Process modelling

During Societies' Day, students usually sign up for different societies. There are five different societies: Film Society, Football Society, Watersports Society, Information Society, and Extreme Ironing Society. The societies manager is attempting to figure out the number of people he needs to make sure that students don't wait too long to register for their chosen society. It is often difficult to get volunteers so he needs to know the minimum number for an acceptable service. In this slightly artificial scenario, students can only register for one society. The manager has a good idea of demand and knows how long it will take to register each student to each society. He also has the option of organising single queues for each society or one queue for all societies but is not sure which one is the best. Simul8 will be used to build different models for investigating the above scenario. Simul8 will create visual models for this scenario by drawing simulation objects.

Model Development

Simulation run: 1 day, 8 hours

Number of students: 1, 000

Inter-arrival time: 0. 40

Society preference profile:

Film Society: 10%

Football society: 35%

Watersports Society: 35%

Information Society: 10%

Extreme Ironing Society: 10%

Film Society: 10

Football Society: 14

Watersports Society: 14

Information Society: 12

Extreme Ironing Society: 14

The first step entailed attaching text labels to all the work items in the simulation and using them to store data about the work items. Labels had texts and number and throughout the simulation, simulation objects that had label actions functionality were varying. The label ‘ society’ was attached to the work item type ‘ students’ and it was set to a code number as they entered the simulation of the assignment. Every code number represented a society. In the “ work entry point properties” window, the ‘ actions’ button was selected and in the ‘ actions’ window, the ‘ add a label to change’ button was selected so as to add the five labels which would be changed in the work entry point. The ‘ set to’ radio button was selected and the ‘ label value’ window popped up. In this window, the distribution that the labels would take values from was selected. The next step entailed using the “ labels to route” to the correct workstation.

To route a work item depending on a label value, the “ label” radio button in the

" routing out" was selected and then the " detail" button was used to select what label to use. The Work Items to be routed had this label attached to them. The default routine rules (circulate) were used for labels missing from a work item type that went through the work centre. The values of the label were between one and the number of the alternative routing destinations.

The destination with the largest number was used in instances when the label values were greater than the number of destinations. To prevent the simulation from receiving work items after the 1000 mark, the interval time was set at 0. 4. To do so, the visual Logic Code at the Work Entry Point was added. The new inter-arrival time remained even after resetting the simulation and this was enabled by adding code on reset logic. The contents of the queue were examined in situations when the queue was not working properly to decide what was causing the problem.

Model II (Single Queue for every society)

The first step entailed attaching text labels to all the work items in the simulation and using them to store data about the work items. Labels had texts and number and throughout the simulation, simulation objects that had label actions functionality were varying. The label ' society' was attached to the work item type ' students' and this label was set to a code number as they entered the simulation of the assignment. Every code number represented a society.

In the " work entry point properties" window, the ' actions' button was selected and in the ' actions' window, the ' add a label to change' button was selected so as to add the five labels – Film Society, Football Society, Waterports Society, Information Society, and Extreme Ironing Society which would be changed in the work entry point. The ‘ set to’ radio button was selected and the ‘ label value’ window popped up. In this window, the distribution that the labels would take values from was selected. The next step entailed using the labels to route to the correct workstation.

To route a work item depending on a label value, choose the “ label” radio button in the

“ routing out” and then use the “ detail” button to select the label to use. The work items had this label attached to them. The default routine rules (circulate) were used for labels missing from a work item type that went through the work centre. The values of the label were between one and the number of the alternative routing destinations.

In instances when the label values were greater than the number of destinations, it entailed using the destination with the largest number. To prevent the simulation from receiving work items after the 1000 mark, the interval time was set at 0. 4. To do so, the visual logic code at the work entry point was added. The new inter-arrival time remained even after resetting the simulation through adding code on reset logic. The contents of the queue were examined in situations when the queue was not working properly to decide what was causing the problem.

In one queue for all societies, there is a single queue or interconnected systems where the students are supposed to move from one queue to the next. In the one queue for every society, there are no interconnected systems and the students do not move from one queue to anothe. The difference between the two queues implies that there is a need to balance between service to students (short queues implying numerous servers as well as economic considerations (limited servers)). In essence, the queuing system for the societies can be broken into individual sub-systems that consist of entities queuing for the same activity (one queue for every society). This individual subsystem would deal with students queuing for specific societies: film society, football society, watersports society, information society, and extreme ironing society. To use the ‘ one queue for every society’ model, information related to the way students arrive e. g. in groups or single, the way arrivals are distributed in time. For instance, the probability distribution of time between consecutive arrivals that is the inter arrival distribution of time-0. 4 and whether there a finite students number-1000. The simplest arrival process is a situation where there are regular student arrivals (for instance the same constant time arrivals between successive arrivals). The simplest stream of student arrivals corresponds to random arrivals of students. Successive students arrive after distribution intervals of 0. 4 which independently are exponentially distributed. This model is important because it is a convenient model of most real life queuing systems. It is described by one parameter, which is the average rate of arrival of students as opposed to time dependent arrival rates where the arrival rate changes depending on the time of the day.

In the one queue for every society, service mechanism is dependent on a description of resources required to begin serving students wishing to join the five societies. It also depends on the duration that the service will take: the number of servers available, whether the servers are in parallel (one queue for all the servers) or in series (every server has a separate queue) and whether to allow pre-emption.

The queue characteristics or queue discipline influence both models. This entails how the server attends students waiting for service. The server can choose the student to serve next in a first come first served (FCFS) or first-in first out (FIFO), last-in first-out (LIFO), or a random manner. There are other characteristics that influence queues: reneging (students leave the queue in case they wait too long for the service), balking (students opt not to join the queue because it is too long), queue that are of infinite or finite capacity, jockeying (students switch between the queues in case they believe that they will be servers) will be faster.

Altering the discipline of a queue, that the rule by which servers choose the next student to be served, can often reduce congestion in the queues. Servers often choose students with the least service time as this causes the smallest value for the time a student spends queuing. In both models, the idea of uncertainty in service times and inter-arrival times is important to queuing situations.

In analysing the queuing situation the most important issues typically have to do with the system performance measures and can include the duration the student expect to wait in a queue before they are served and the duration before the service is completed. The probability of the students having to wait longer that the given time interval is also an important issue. There is also a need to consider the average queue length, the probability that the queue will be longer, the expected utilization of the server as well as the expected duration which he or she will totally engage needs to be considered. These issues are important and should be taken into account so that the school management can assess alternatives in an endeavour to improve or control the situation. Simulation is computer based that assists in answering whether it is advisable to invest effort in reducing student service time, the number of servers that should be employed, whether priorities for particular types of students out to be taken into account and whether the student waiting area is enough.

In one queue for all societies there is just a single queue and thus a simple queuing system whereas in the one queue for every society, students mode from one queue to another. There are three levels of variation in the two simulation experiments: Lower level, Intermediate level and Higher level. At the lower level, there is a difference between distinct work items such as the time spent in the system as well as the simulated queuing time by every simulated work item. At the intermediate level, there is disparity between diverse turns in a simulation trial. For instance, completed simulated total work items. At a higher level, there is discrepancy between simulation trials that have diverse random number streams offering diverse simulation results.

Simulation models can be very complex and simple depending on the purpose. A queuing model of students wishing to join the various societies requires only a simple model of arrivals as well as the empirical estimates of the mean arrival rate by time of day. The one queue for every society has multiple checkouts and is more complex. A model of one queue for every society is very complex.

Simulation modelling is very useful to plan resources for process improvement. It gives institutions the flexibility to model their working environment, simulate the inferences of various business choices, and value the processes. Process improvement is effective in identifying as well as analysing workflow and failure cost problems. However, simulation shows ways of implementing practical interventions as opposed to making improvement promises. It attempts to imitate the behaviour of a real system or activity using models, which are simplifications that try to include the essentials while omitting unimportant details. Simulation assists in quantifying relationships among variables that are too complex to analyse mathematically. The current simulation model leads to realistic predictions since it assesses volunteers' impact on society registration without actually having to experiment with or perturb the real system.

The current system simulation mimics the operation of the real system in a computer-volunteer assignment in registering students who are joining various societies. The simulation software has made it possible to model as well as analyse the operations of the real system. Simulation is planning. Preparations for registering students in various societies begin in advance before they arrive, picking venues, analyssing the venue capacities, and envisioning the number of students to join the five societies. This evaluation involves many what-if questions; where will registration holdups develop? How long, on average, will it take students to be registered? How long will the students have to wait in queues before being registered? Simulation modelling assists in solving all these questions. Simulation is a behavioural tool that assists decision makers to concentrate on significant aspects of a problem, rather than bickering about details, preferences or personalities. In creating a simulation model, there are various assumptions and naming of important variables. The model suggests relationships among the variables. Simulation thus is not just a quantitative tool for operations research specialists, but rather is a general device to help people to think clearly.

Simulation models can be quite simple or very complex, depending on the purpose. A queuing model of students to join various societies requires only a simple model of arrivals and empirical estimates of the mean arrival rate by time of day. A queuing model of a single queue for every society is more complex. The models presented above simulate events by using people, as in simulations to test waiting or queuing lines while registering students.

Simulation in this case is attractive because real life experiments are not possible. Simulation models presented adequately describe the reality because the system if very complex, processes are repetitive, real experiments are costly and impossible and uncertainties exist in the variables. There is usually a less inclination to stimulate in case the system is simple, variables are non-varying, real experiments are non-disruptive and cheap, and if the event just occurs one time. Simulation modelling improves processes because it reveals potential problem areas without carrying out an actual physical test of the system operations.

Simulation modelling is advantageous in that it allows the key variables to change in random but specified ways, so that managers can see what happens to the bottom-line decision variable(s) of interest. It helps us to understand the range of possible outcomes and their probabilities and allows a sensitivity analysis showing which factors have the most influence on the outcome. Simulation is useful because it is less disruptive than real experiments, forces clearly stated assumptions, helps in visualising the suggestions of the assumptions made, reveals system interdependencies, quantifies risk by showing probabilities of events, visualises a range of possible outcomes, and promotes constructive dialogue among stakeholders. Simulation allows main variables to change in unsystematic and specific manners, so that people can understand what happens to the outcome decision variable(s) of interest. It helps to understand the range of possible outcomes and their probabilities and allows a sensitivity analysis showing which factors have the most influence on the outcome.

It is possible to observe the performance of an institution in a prolonged period under a number of various scenarios. Simulation modelling offers a more reliable evaluation of behaviour in service processes as it integrates the dynamic (time-dependent) operation systems behaviour. There is variability in both the durations and demands on activities within the system. Demand on systems in this case takes in student registration whereas duration represents time taken to register the student. The use of average or fixed values has provided some performance indications. However, simulation has allowed the use of statistical distributions. It thus offers an indication of both the variability as well as the range of system performance. This is significant in customer-based systems because it prevents average performance not to drop to a particular level. For instance, the student service time should not go below a particular level because the students will fail to register in the specific societies. In the service systems, performance measures evaluate the maximum queuing time for the students as well as the utilisation that is the percentage of time occupied by those serving the students. The systems have various decision points that influence the entire system performance. The simulation technique incorporates statistical distribution to show the possible decision options. The evaluation of the ‘ knock on’ effect of numerous interdependent decisions over a period is possible because the simulation has the capacity to show the system behaviour in a period.

The simulation above can be used to improve the societies registration process because the students wait very long to be served. There are five societies and the simulation model estimated the service time for the students. Using a fixed time between customer arrivals of 0. 4 and with a 10% probability - Film Society, 35% - Football Society, 35% - Watersports Society, 10% - Information Society and 10% - Extreme Ironing Society, the overall service time for students has a range between five to ten minutes and no queues were present in the system. The simulated time between arrivals of students, which follows an exponential distribution (the exponential distribution mimics the behavior of student arrivals. The simulation shows the way unpredictability influences the performance of even simple systems. Inconsistency in this system would present in other areas such as student service times as well as the mix of student types over time. The simulation model can incorporate every source of variability to offer a more realistic picture of system performance. The process mapping technique used to identify and document process activities is the basis for the simulation model design. Simulation models measure the processes of performance over time by taking into consideration independent factors as well as variability and this leads to process improvement because the models identify areas that need to be improved. The potential of simulation models in improving business processes is enormous and software and associated techniques are important in analysing and evaluating major changes that can streamline the processes and boost profits. Process improvement is a structured way to employing policies, methods, tools, and metrics to optimize organisational activities. Simulation models are a tool for process improvement. It is a part of a business tool designed to improve core capabilities and competencies. The models ensure that activities add value to institutions and businesses.