Analysing Processes

In the previous video, we discussed different process modeling languages, and we had a look at examples of diagrammatic process models. The visual representation of healthcare process models is very useful, as it allows us to easily and quickly get a general idea of how healthcare services are organized. It is however, by analyzing process models that we can make the most of their potential. There are two main approaches to analyzing processes, verification and simulation. Process verification is concerned with the correctness of a process. Correctness here is understood in terms of the structure of the process model and the associated control flow. For instance, we may want to check whether the end state or the end event, can be reached from any activity in our process model. This abstract example here, does not satisfy this requirement, as the end event will never be reached. In fact, even activity E will never be reached as there is a conflict at the AND-join, what we call a deadlock. The AND-join is waiting for both B and C to be completed, but this will never be the case, given the preceding XOR-split. We may also want to check whether a process model is free of live locks, which are endless loops. This example here is not live lock free, as activities B and C will keep executing one after the other without ever stopping. In addition to generic properties, such as deadlock freedom, formal verification allows us to investigate more specific properties too. Typically, expressed in temporal logic. For instance, when studying the breast cancer care pathway that we saw earlier, we may want to answer questions such as, does pathological assessment always take place after imaging assessment? Or is there at least one path in the care pathway, that does not include a surgical intervention? Such questions, can be answered with the use of model checking techniques. Model checking, is also widely used for verifying care pathways, over medical guidelines, such as those published by the National Institute for Health and Care Excellence in the UK. An example here involves checking whether the breast cancer care pathway meets the following medical guideline. If morphologically abnormal lymph nodes are identified, ultrasound-guided needle sampling is offered. Okay, so we've seen that verification helps us analyze the correctness of a process model, but how about simulation? Simulation techniques are useful for analyzing the performance of our processes, in terms of time, cost, or quality. When simulating a process, we're essentially reproducing the behavior of the process for analysis purposes. This way, we can study previous cases, and diagnose why certain behaviors were observed. Or we can make predictions about future cases. Another typical use of simulation, is for performing what-if analysis. In other words, for experimenting with different process or environmental parameters, so as to improve the performance of our processes. Let's make this more concrete with the use of an example, regarding breast cancer care. Suppose that we're interested in personalizing the breast cancer care pathway, for a particular patient called Anna. In addition to the generic process model, we need to feed our simulation with data about Anna, such as the size of a tumor detected, or her preferences regarding treatment. Then, by running the simulation for Anna's case, we can see what the execution path looks like for her, and what characteristics her care might have. Simulation can be used to run not just one, but also several cases thus allowing us to study the dynamics of complex behaviors. For instance, we may want to study breast cancer care services, in a particular hospital, over the course of a year, so as to analyze performance. In this case, we need to feed the simulation with a process model, data about the different patients, as well as data about resources needed for process execution, such as beds, doctors, operating theatres, etc. This information is important, as different cases or different activities, are competing in a sense, for a limited number of resources. This may lead to long waiting times in so-called bottlenecks in our processes. By running the simulation over an entire year, we can measure how long the breast cancer care pathway, might be on average, or how much related services cost, in the particular hospital. We can use historical data and run simulations to identify bottlenecks and thus decide, which part of the care pathways we should improve. And we can also experiment with a different process structure, or different parameters. For example, by introducing more beds or doctors, to see what effect they may have on cost and time. Such analysis is key to process redesign and re-engineering, as well as healthcare improvement.