INSTRUCTORS' NOTES–USING PIVOTTABLES IN MANUFACTURING TO EVALUATE INVENTORY COUNT ACCURACY: AN INFORMATION SYSTEMS BUSINESS CASE ANALYSIS STUDY

Penelope Lyman, University of North Georgia

CASE DESCRIPTION

PivotTables can be used in manufacturing to summarize large quantities of data without extensive formula development. The primary purpose of this case study is to provide students with an opportunity to use spreadsheet-based PivotTables to analyze the count accuracy of a single factory's monthly physical inventory. To conduct this investigation, students apply concepts from their undergraduate accounting courses and learn how to improve their use of spreadsheet software. The case has a difficulty level appropriate for junior- or senior-level undergraduates taking an AIS (Accounting Information Systems) or Auditing course. The case should require approximately half an hour of class time to generate the PivotTables and an hour of student time outside of class to analyze the results.

CASE SYNOPSIS

The purpose of this assignment is to determine whether the materials manager of M'Zadi, Inc., a Japanese-owned American parts manufacturer, can rely on the accuracy of the count following a monthly physical inventory. After reading a brief description of the company, students receive a spreadsheet file containing pre- and post-inventory counts (thousands of records) for April at M'Zadi's Ohio factory. Acting as the materials manager, students create spreadsheet-based PivotTables to summarize the inventory data for analysis. Without having to build complex formulas, students can use the PivotTables to identify problem areas in the inventory count that require investigation. Their analyses should include inventory accuracy for (a) total inventory, (b) inventory types (e.g., raw materials, WIP, and finished goods), (c) inventory production areas (e.g., production line, receiving, and shipping), (d) individual inventory items, and (e) service inventory. Students also develop PivotTable-supported evaluations to validate acceptance or rejection of the inventory count.

RECOMMENDATIONS FOR TEACHING APPROACHES

This case is appropriate for junior or senior undergraduate AIS or Auditing courses. The case is designed to be an out-of-class assignment that gives students an opportunity to evaluate summary information using decision-making skills acquired from previous Accounting courses. Based on the end-of-case assigned instructions, students prepare four PivotTables to help them decide whether to accept or reject the physical inventory count following a monthly physical inventory at a single factory. Quantitatively, each PivotTable should show in dollars the discrepancies between reported (i.e., pre) and actual (i.e., post) inventory. Based on the case

description of operations, students list possible reasons for pre- and post-count differences. In conclusion, they render a supported "preliminary decision" to accept or reject the physical count.

Instead of completing the entire case assignment outside of class, the instructor might show students how to create one or more of the required PivotTables in class. This activity should take no more than thirty minutes to complete, depending on the amount of support students need to use spreadsheet software. Students need access to spreadsheet software (e.g., Microsoft Excel) to create the PivotTables. The case has three deliverables: (a) four PivotTables, (b) list of reasons for the gains and losses reported in each PivotTable, and (c) preliminary decision to accept or reject the post-inventory count.

The instructor should remind students to read the case description carefully before they analyze the results of their PivotTables. Reasons for discrepancies should refer to common-sense behavior, such as accurate counting and scan transactions. The final preliminary decision should include supporting reasons. Either recommendation is acceptable as long as the analysis of the inventory count, based on the four PivotTables, supports that recommendation.

Most students learn how inventory costs move in a manufacturing environment (i.e., from Materials to Work in Process (WIP) to Finished Goods to Cost of Goods Sold) from Accounting Principles II, Cost Accounting, or Manufacturing courses. However, most business school graduates have little experience with the details of materials requirements planning (MRP). One of the first tasks they are likely to perform in the field will be an audit for a retailer or manufacturer. Learning to use spreadsheet-based PivotTables to summarize large quantities of data should improve their technical expertise and support job-related auditing assignments. Reading the MRP operations for the Ohio factory should help students better understand how a business accounts for physical and recorded inventory.

LEARNING OBJECTIVES

1. To understand challenges presented during a physical inventory in a manufacturing environment.
2. To use PivotTables to create summary quantitative data that will facilitate qualitative assessments.
3. To prepare a recommendation supported by the PivotTables and the MRP process as outlined in the case and presented in previous accounting courses.

ASSIGNMENT REQUIREMENTS FOR HOMEWORK

The purpose of a physical inventory is to determine whether the inventory count is acceptable. The process to support this decision includes the following groups of steps:

Prepare Four PivotTables

1. PivotTable 1: Create a PivotTable that shows the difference between total pre- and post-inventory, expressed in dollars and percentage, and the difference between pre- and post-inventory by type (e.g., raw materials, WIP, and finished goods), expressed in dollars.
2. Pivot Table 2: Create a PivotTable that shows which production areas gained or lost inventory (e.g., production line [W + number], receiving area [rm], shipping [fg], and quality control [qa]), expressed in dollars with the Difference column sorted smallest to largest.
3. PivotTable 3: Create a PivotTable that shows which items (i.e., part numbers) have the greatest gains or losses, expressed in dollars with the Difference column sorted smallest to largest.
4. PivotTable 4: Create a PivotTable that shows the gain or loss of service inventory, expressed in dollars.

Investigate Discrepancies Found between Pre- and Post-Inventory Counts

1. Based on the description of factory operations, discuss possible reasons for the discrepancies shown in the PivotTables.
2. Deliver a supported "preliminary decision" to accept or reject the physical count.

SOLUTIONS TO ASSIGNMENT QUESTIONS

The materials manager must decide whether to accept or reject the physical inventory count for April at the Ohio factory. Using the 2019April_PrePostInventory.xlsx file and acting as the materials manager, each student will evaluate the results of the physical count, both quantitatively and qualitatively, to deliver a "preliminary decision." The column labels used in the data file are displayed in Table 1.

Table 1
M'ZADI, INC.
Physical Locations of Inventory at the Ohio Factory

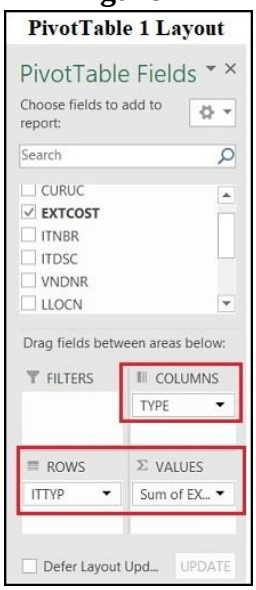
MAPICS Inventory Location (LLOCN) Codes	Actual Physical Location of Inventory
fg	Active finished goods, located in the Finished Goods and Shipping section of the factory
glue	Raw materials of glue in large containers, located in the WIP area of the factory
qa	Quality assurance hold area for inventory items segregated to the side of the factory WIP area
rm	Raw materials, located in the receiving area of the factory
rmbkv	Raw materials used in service production, located in the warehouse adjacent to the factory or raw materials in service production shipped as finished goods
silo	Resin silos, located outside the plant (high dollar values)
svc fg	Finished service goods, located in the Finished Goods and Shipping area of the factory (usually made once a month)
W + number (not 49)	Parts purchased from outside suppliers, located in various production line areas of factory WIP
W49 + number	M'Zadi-made parts used in production, located in various production line areas of factory WIP
Wbkv	Service parts purchased from outside suppliers for assembly on production line 1, located in the warehouse adjacent to the factory
Wbkv2	Service parts purchased from outside suppliers for assembly on production line 2, located in the warehouse adjacent to the factory
WINJ	Resin brought into the factory from silos in each production line area in WIP to make parts, located in the factory (approximately 20 production lines for active inventory)
WPT00	Specialized parts purchased from outside suppliers and required for active parts assembly, located in various production line areas of factory WIP

Prepare Four PivotTables

Prepare PivotTable 1 by moving the PivotTable Fields into the Area boxes as directed below (see Figure 1):

1. Click on the ITTYP field and drag it into the ROWS box in the Areas section under the Fields list.
2. Click on the TYPE field and drag it into the COLUMNS box in the Areas section.
3. Click on the EXTCOST field and drag it into the VALUES box in the Areas section.

Figure 1



In the resulting PivotTable 1 (see Figure 2), calculate the percentage difference in dollars between pre- and post-inventory:

1. Select cell A11 and type **Percentage**.
2. In cell B11, type "**=B9/C9**" and press Enter. (Note: This is a basic spreadsheet calculation, external to the PivotTable.)

Figure 2

PivotTable 1 Pre/Post Total Inventory Difference in Dollars and Percentage
Pre/Post Inventory Types Difference in Dollars

	A	B	C	D	E
1					
2					
3	**Sum of EXTCOST**	**Column Labels**			
4	**Row Labels**	**post**	**pre**	**Difference**	**Grand Total**
5	1	411739.3312	423488.3737	-11749.04245	823478.6624
6	2	673233.5673	723656.6272	-50423.05988	1346467.135
7	3	2787424.317	2821016.02	-33591.70232	5574848.635
8	9	193274.4848	197898.2409	-4623.7561	386548.9696
9	**Grand Total**	**4065671.701**	**4166059.262**	**-100387.5608**	**8131343.402**
10					
11	Percentage	0.975903473			
12					
13					

Prepare PivotTable 2 by moving the PivotTable Fields into the Area boxes as directed below (see Figure 3):

1. Drag LLOCN into Rows
2. Drag TYPE into Columns
3. Drag EXTCOST into VALUES

Partial results for PivotTable 2 are shown in Figure 4. PivotTable 2 should end at row 85 and contain 80 records sorted smallest to largest on the Difference column. To sort the Difference column, right click on the first data cell in the PivotTable Difference column (i.e., B5, assuming the Difference column appears in the B column) and select Sort -> Sort Smallest to Largest.

Figure 3

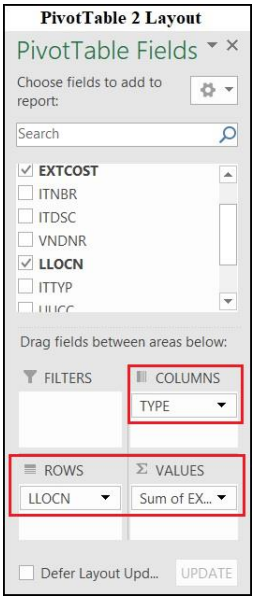


Figure 4

PivotTable 2 (partial) Production Areas
Gains/Losses Sorted Smallest to Largest

	A	B	C	D	E
1					
2					
3	**Sum of EXTCOST**	**Column Labels**			
4	**Row Labels**	**Difference**	**post**	**pre**	**Grand Total**
5	WINJ	-28485.39009	210877.7128	239363.1029	421755.4257
6	W4940	-13130.5948	36875.9445	50006.5393	73751.88901
7	Wbkv2	-11667.80209	48342.98358	60010.78567	96685.96716
8	W4160	-8541.129702	75820.8839	84362.01361	151641.7678
9	W4180	-7801.001973	15344.86991	23145.87188	30689.73982
10	fg	-6333.189594	372393.3783	378726.5679	744786.7567
11	W4924	-6169.4331	2871.036	9040.4691	5742.072
12	W4140	-5283.487999	34244.87755	39528.36555	68489.7551
13	W4112	-5109.59949	206.5276213	5316.127112	413.0552427
77	W4152	801.403753	10122.47352	9321.069763	20244.94703
78	qa	1243.158362	25013.8111	23770.65273	50027.62219
79	W4125	1547.909149	11481.66934	9933.760192	22963.33868
80	W4164	1935.38855	24476.82922	22541.44067	48953.65844
81	W4970	3852.676115	7949.518014	4096.841899	15899.03603
82	W4975	5246.266265	11015.20475	5768.938483	22030.4095
83	W4124	6691.197051	93373.70328	86682.50623	186747.4066
84	rm	7694.156009	1553734.294	1546040.138	3107468.589
85	**Grand Total**	**-100387.5608**	**4065671.701**	**4166059.262**	**8131343.402**

Prepare PivotTable 3 by moving the PivotTable Fields into the Area boxes as directed below (see Figure 5):

1. Drag ITNBR into Rows
2. Drag TYPE into Columns
3. Drag EXTCOST into VALUES

Partial results for PivotTable 3 are shown in Figure 6. PivotTable 3 should end at row 3574 and contain 3570 records sorted smallest to largest on the Difference column.

Figure 5

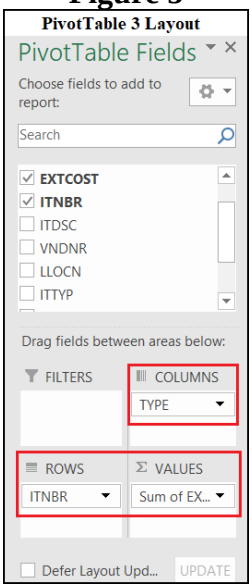


Figure 6

PivotTable 3 (partial) Part Numbers
Gains/Losses Sorted Smallest to Largest

	A	B	C	D	E
1					
2					
3	**Sum of EXTCOST**	**Column Labels**			
4	**Row Labels**	**Difference**	**post**	**pre**	**Grand Total**
5	60STXA010M1388	-7825.7113	35227.1755	43052.8868	70454.351
6	00XSAA510K832	-6107.165304	4106.542187	10213.70749	8213.084375
7	00VAAA010G835	-5035.488811	7688.414124	12723.90294	15376.82825
8	222G150257FDW	-4773.6	24112.8	28886.4	48225.6
9	22STXAA100C835	-4680.4224	50790.4	55470.8224	101580.8
10	425G152UA1VCAH	-3955.705934	2499.563088	6455.269022	4999.126176
11	H167SRH35NFRFX	-3815.106984	3359.3052	7174.412184	6718.6104
12	029002F2897V	-3638.75	7986.8	11625.55	15973.6
13	H598CHP275MRFX	-3418.907105	1512.726112	4931.633217	3025.452223
14	50SVAA120M1357	-3326.4306	44259.3018	47585.7324	88518.6036
15	NH167LB1250MJE	-3228	18173.64	21401.64	36347.28
16	H167CPD700MRFX	-2936.718446	155.2143346	3091.932781	310.4286692
3560	53STXA001C1321	2662.48	6424.68	3762.2	12849.36
3561	08389KE	2723.214115	9210.757801	6487.543686	18421.5156
3562	50VAAA010G835	2779.657414	8626.231671	5846.574257	17252.46334
3563	04TXAA0Z835	2786.193536	3243.188243	456.9947069	6486.376486
3564	04H598AH87064MB	2874.470899	6913.492063	4039.021164	13826.98413
3565	602CF10AZB	2898.507285	7855.39287	4956.885585	15710.78574
3566	FXH1SRH35NFRPR	3014.09012	9604.320978	6590.230858	19208.64196
3567	NH167LB1310MJE	3403	23821	20418	47642
3568	302C150VC1WCMH	3421.74744	3678.292	256.54456	7356.584
3569	953MAA0CT398	3621.3597	4480.0689	858.7092	8960.1378
3570	029022F2897V	3761.75	11762.9	8001.15	23525.8
3571	000CHP275RFX	4002.49578	19438.806	15436.31022	38877.612
3572	280R202H1041T	4533.58	12976.43	8442.85	25952.86
3573	16721346A4LCMH	4735.663374	16207.2961	11471.63272	32414.5922
3574	**Grand Total**	**-100387.5608**	**4065671.701**	**4166059.262**	**8131343.402**

Prepare PivotTable 4 by moving the PivotTable Fields into the Area boxes as directed below (see Figure 7):

1. Drag UUOC into Rows
2. Drag TYPE into Columns
3. EXTCOST into VALUES

Results for PivotTable 4 are shown in Figure 8. The service inventory is displayed in row 6.

Figure 7

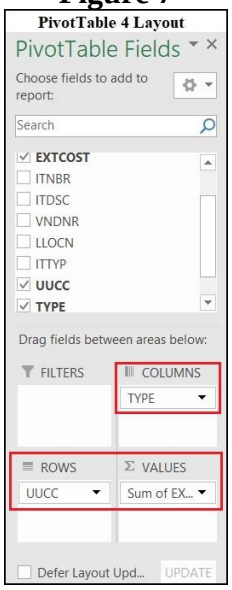


Figure 8

PivotTable 4 Service Inventory Gains/Losses

	A	B	C	D	E
1					
2					
3	**Sum of EXTCOST**	**Column Labels**			
4	**Row Labels**	**Difference**	**post**	**pre**	**Grand Total**
5	OB	-336.1630655	5616.523597	5952.686663	11233.04719
6	SV	-6030.420889	970374.0098	976404.4307	1940748.02
7	(blank)	-94020.9768	3089681.167	3183702.144	6179362.335
8	**Grand Total**	**-100387.5608**	**4065671.701**	**4166059.262**	**8131343.402**

Investigate Discrepancies Found between Pre- and Post-Inventory Counts

PivotTable 1

PivotTable 1 (see Figure 2) displays the difference between the pre- and post-inventory count, expressed in dollars and percentage for total inventory and in dollars for inventory type (e.g., raw materials, WIP, and finished goods). Differences include a total loss of $100,387 between the reported inventory in MAPICS and actual inventory on hand. Expressed as a percentage, recorded inventory is 97.59% accurate, meeting the best practices minimum requirement of 97%; however, the dollar loss is high enough to warrant further investigation.

The pre/post dollar differences by inventory type (i.e., 1, 2, 3, and 9) display the highest difference in WIP (2), $50,423, and the second highest difference in finished goods (3), $33,592. Most pre/post count discrepancies are caused by incomplete scan transactions. That is, either a "from" or a "to" scan is missing in the system.

Even though WIP shows a higher dollar difference between the pre- and post-counts, investigation of discrepancies in the finished goods count typically happens first. Finished goods are a primary asset representing the inventory required to fill customer orders. The production cycle is generally three days long, so only one or two days of active inventory are routinely on hand. Quickly identifying a large discrepancy in finished goods can help prevent immediate problems with customer order fulfillment.

Based solely on the results of PivotTable 1, the materials manager might guess that the finished goods discrepancy resulted from incomplete transactions for outgoing inventory (i.e., customer shipping) before the system inventory was frozen prior to the physical inventory count. Alternatively, handlers in WIP might have scanned finished goods out of WIP and into Finished Goods and Shipping without physically moving the items.

Regarding the WIP discrepancy, raw materials and finished goods are constantly moving during the factory production process. Raw materials not only move to and from storage, but they also move among 22 different production lines on the factory floor. The volume of movement into and out of WIP is the most likely cause of scan errors. Furthermore, freezing the inventory at the start of physical inventory can interrupt scans.

The discrepancies displayed for all raw materials are relatively small compared to the total pre/post loss. The materials manager would probably attribute the small losses to scan errors during inventory receipts or transfers to WIP and, therefore, to focus the investigation on two areas: (a) Finished Goods and Shipping and (b) WIP.

PivotTable 2

PivotTable 2 (see Figure 4) should contain 80 records based on the location (LLOCN) of items in the factory and the adjacent warehouse and sorted on Difference from smallest to largest. The Ohio factory's MAPICS physical inventory location codes in the LLOCN column of the PrePost worksheet are described in Table 1.

The pre/post counts in PivotTable 2 still show a total discrepancy of $100,387, but now the differences are broken down in detail by location. Per the case description, discrepancies greater than +/- $10,000 must be investigated. A recount in locations where a discrepancy exists might be necessary to verify that the correct quantity of a particular part number was recorded in the correct location.

The highest loss shown in PivotTable 2 is $28,485 (~28% of the total) in resin brought in from silos for production in the WINJ location. A resin loss could result from unreported scrap caused by a failed vacuum tube or hose or an accidental spill on the production line. Alternatively, operator or machine errors could result in higher resin usage than requested on the bill of materials (BOM). Because the discrepancy and unit cost for resin are so high, the materials manager needs to investigate both the WIP production line areas and silo areas to resolve as much of the difference as possible.

Other large losses at the top of PivotTable 2 appear to be in WIP (i.e., W4940 [M'Zadi-made parts]) and in the adjacent warehouse (i.e., Wbkv2 [service goods, production line 2]). Unreported scrap or incomplete transactions are likely reasons for the large differences. The

materials manager needs to investigate both areas to determine whether the discrepancies might be resolved.

The highest gain at the bottom of the PivotTable occurred in raw materials. Most of the other gains and losses on the PivotTable are located in WIP production lines. These discrepancies probably occurred because items were incorrectly recorded when moved between the WIP and raw materials locations.

Realistically, scanning errors in production areas when transferring items to either Finished Goods and Shipping or Raw Materials generate the most problems because neither area prevents production operators from moving raw materials as needed. They pilfer from each other to keep the line going; they move bins into Finished Goods and Shipping because they run out of room in WIP, or they move unneeded parts or unused parts back to Raw Materials storage because they run out of room. These transfers occur without scanning or without asking personnel with scanners to record the transactions because they are "busy."

PivotTable 3

PivotTable 3 (see Figure 6) should contain 3,570 records based on the part numbers (ITNBR) of items in the factory and the adjacent warehouse and sorted on Difference from smallest to largest. No individual part number exceeded a +/- $10,000 difference during April's physical inventory. The differences on rows 5, 6 and 7 are a little high, so tracking the locations of those parts might be a good idea. They might have been moved to different production lines in WIP without being scanned, possibly causing a loss in one area but a gain in another.

The manager might check the parts PivotTable for March to identify any high discrepancies for the same parts. Investigating repeated high discrepancies for the same parts could determine whether the losses resulted from operator errors, machine inefficiencies, or BOMs that are out of date.

Gains and losses in raw material parts in WIP might result from incorrect counting. For instance, physical inventory counters might have needed to estimate the total number of screws in a given location. They might not have time to count each individual screw, so they might weigh 10 screws to establish a base weight and then weigh all the screws in the bin and divide by 10. However, if the base weight is inaccurate, the final count will be incorrect.

Gains and losses in the raw materials receiving area might occur because the receivers counted the parts incorrectly as they arrived. Alternatively, the receivers might not even count new arrivals if they are extremely busy; instead, they might assume that the packing list is correct. If the quantity of new arrivals scanned into the system is based on the packing list but does not match the actual quantity received, the reported quantity will be incorrect. Purchase orders are linked to reported quantities of inventory on hand; inaccurately reported quantities will lead to overstocked or understocked inventory.

The top and bottom of the PivotTable might also contain similar part numbers. A part number might show a loss at the top of the table, and a similar part number might show a gain at the bottom. This paired discrepancy might occur because part numbers were misread or transposed when manually entered.

As noted in the solution for PivotTable 2, line operators might move inventory into, out of, and within WIP as needed. However, if they do not scan these transfers correctly, the reported inventory count will be inaccurate in the system. Only one event trumps the inventory "freeze" during a physical count: shipping finished goods. The automotive customer (e.g., Nissan and

Toyota) requires that M'Zadi keep two hours of inventory on hand at the customer factory at all times. M'Zadi has to adhere to a strict shipping schedule to meet their contractual obligations. The Ohio plant must identify all shipments by part number prior to the freeze and segregate those shipments on the shipping dock. Sarbanes-Oxley regulations prevent finished goods from being scanned out of inventory until the finished goods have physically left the factory. Therefore, the finished goods physical count must be reconciled with the shipment paperwork for parts shipped during the physical count. If the shipping operators do not count the finished goods on the docks before loading them onto the trucks and scanning them out of the system, the shipped part numbers will show a post-count loss.

PivotTable 4

PivotTable 4 (see Figure 8) displays a service inventory loss of $6,030 in row 6. The loss is not large, but it should be checked with customer orders and invoicing to make sure that an order was actually made that used the parts. It could be that there was a count discrepancy for a few, unique service parts. If there is a large observed discrepancy in OB (obsolete) or SV (service) inventory, it would need to be checked with customer orders and invoicing to make sure that an order was really made that would have used the item.

Deliver "Preliminary Decision" to Accept or Reject Physical Count

PivotTable 1 shows a total inventory accuracy of 97.6%, which is greater than the industry standard of 97%. Some of the locations show gains or losses greater than the materials manager's maximum tolerance of $10,000, but those differences can be resolved using physical inspections and/or specific location recounts. No individual part displayed a gain or loss greater than $10,000. Based on the case specifications for acceptance or rejection of the Ohio factory's physical inventory count, preliminary acceptance is reasonable.

TEACHING EPILOGUE

The materials manager prepared only four PivotTables during this investigation based on the fields downloaded from MAPICS into the 2019April_MZadiPrePost_InventoryData spreadsheet file. MAPICS has many other fields, and many other PivotTables using additional fields to compare multiple data points are possible. Comparison and investigation need to be as quick and efficient as possible because production lines are down and operators are not producing during a physical inventory count and subsequent investigation. As evidenced by this case study, PivotTables are easy to create, and they make investigating large amounts of data very efficient.