How do you best adapt the existing logistics network for production involving multiple chemicals to a planned capacity expansion? Experts from Bayer Technology Services have developed a computer simulation program that lays the foundation for important investment decisions.

How often are your raw materials not delivered because the workers of the supplier go on strike?” Or, “has the train service between Leverkusen and Dormagen ever been interrupted because of weather conditions so that your required intermediate cannot be transported?” “And how long does such a downtime then last on average?” Or also: “What are the flow rates in the pipelines between your production and the storage tanks?”

Indeed, Dr. Michaela Graf and her team working at Bayer Technology Services had a lot of questions for their contacts at Bayer MaterialScience. In fact, they wanted to know some particulars in such detail that sometimes the Bayer MaterialScience colleagues even had to make their own inquiries in order to deliver the answers.

Graf and her team required these data to produce a computer simulation that is as close to reality as possible. This information was meant to clarify how well the existing infrastructure of Bayer MaterialScience is prepared for the expansion of production of polyurethane-based raw materials for certain coatings at the Leverkusen site.

The main aim of the simulation was to depict the chronological sequences of the material flows as accurately as possible,” Michaela Graf explains. How much of the intermediate is produced at a given time and then stored in the tanks; how much of the product is collected from here during the same time period to be sold or further processed, and so on. Pertinent data for this network were gathered in detailed and carefully documented interviews with the respective production and shift managers.

The particulars included the sizes of the tanks, production rates, time designations in connection with filling and discharging containers, frequency and duration of unscheduled downtimes, key data regarding the transport by train from Leverkusen to Dormagen and much more. The team obtained information on the annual sales development as well as market and demand prognoses from the marketing departments. These details were then presented with the help of probability distributions. Ultimately, all the collected information was entered into a simulation programme.
that was created specially for this task. Dr. Andreas Schluck, an expert on material flow simulations at Bayer Technology Services, had customized and further developed a software product that was already commercially available.

But how does the team factor in imponderables, for instance, in connection with the delivery of raw materials? Or transport delays due to winter conditions? Or unscheduled downtimes? “On the basis of the interviews, we were able to estimate the probabilities for all these situations and also to quantify the respective consequences for the material stocks,” says Graf. In the case of raw materials, for example, there are on average delivery delays of seven days once a year due to strikes or weather conditions. This can be calculated mathematically. But delays of on average five hours also occur once a year during the transit between Leverkusen and Dormagen. However, these are mean values, and the fluctuations each year can also be substantial. For this reason, the team usually simulated some 100 annual runs, whereby some imponderables were left to chance according to the probability of their occurring. “When simulating 100 runs,” says Graf, “the worst possible scenario is also taken into account, such as a catastrophic winter coming together with a strike and a plant shutdown.” The statistical analysis eventually showed where the infrastructure had to be modified. For example, higher flow rates were necessary between production and storage in Leverkusen. The customer resolved this problem by introducing more powerful pumps. The simulation also indicated the optimal tank capacities for all the production facilities. In the case of Dormagen, for instance, it turned out that a second filling station would be more advantageous than a new tank that was close to being planned. Generally speaking, Graf’s team had always reserved a certain buffer stock in the tanks to ensure the delivery capability requested by the customer. “And yet despite this, it was still possible to reduce the working capital by up to 25 percent,” Dr. Martin Hecker, co-initiator and during the project Head of Coatings Raw Materials Production in Dormagen for Bayer MaterialScience, is pleased to say.

In addition to this economic success, Graf also found the project a lot of fun and especially enjoyed the exchanges with colleagues involved in the different disciplines, such as marketing, production, transport and also stock logistics. “The quality of our subsequent simulations ultimately depended on the information obtained during these interviews.” She believes such simulations could help many production facilities systematically optimize their infrastructure. For example, the same simulation model also works well for multi-component production spread over several sites.