with 70,000 activities in approximately 1 hour and 3 minutes. Scheduling a more complex process with 130,000 activities took around 2 hours and 13 minutes.

You can check the performance curve for the calculation time on the reference Azure node in the accompanying chart. Resulting times were calculated as an average computation time of 10 independent runs of the algorithm for the specified number of activities.



1 https://docs.microsoft.com/en-us/azure/virtual-machines/dv5-dsv5-series#dsv5-series

Conclusion

AdInsure activity scheduling enhances the task management capabilities of AdInsure by planning and allocating activities in an optimal way. This can be particularly useful for insurance companies that have a limited amount of employees to manage a wide range of business processes, from sales and underwriting to claim inspection and liquidation.

While automatically calculated activity schedules can be used for operational task management and planning for all processes and organization units, the estimated workload analysis they provide also enables proactive capacity and availability management. In this way, managers will be able to learn about any missed deadlines, bottlenecks, and shortages in advance, allowing them to prevent any issues. Long-term workload analysis can also help support decision-making in process improvement and resource optimization.

- OPTIMAL ACTIVITY SCHEDULING
- OPERATIONAL TASK MANAGEMENT AND PLANNING
- PROACTIVE CAPACITY AND AVAILABILITY MANAGEMENT
- PROCESS IMPROVEMENT AND RESOURCE OPTIMISATION

About Adacta

Adacta is a leading software provider for the insurance industry. Its insurance platform – AdInsure – provides Life and P&C insurers with a future-proof way to streamline their operations and processes. Since 1989, Adacta has spent decades helping insurance organizations grow their digital capabilities and drive increased profit. Their mission is simple: Empower tomorrow's industry leaders to realise their potential through technology.

About AdInsure

The AdInsure insurance platform is the digital foundation your business needs to keep up with industry changes. It connects and supports all your teams, helping you work smarter, launch products faster, and provide modern customer experiences.

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