FIT3158 Business Decision Modelling
Semester 2 2022
Assignment – Case II

Case II (Network Modelling) – Production and Distribution at ModularDYNAMICS

ModularDYNAMICS, an advanced electro-mechanical systems engineering company is producing a next generation self-adapting robotic arm (the FlexAdapt 1.0) that is receiving high demand from a variety of industries specialising in material handling and manufacturing to automate their manufacturing processes. The FlexAdapt 1.0 robotic arms are currently produced at two specialised production facilities in Vietnam and South Korea. The company sells the product through its distributors only in select markets identified as key manufacturing hubs with potential for future sales growth. The selected markets are the United States, United Kingdom, Germany, and China. The production facility in Vietnam has the capacity to produce 3000 units per month and the South Korean production facility can produce 4000 units per month. The estimated cost of shipping a crate of 10 robotic arm units for the upcoming year-end month of December to distributors in each of the identified market countries are estimated to be as given in the following table.

Production Facility	Shipping Cost per Crate of 10 Units – December			
	United States	United Kingdom	Germany	China
Vietnam	$300	$260	$250	$230
South Korea	$270	$290	$220	$240

It has also been informed to ModularDYNAMICS that the above costs will increase by 15% for the month of January in the new year considering current global inflation trends as applied to shipping and transportation costs. Each country has a standing order of 1500 FlexAdapt 1.0 robotic arm units for December and 2000 robotic arm units for January. For a particular month, ModularDYNAMICS can also ship 500 units more than the standing order to distributors in each country, provided that a discount of $100 per unit is given on the excess amount. The distributors will hold this amount in inventory from that month to the next.

The per unit robotic arm production costs for the month of December are estimated to be $1200 at the production facility in Vietnam and $1300 at the facility in South Korea. It is also expected that these costs will be $1250 per unit at both facilities for the month of January.

ModularDYNAMICS wants to develop a plan that optimizes production and distribution for the future months of December and January so that the demand at each market country is met at the minimum cost.

1) Considering the network flows (decision variables) as representing the number of crates being shipped from each production facility to each market country for a particular month of interest and representing the amount of excess stock (number of crates) being held from December to January at each country, represent the decision problem for ModularDYNAMICS using an appropriate network flow diagram. The discount given on the excess amount held on inventory by the distributors can be interpreted as a cost (for holding inventory) from the perspective of ModularDYNAMICS. Include all supply, demand values at nodes and any applicable costs/flow bounds on arcs in your diagram.

   (hint – Each node can be represented as a combination of country and month. For example, a **Vietnam-DEC** node to represent supply from Vietnam in December and a **Germany-DEC** node to represent demand at Germany in December etc.)

2) Design and implement the model in Excel following goals/guidelines for good spreadsheet design and using the balance of flow rules approach for network modelling.

3) Solve using solver to find the optimal solution.

Delivery structure and submission instructions for Case II.

Your delivery should include an Excel file comprising the following work sheets.

- Case II Title Page
- Case II Model
- Case II Report /Solution Summary

1) The "**Case II Title Page**" should include the following information.

- The Title and brief description of the case.

- The complete network flow diagram for the problem.

- Each group members contribution (tasks performed and contribution percentages in a table).

2) The "**Case II Model**" sheet should include the following.

- The spreadsheet implementation of the model following goals and guidelines for good spreadsheet design and using the balance of flow rules approach for network modelling.

- Complete solver settings should be included in the submitted file and be visible when solver is opened.

- The model should consistently produce accurate and reliable results.

- Every member in the group must know the model well and be able to demonstrate/explain the model when asked.

3) The "**Case II Report/Solution Summary**" sheet should include the following.

- A summary of the solution based on the created excel model clearly presenting the optimal values for the decision variables and the total minimum cost for ModularDynamics.

The Excel file should be named as <Group_No.>_Assignment_Case2.xlsx (or.xlsm) where the <Group_No> is the number assigned to your group by the tutor.

The file should be uploaded on the FIT3158 Moodle site under the submission link together with Case 1 and Case 3 files by the due date.

Marking Criteria

Criteria	**Content**	**Marks Allocation**
Title Page/Sheet	Title and brief description of case.	2
	Each group member's contribution (tasks performed and contribution percentages).	2
	Complete Network flow diagram. - Correct representation of flows - Correct representation of nodes - Correct supply/demand values at nodes - Correct cost/flow bounds values as applicable in arcs	8
Case II Model Sheet	Correct implementation of spreadsheet model considering goals and guidelines for good spreadsheet design. The model should be robust and produce accurate and reliable output consistently. - Correct representation of nodes - Correct supply/demand values at nodes - Correct representation of flows - Correct cost values as applicable - Correct flow bounds as applicable - Correct net flow values for constraints - Correct representation of objective function	14
	Solve settings. - Correct solver setup for objective Function and decision Variables - Correct constraints in solver	2
Case II Report/Solution Summary	Accurate Summary of solver output including correct values for decision variables and the total minimum cost.	2