IE-462
Section 1, CRN: 33602/603/604
Section 2, CRN: 38318/319/320
Section 3, CRN: 76433/434/435

Second Semester 1440-41 H (Spring – 2020) – 2(2,1,1)
"INDUSTRIAL INFORMATION SYSTEMS"

Sunday, April 08, 2020 (15/08/1441H)

Homework 1

Group #:	Student Names:	Student Numbers:	Sections (circle one):
		43	9 AM / 10 AM /11 AM
		43	9 AM / 10 AM /11 AM
		43	9 AM / 10 AM /11 AM
		43	9 AM / 10 AM /11 AM
		43	9 AM / 10 AM /11 AM

1) ACME Machine Shop Case

Introduction The ACME Machining Company is a small job shop that provides machining services. The company owns ten general-purpose computer numerical control machine tools and employs 15 people, 8 of whom are tool designers and machine tool operators. The company provides machining services to other manufacturers in the area who require machining services done that they are not interested in doing in-house. Therefore, ACME's orders from customers are usually for high precision or special-purpose machined parts in small lots.

The most important assets of the business are the highly trained tool designers and machinists, and the very expensive precision tools owned by the company. The owner of the company has a simple view of his business: whenever a machinist or a machine is idle and there are jobs waiting to be processed, the company is losing money. Therefore, the owner has always put a high priority on machine maintenance, especially preventive maintenance, to avoid unnecessary downtime.

Maintenance is the responsibility of the plant supervisor, Mr. Bill Wrench. Bill has set up the entire preventive maintenance program for the plant, which consists of regularly performing certain preventive maintenance tasks based on the number of hours of operation on a machine. The manufacturers of each of the 10 machine tools have provided Bill with a list of preventive maintenance tasks and the frequency with which they are to be done.

The company owner has suggested to Bill that he maintain records of the preventive maintenance functions in a computer database. The owner has heard that there are inexpensive database systems that can be purchased and used for this purpose. Also, a nearby college has students that are knowledgeable about the use of databases, and they can be hired as interns to help to design the application. Bill decides to follow-up on his boss's suggestion, and he hires you to advise him on the design.

The Preventive Maintenance Function. Your first step is to meet with Bill to discuss the preventive maintenance function as it is now performed. The description that Bill provides you is given in the following paragraphs:

Bill: "First, let me show you my database; it's over here in the fi ling cabinet." [He opens a drawer.] "These documents are the most important information that I have. The machine tool vendors have given me the exact maintenance that I should follow on each machine. For example, look at this schedule [Exhibit CS4.1]. It's for the Mazak 2120 CNC Mill. See, every 100 hours of operation I have to check the slides for lubrication, and every 500 hours of operation I have to do a tear down of the milling head to check the condition

of gears and belts. The other vendors have provided me with similar kinds of instructions for their machines."

Student: "So how do you know when the machine has been operated for 100 hours or 500 hours since the last maintenance?"

Mazak Corporation
122 Mill Street
Lexington, KY

PREVENTIVE MAINTENANCE SCHEDULE FOR: 2120 CNC Mill

PM TASK NO	FREQUENCY	DESCRIPTION	REFERENCE
1	Every 100 hours	Lubricate slides as needed	Manual M5.1, p. 4
2	Every 500 hours	Milling head: check gears and belt	Manual M5.1, p. 6
.	.	.	.
.	.	.	.
.	.	.	.

EXHIBIT CS4.1 Example Preventive Maintenance Schedule

Bill: "Oh, I keep records. Each machine has a meter on it that keeps track of operating hours. In the morning, the manufacturing department collects the meter readings and sends them to me. The machinists then reset the meters for the start of a new day. This way, I have a record of the hours of operation for each day. I also keep a sum column so that I know the total number of hours on the machine. See." [He holds up Exhibit CS4.2.]

Student: "Let me see if I understand. The first thing you do in the preventive maintenance function is that you receive the hours of operation data from manufacturing. Then you add those hours to your record. Then you look up the preventive maintenance schedule for each machine and compare it to the sum of the hours of operation in your record. If the prescribed number of hours of operation has elapsed since the last time a particular preventive maintenance task was done, you perform the task. One thing I don't understand. How do you know that the prescribed number of hours have passed since the last time you performed the task?"

MACHINE OPERATING HOURS RECORD

	MAZAK 2120		CINCINNATI CNC LATHE	
DATE	DAY	TOTAL	DAY	TOTAL
2/1/99	4	90	-	-
2/2/99	8	98	-	-
2/3/99	6	104	5	5*
2/4/99	0	104	6	11
2/7/99	5	109	8	19
2/8/99	6	115	6	25
2/9/99	8	123	5	30
2/10/99	8	131	8	38
2/11/99	4	135	4	42
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

* first day put into service.

EXHIBIT CS4.2 Record of Operating Hours by Machine

Bill: "Oh, that's easy. I find that information in my fi le of completed maintenance records, which is this drawer containing completed maintenance work orders." [He opens another file drawer.] "Each time I request preventive maintenance on a machine, I make out a work order. I put the work order into this tray [points to tray on desk], which is my open work order fi le. The maintenance technician works off this tray. He takes each order in sequence, performs the maintenance, and then returns the work order to me when the maintenance is completed. He puts the time worked on the work order and returns it to me for fi ling. Here, look at this [Exhibit CS4.3]. This is one of EXHIBIT CS4.2 Record of Operating Hours by Machine EXHIBIT CS4.3 my records of preventive maintenance done in the past. The work order number is a unique number that I assign each time I request a specific task on a machine. Basically, it's just a rotating five-digit number. This one shows that this is the 512th preventive maintenance task I have performed on any of our machines. I put in the machine ID to identify the specific machine that is being worked on and the date work requested to show when the work was assigned. The machine ID is a number that comes off the manufacturer's data plate. It's basically his serial number, and it is unique for his machines. I also record the machine hours, which show how many total hours were on the machine when I did the maintenance. I get that number off this sheet [Exhibit CS4.2, again]. Finally, I record the preventive

maintenance task that is to be performed, and the maintenance technician records how long it took to do the maintenance."

PREVENTIVE MAINTENANCE WORK ORDER

PM WORK ORDER NUMBER: 00512
MACHINE ID: E41520
MACHINE NAME: Mazak 2120 CNC Mill
PM TASK: #1 – Lubricate slides as needed
MINUTES WORKED: 120

DATE WORK REQUESTED: 2/4/99
MACHINE HOURS: 104
DATE WORK DONE: 2/4/99

EXHIBIT CS4.3 Example Work Order

Student: "When the maintenance technician returns the completed work order to you, does he hand it to you? What actually happens?"

Bill: "No, he doesn't actually hand it to me. See this empty tray next to the one I use for open orders? He puts the completed work orders into this tray. I empty this tray at the end of the day. I add the last piece of information to each work order, the date work done, and then I put the completed work order into my completed maintenance record fi le. This is where I look to find out when a particular maintenance item was last done."

Student: "Okay, Bill, I think I understand what you are doing. Please do me a favor and provide me with any other information you think might be relevant [provided later as Exhibit CS4.4]. Also, since we are going to have your records on a database, try to describe the kinds of summary reports that you think would be desirable to print out for your own purposes or for your boss. We might as well plan to accommodate all the desired information in our design at this time." [Exhibit CS4.5 provided by Bill later.]

Machine name: Mazak 2120 CNC Milling Machine

Manufacturer: Mazak Corporation

Serial No.: E41520

First date in service: December 1, 1998

Warranty expiration date: December 1, 2003

EXHIBIT CS4.4 Machine Data

Requirements

1. Design a functional model using the IDEF0 methodology that shows how the preventive maintenance function is done.

2. Design a data flow diagram of the processes and information flows involved in the preventive maintenance process.

1. A list of warranty expiration dates by machine. We regularly extend our warranty dates by purchasing new contracts. I would like to be able to review them when I please.

MACHINE NAME	MACHINE SERIAL NO.	FIRST DATE IN SERVICE	WARRANTY EXP. DATE
2120 CNC Mill	E41520	12/1/98	12/1/03
Cincinnati CNC Lathe	C5001	2/3/99	2/3/01
Cincinnati CNC Lathe	C4010	4/1/96	4/1/01
.	.	.	.
.	.	.	.

2. I would also like to be able to obtain a preventive maintenance history by machine and by task.

MACHINE NAME	PM TASK NO.	DATE DONE	MACHINE HOURS	MINUTES WORKED
CNC Drill	1	1/10/98	205	30
CNC Drill	1	3/5/98	410	35
CNC Drill	1	7/2/98	605	40
CNC Drill	1	10/1/98	800	35
CNC Drill	1	2/1/99	1010	32
CNC Drill	2	6/2/98	500	150
CNC Drill	2	2/1/99	1010	130
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

EXHIBIT CS4.5 Requested Summary Reports

Source: Q4.5; *Boucher and Yalcin, 2006* textbook, pp 132-6.

2) University Food Company Case

The University Food Company wants to incorporate more information technology into its organization, particularly its shipping department. The sales department has already implemented a database for order entry functions, and the production planning department has an information system for tracking inventory, including finished goods. The shipping department currently uses information from these sources in the course of doing its daily tasks. The shipping supervisor has asked you to study the activities in the department and to recommend an information system design to support the operation. What follows is a description of the tasks performed by the shipping clerk and support personnel during a typical day.

At the beginning of each day, the sales department prints a report and sends it to the shipping department. This report, called the "Open Orders Report," is a list of orders taken by sales that have not been closed out. Orders are not closed out until the final shipment has been made against the order. An example of a typical open orders report is shown in Exhibit CS4.6. Open orders are listed in the ascending order of their promised delivery date.

University Food Company, Inc Open Orders Report, 11/01/03

Order #	Cust id	Name & Ship to	PO #	Product ID	Label	Qty(cases)	Price	Extension	Deliver by
03564	3950	Columbia University 4677 Broadway New York, NY	58900	243	Macaroni & Cheese	800	27.00	$21,600	10/29/03
03565	1000	Lehigh University 210 Packer Street Bethlehem, PA	03-100	430 350 235	Turkey Soup Beef Ravioli in Sauce Chili w/ Beans	600 300 1000	30.00 45.00 40.00	$18,000 $13,500 $40,000	11/01/03 11/01/03 11/01/03
03580	1050	New Jersey Institute 500 Martin Luther King Blvd. Newark, NJ	20300	350 440	Beef Ravioli in Sauce Corned Beef Hash	500 700	45.00 32.00	$22,500 $22,400	11/01/03 11/01/03
03566	873	University of Massachusetts 125 Springfield Ave. Amherst, MA	03-222	243 333	Macaroni & Cheese Chicken Noodle Soup	1000 3000	27.00 22.00	$27,000 $66,000	11/02/03 11/02/03
03564	3950	Columbia University 4677 Broadway New York, NY	58900	380	Fish Chowder	400	30.00	$12,000	11/03/03
03567	1200	New York University 10 Folly Square New York, NY	4999	430 905	Turkey Soup Beef Stew	500 600	30.00 50.00	$15,000 $30,000	11/03/03 11/03/03

EXHIBIT CS4.6 Open Orders Report

University Food plans its production in two ways: produce to order and produce to inventory. In the first case, production is scheduled for a specific order. In the second case, production is done in the absence of a specific order. The second case occurs because a specific order is small and it is desirable to have a longer production run before changing over to another product. Changeovers require that the machinery is thoroughly cleaned before the next product can be made, thus incurring a significant cost. The excess production is placed in inventory and is available for shipment the next time a customer orders the product. Also, sometimes production runs of the most popular food products are made to inventory during periods of slack demand.

The shipping clerk receives a report (printout) of the finished goods inventory from the production planning department, showing the location of the finished

goods inventory by inventory lot. The report is ordered by material ID in the ascending order. The clerk examines each of the open orders and determines whether or not there exists a matching product inventory lot. If the match occurs, a shipment can be made. A typical finished product inventory report is shown in Exhibit CS4.7.

Finished Product Inventory Report, 11/01/03

Material ID	Description	Lot no.	On Hand	Location			
				area	isle	tier	bin
235	Chile w/ Beans	13180	500	5	1	1	6
		13210	2000	5	2	1	10
243	Macaroni & Beans	12920	400	5	1	1	8
		13010	1000	5	4	2	4
333	Chicken Noodle Soup	13220	1000	5	2	1	3
		13400	1000	5	2	2	1
350	Beef Ravioli in Sauce	12840	100	5	3	2	10
		13006	600	5	3	1	6
		13285	600	5	1	1	4
380	Fish Chowder	13401	600	5	4	2	2
430	Turkey Soup	13080	1000	5	1	1	5
.	.	.	.	.			
.	.	.	.	.			
.	.	.	.	.			

EXHIBIT CS4.7 Finished Product Inventory Report

After identifying an inventory lot that can be shipped, the shipping clerk dispatches the forklift truck operator to the warehouse to fetch items to be shipped. He does this by giving verbal instructions to the driver concerning the lot number and location of the product. The driver collects the items and brings them on pallets to the shipping dock. He informs the shipping clerk that the pallets have been retrieved and gets his next assignment.

It is the responsibility of the shipping clerk to keep a daily record of everything that is transferred out of the warehouse for shipping and to indicate on the record the customer order against which it is shipped. The warehouse transfer report, shown in Exhibit CS4.8, is used for that purpose. The shipping clerk completes this record when pallets are brought to the loading dock. This document is transferred at the end of the day to the sales department where it is used as the source of information to close out sales orders.

After completing an entry on the warehouse transfer report, the shipping clerk directs his personnel to load the cases of product on to a truck. As cases are being loaded, he fills out another important report maintained by the shipping clerk, the shipping summary report. This report is kept daily and held in a fi le in the shipping department. It describes the quantity of cases that are shipped, the customers to whom they are shipped, and the truck number on

which they are shipped. University Food maintains its own fleet of trucks, which is managed by the company's transportation department. The shipping department is only responsible for tracking the shipment to the truck on which it is dispatched. The transportation department is responsible for tracking deliveries to the final customer. A typical shipping summary report is shown in Exhibit CS4.9.

Warehouse Transfer Report, 11/01/03

Order #	From Location	Product	Lot no.	Qty. (cases)
03564	5-1-1-8	Macaroni & Cheese	12920	400
"	5-4-2-4	"	13010	400
"	5-4-2-2	Fish chowder	13401	400
03567	5-1-1-6	Turkey soup	13080	500
"	5-5-1-1	Beef Stew	12604	600
03565	5-1-1-6	Turkey Soup	13080	500
"	5-3-2-10	Beef ravioli in sauce	12840	100
"	5-3-1-6	"	13006	400
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

EXHIBIT CS4.8 Warehouse Transfer Report

Shipping #	Customer	City & State	PO #	No. of Cases	Weight (Lbs.)	Truck No.
03550	Columbia Univ.	NewYork, NY	58900	1200	6000	3
"	NewYork Univ.	NewYork, NY	4999	1100	5500	3
03551	Lehigh Univ.	Bethlehem, PA	03-100	1900	9500	4
03552	New Jersey Inst.	Newark, NJ	20300	1200	6000	2

EXHIBIT CS4.9 Shipping Summary, 11/01/03

For each customer shipment on a truck, the shipping clerk prepares a bill of laden for the truck driver after the cases of product are loaded on the truck. Most of the information for the bill of laden is taken off the shipping summary and open orders reports. A copy of the bill of laden is sent to the transportation department at this time, and the other copies are given to the truck driver. No copies are kept in shipping. This bill of laden is presented to the customer when the driver arrives at the customer's receiving location. A signed copy of the bill of laden is turned in to the transportation department when the driver returns from a delivery. The transportation department matches this copy to the one sent by the shipping department and closes out the delivery in its records. A typical bill of laden is shown in Exhibit CS4.10.

Requirements

1. Using the description presented earlier, develop a functional architecture based on the IDEF0 method. The context diagram should be labeled "Operate Shipping Department."

2. Draw a corresponding data flow diagram.

FREIGHT BILL OF LADEN

To: New Jersey Institute of Tech
500 Martin Luther King Blvd.
Newark, NJ 07050

From: University Food Company
1766 New England Ave.
Piscataway, NJ 08854

Date Shipped: 11/01/03
Truck Number: 2
B/L No.: 03552

Code	Quantity	Weight	Description	Reference
350	500 cases	2500 Lbs	Beef Ravioli in sauce	PO 20300
440	700 cases	3500 Lbs	Corned Beef Hash	PO 20300
	Total Weight	6000 Lbs		

Received by:_____ **Date:**

Driver: _____ **Lic. Number:** _____

EXHIBIT CS4.10 Freight Bill of Laden

Source: Q4.6; *Boucher and Yalcin, 2006* textbook, pp 136-9.

Rules:

- You should work with your **project group** for this assignment.
- Read carefully the question and **answer the requirements** stated along with each question statement.
- You are first required to show the list of activities involved in the IIS; e.g. using a **business model** similar to the *Hoosier Burger Inventory Control System* (*Valacich, Fig 7-12*)
- You must then use **modeling software** (e.g. *MS Visio*) to produce the requested models in each question. You must state the name of the utilized software in the supporting documentation.
- You must also provide **screenshots of all your diagrams** and provide them (with appropriate description) in a *MS Word* (.docx) file.
- Any written supplemental material must be **typed** and written in **proper English**.
- You must **submit your work by email** (in one zipped file, e.g. "HW01_G12.zip" to aelsherbeeny@ksu.edu.sa), containing all work that you have done, including:
  - models (saved in their original formats)
  - diagram screenshots (in the .docx file)
- The above questions have been assigned to projects groups as follows:
  - Q1: groups 1, 3, 5, 7, 9, 11, 13, 15, 17
  - Q2: groups 2, 4, 6, 8, 10, 12, 14, 16, 18
- Due date: **Sunday, April 12th, 2020** (19/08/1441) at **2:00 PM**