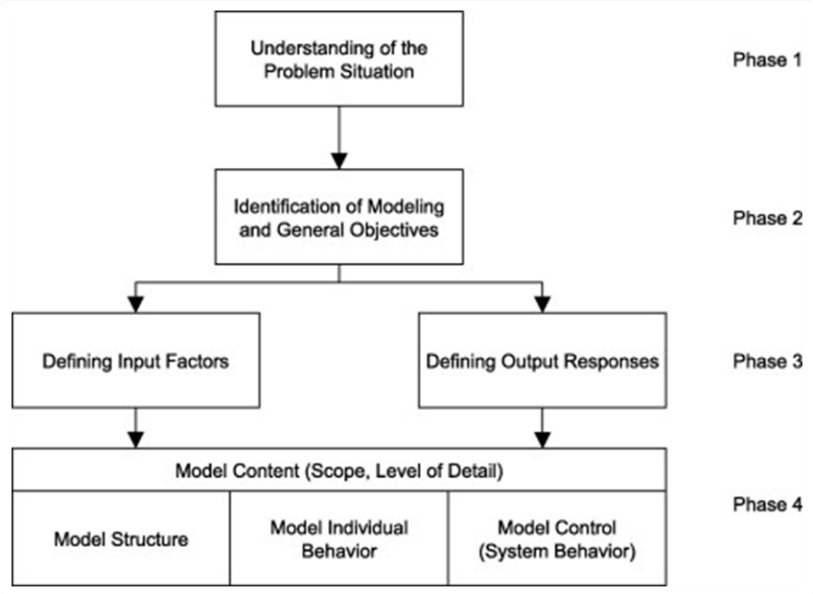
Conceptual Modelling Lab 2

In this lab we continue to work through the Hierarchical Control Conceptual Modelling (HCCM) framework to build a conceptual model, aligned with the HCCM standard from lectures, that represents the practical activity, i.e., making paper cubes, from the earlier lab.

You will finish working through the steps for HCCM modelling shown below and complete templates for those steps.



~~Understanding of the Problem Situation~~

~~Identification of Modelling and General Objectives~~

~~Modelling Objectives~~

~~General Objectives~~

~~Defining Input Factors~~

~~Defining Output Responses~~

Model Content

Recall that for the model content definition of our conceptual model we will follow the new HCCM standard. This standard is presented in an academic article (currently under review) that is available on Canvas under `Files > Lectures > Conceptual Modelling` in the file `hccm-standard.pdf`

~~Identifying Entities~~

~~Drawing Behavioural Paths~~

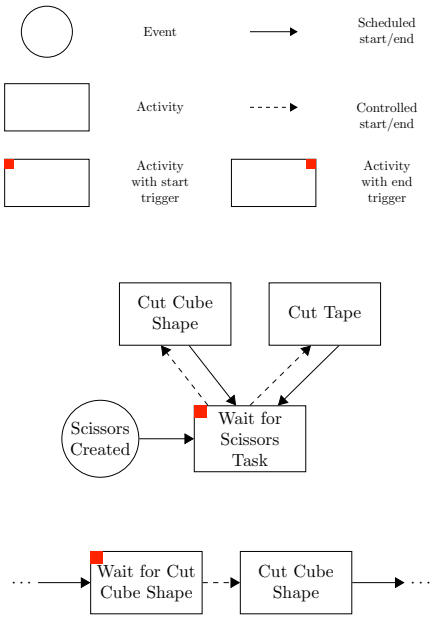
Model Control – Defining Logic

Now that the behavioural paths of the active entities have been defined (in the last lab) you need to define the logic for each of your triggers (the little red squares). In the box below the logic for one of those red squares – triggered on the start of Wait for Cur Cube Shape – is shown along with a reminder of snippets of the behaviorual paths that are relevant to this trigger. In this box and the next two write down pseudocode for all your triggers.

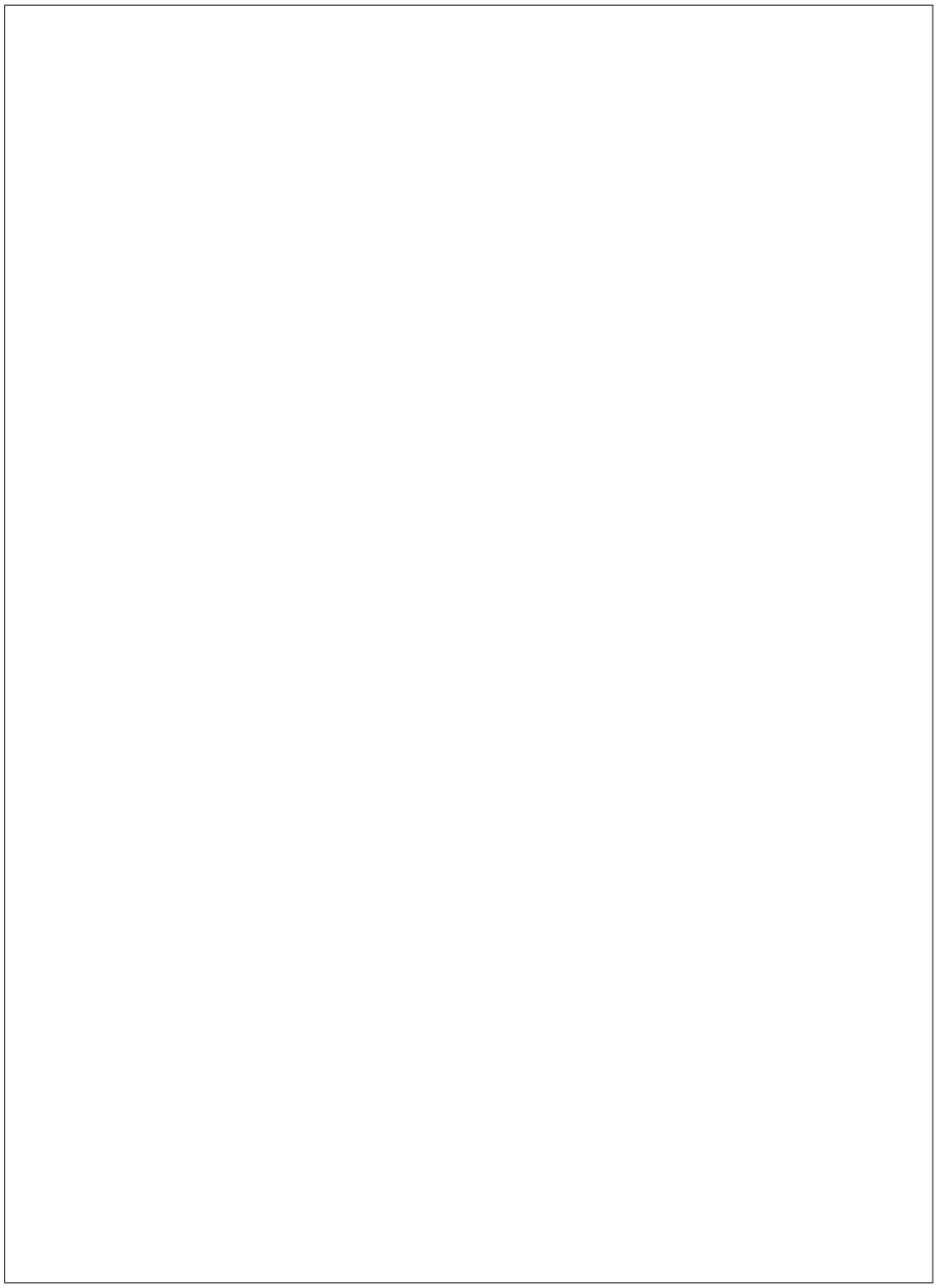
On Start Wait for Cut Cube Shape

Triggered by	Cube c

```
1: if Scissors.CurrentActivity = Wait for Scissors Task then
2:     Wait for Scissors Task.End with Scissors
3:     TRANSITION Wait for Scissors Task.End to Cut Cube Shape.Start WITH Scissors
4:     Cut Cube Shape.Start with Scissors and c
5: end if
```



Defining Logic (continued)



Defining Logic (continued)

Checkpoint Get the lab tutors to review and mark off your logic pseudocode.

Model Data

Finally, you need to give detailed defintions of the data, entities, transitions, activities and events. You may not have collected data during cube making, but fill out the following table that describes the kind of data you would need to collect to simulate cube making.

Name	Description	Inputs	Outputs
CubeCutDuration	The time taken to cut a cube pattern from a piece of paper	(Maybe) person cutting	Cut duration

Model Entities

In the following table list the entities again, but add attributes that the entities will need to capture the performance of the system, e.g., waiting time until the cube was cut. The Cube entity has been started for you.

Entity	Attributes	Description
Cube	Number	The number of the cube being cut
	CurrentStart	When did it start the current activity it is participating in
	CurrentActivity	What is the current activity it is participating in
	WaitingForCubeCutTime	How long did it wait until it was cut from a sheet of paper

Model Transitions

In the following table list the transitions between activities and events. Not that you may want to prefix these transitions by the behavioural pathway they come from.

No.	Participant(s)	From Event(s)	To Event(s)
C.T3	Cube (c)	Trace Cube (c, Pattern p)	Wait for Cube Cut Shape.Start(c)
C.T4	Cube (c)	Wait for Cube Cut Shape.End(c)	Cube Cut Shape.Start(c)

Model Activities

In the following table list the activities from the behavioural pathway diagrams along with the state changes for the start and end event of each activity.

Activity	Participants	Event	Type	State Change
Trace Cube	Cube (c), Pattern (p), Tracer (s)	Start	Scheduled	1: SCHEDULE Trace Cube.End at TIME + TraceCubeTime(s)
		End	Scheduled	1: TRANSITION C.T3 WITH c 2: TRANSITION P.T<to complete> WITH p 3: TRANSITION S.T<to complete> WITH s
Wait for Cube Cut	Cube (c)	Start	Scheduled	1: c.CurrentActivity = Wait for CubeCut 2: c.CurrentStart = TIME 3: TRIGGER OnStartWaitForCubeCut WITH c
		End	Controlled	1: c.WaitingForCubeCutTime = TIME-c.CurrentStart 2: c.CurrentStart = TIME 3: TRIGGER OnStartWaitForCubeCut WITH c

Model Activities (continued)

Activity	Participants	Event	Type	State Change

Model Activities (continued)

Activity	Participants	Event	Type	State Change

Model Events

In the following table list the events to start and finish the simulation along with the events from the behavioural pathway diagrams along with the state changes for each event.

Event	Participants	Type	State Change
Simulation Start		Scheduled	1: **for** the maximum number of cubes that could be created **do** 2: CREATE Cube c 3: SCHEDULE Arrival with c at TIME ▷ Make the cube arrive now 4: **end for** ▷ Create other entities, e.g., Scissors 5: CREATE Scissors s 6: TRANSITION S.T1 with Scissors ▷ Go to Wait for Scissors Task 7: <to complete – create other entities> 8: SCHEDULE Simulation End at SimulationHorizonTime
Arrival	Cube (c)	Scheduled	1: c.ID = CubeNumber 2: CubeNumber = CubeNumber + 1 3: TRANSITION C.T1 WITH c

Model Events (continued)

Event	Participants	Type	State Change
Simulation End		Scheduled	1: Calculate end of simulation statistics

Checkpoint Get the lab tutors to review and mark off your tables. You will need your behavioural pathways handy to show them how you have translated those pathways into tables.

You have now completed the conceptual model of the cube making activity and you could use this model as the staring point for implementing a simulation model in JaamSim using the HCCM library.