ABC Inc. Report

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Industrial and Systems Engineering Department
Rochester Institute of Technology
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Summary

This report provides an analysis and evaluation of the current and prospective profitability, the availability of liquid assets and the current and prospective financial stability of ABC Inc. After evaluating several options and circumstances, we are honored to present the following proposal, which fulfills all requirements and areas of improvement that was asked of us throughout our research. Methods of analysis include flow process diagrams, shipping log, new item master and total equipment cost. Other calculations include, equipment depreciation rate, utilities cost and total profit from efficiency gain, to name a few. All calculations can be found in the appendices and throughout the powerpoint.

Results of the data analyzed shows that the best method with the highest present value is the usage of put-to-light in the put stations. The current design and calculations are optimized to meet supply and demand through the year 2019. In particular, the put-to-light system did accumulate the second highest equipment cost than any other option, but estimated calculations has the put-to-light system yielding the most total profit from efficiency gain and the most present value. While our model and calculations do in fact generate large upfront costs compared to the other options, the return on investment in terms of present value and efficiency is second to none.

After extensive research, a corrective approach to the company's pain points, exposed the need for a new warehouse management system (WMS) planning, including a sortation conveyor system, an enterprise resource planning (ERP) system and a material requirements planning (MRP) system. The majority of the pain points can be unraveled if remedial action is taken to implement the new systems mentioned in the power point. The enclosed proposal also includes a detailed financial summary and equipment specifications. We look forward to your response as you review our proposal. We look forward to working with ABC Inc. in the future.

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Options Considered:

There were four major options that we as a group needed to evaluate throughout our research and development of the project. We reviewed every option carefully to put forth the finest and most accurate analysis and evaluation for ABC. Inc. For every option, we researched what products and machinery can benefit each option for better efficiency and present value. From there on, we created a financial summary in which we compared and reviewed the numbers that our calculations generated. Consequently, we chose our most successful option based on net present value and began to implement it in the facilities with flow charts and a new layout plan.

The first option is the current operation which involves ⅚ order cluster picking. Rather than having the picker go to the print room to get pre-printed labels for the following batch, a print and apply labeling system would be installed. Totes with permanent LPN numbers would be assigned. The LPN numbers would be scanned on their way to shipping to be labeled by print and apply equipment.

Option two involves the current operation with ⅚ order cluster picking. This option is quite different from the first option. Instead of having pickers using RF terminals on the floor, it would be replaced with voice command.

Option three is the option that was chosen as our most productive and efficient model.This option includes a variety of changes to the original operation. To sum it up, option three focuses on batch pick-to-put with non-automated picking and using put-to-light technology in the put stations. RF terminals direct the pickers, which is the opposite of what option two recommended.

Finally option four institutes a batch pick-to-put with automated picking. Essentially, it is the same as option three, but instead of the manual picking of residuals, an automated goods-to-man machine that brings the required SKU’s to the put area would be introduced to fill residual demand.

Recommended Option:

After extensive research and calculations, we interpreted our final results from all four options and set them side by side to separate the best option from the rest. We decided that the very best way to determine the preeminent option of the bunch would be to create a financial summary. A financial summary would present us a more visual and concrete approach through mathematical analysis rather than assumptions and hypotheses. All our calculations for the options contained different variables to consider such as costs, expenses, efficiencies and profits. All our calculations span from this present year 2014, through 2019. Our formulas and calculations can be found on our financial summary to get an idea on how we computed everything. After each year we summed the present value, and then after five years, we summed the cumulative present values from each year. The present value is beneficial to us because it gives us an idea of the present sum of money for each year. The put-to-light system totalled a $65.5 million net present value, beating out the goods-to-man machine in second place which finished with $55.2 million, an increase of about 1.19% at the end of the five year period. What is important to notice is the total profit from efficiency for the put-to-light system increases each year starting at $14.5 million in year one to $17.35 million in year five tallying a total of $80 million after five years for the put-to-light. The improvement on efficiency will benefit ABC Inc. enormously because it will eliminate any non-value added activity. In our proposal, we plan to use the put-to-light system as well as a pick-to-light system throughout the shop, which will help develop a high speed picking process with a low error rate. The easily visible lights located directly on the storage slots indicate when the next items are to be picked, which will then signal the number of items to be retrieved. The changes are also visible in our facilities layout where we indicate the areas where put-to-light will be put into effect.

Final Solution:

The narrative description of the recommended option illustrates the pick-to-light and put-to-light systems ABC Inc. should utilize to incorporate themselves into becoming a more efficient and successful company for today and more importantly, for the future. In the grand scheme of things, the true transformation of this company would not be complete if we did not consider a plan to address the key issues and incorporate them into our final solution. One of the most prominent issues that was identified by our group, was the inadequacy of the operating systems in the facility. All of the thirteen fundamental issues can be addressed with a sizable upgrade with the ERP, MRP and WMS in both the east and west facilities, and a new state-of-the-art sortation conveyor system in the west facility.

By and large, the WMS will be the more comprehensive upgrade, optimizing the operations and workflow of employees and processes for ABC Inc. A WMS will handle task interleaving by managing the movement of employees to pick and putaway various products throughout their daily routes. It will also allow rush orders to be programmed and it will sort orders based on priority, customer, and carrier. Problem locations throughout the facility will be recognized through WMS software, and will allocate employees to pick up the slack until it is available again.

The MRP system will help maintain stability with replenishment issues by managing inventory and detect dead inventory throughout the facility.Transactions and sales of stores will be managed by the ERP software to keep track of the each-full case-repack order proportions of demand and coordinate with the MRP system which will maintain proper inventory levels accordingly.

As the MRP system monitors levels of inventory, especially in “finger storage”, it will signal for replenishments that way the WMS system can allocate employees to interleave tasks and keep locations full with necessary products to satisfy orders.

The Sortation Conveyor System will allow various products of multiple orders in each pick zone to be put on the conveyor system, and it will also sort small store orders directly to shipping for transportation to a 3PL facility.

Altogether, the four systems mentioned will overlap one another, but they will also be used to cover every aspect, of every pain point that needs to be addressed. Above are the summaries of some of operations each program will be capable of doing and everything can be found in greater detail in the Key Issues section of this report.

Profit Baseline

Product	Nov/Dec Revenue	Avg. Price	Cubic [in] (Min)	Cubic [in] (Max)
TV	$43,671,100.00	$550.00	4900	5500
Home Theatre System	$2,368,000.00	$500.00	15000	1000000
Camera	$295,628,000.00	$400.00	150	200
Car Audio Equipment	$122,371,200.00	$400.00	5500	15000
Laptop	$370,051,500.00	$700.00	500	800
Tablet	$202,769,500.00	$250.00	250	400
Cell Phone	$449,118,075.00	$175.00	30	80
Landline	$12,699,900.00	$50.00	400	500
GPS	$82,887,800.00	$200.00	200	250
Video Games	$279,020,950.00	$50.00	0	30
Office Equipment	$31,027,960.00	$40.00	800	1800
Personal Audio Equipment	$309,161,600.00	$200.00	80	150
Home Audio Equipment	$59,070,500.00	$100.00	1800	4900

Financial Summary

Year	1	2	3	4	5	
Profit Baseline:	$2,372,838,389.25	$2,467,751,924.82	$2,566,462,001.81	$2,669,120,481.89	$2,775,885,301.16	
Automated Labeling: Year	**1**	**2**	**3**	**4**	**5**	**Total**
Total Equipment Cost	$240,000.00	$0.00	$0.00	$0.00	$0.00	$240,000.00
Total Cost to Install Equipment	$20,000.00	$0.00	$0.00	$0.00	$0.00	$20,000.00
Maintenance Expense	$33,306.00	$33,306.00	$33,306.00	$33,306.00	$33,306.00	$166,530.00
Utilities Cost	120,000.00	120,000.00	120,000.00	120,000.00	120,000.00	600,000.00
Equipment Depreciation Rate	$24,000	$21,600	$19,440	$17,496	$15,746	$98,282.00
Employee Efficiency Percent	0.10	0.10	0.10	0.10	0.10	0.10
Employee Efficiency Profit	$2,230,468.09	$2,467,751.92	$2,566,462.00	$2,669,120.48	$2,775,885.30	$12,709,687.80
Production Efficiency Percent	0.30	0.30	0.30	0.30	0.30	0.30
Production Efficiency Profit	$8,921,872.34	$9,871,007.70	$10,265,848.01	$10,676,481.93	$11,103,541.20	$50,838,751.18
Total Profit from Efficiency Gain	$5,576,170.21	$6,169,379.81	$6,416,155.00	$6,672,801.20	$6,939,713.25	$31,774,219.49
Present Value	$4,894,156.39	$5,437,164.46	$5,393,291.44	$5,349,210.84	$5,304,990.26	**$26,378,813.38**
Voice Terminals: Year	**1**	**2**	**3**	**4**	**5**	**Total**
Total Equipment Cost	$630,000.00	$0.00	$0.00	$0.00	$0.00	$630,000.00
Total Cost to Install Equipment	$150,000.00	$0.00	$0.00	$0.00	$0.00	$150,000.00
Maintenance Expense	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$100,000.00
Utilities Cost	$600,000.00	$600,000.00	$600,000.00	$600,000.00	$600,000.00	$3,000,000.00
Equipment Depreciation Rate	$96,923	$82,012	$69,395	$58,719	$49,685	$356,734
Employee Efficiency Percent	0.7	0.7	0.7	0.7	0.7	0.7
Employee Efficiency Profit	$16,277,671.35	$17,274,263.47	$17,965,234.01	$18,683,843.37	$19,431,197.11	$89,632,209.32
Production Efficiency Percent	0.15	0.15	0.15	0.15	0.15	0.15
Production Efficiency Profit	$4,650,763.24	$4,935,503.85	$5,132,924.00	$5,338,240.96	$5,551,770.60	$25,609,202.66
Total Profit from Efficiency Gain	$10,464,217.30	$11,104,883.66	$11,549,079.01	$12,011,042.17	$12,491,483.86	$57,620,705.99
Present Value	$8,540,280.28	$9,435,711.26	$9,381,003.35	$9,323,130.32	$9,262,688.74	**$45,942,813.95**
Put-to-Light: Year	**1**	**2**	**3**	**4**	**5**	**Total**
Total Equipment Cost	$1,250,400.00	0	0	0	0	$1,250,400.00
Total Cost to Install Equipment	$150,000	0	0	0	0	$150,000
Maintenance Expense	$22,204.00	$22,204.00	$22,204.00	$22,204.00	$22,204.00	$111,020.00

Financial Summary

Utilities Cost	$298,522	$298,522	$298,522	$298,522	$298,522	$1,492,608
Equipment Depreciation Rate	$252,960.00	$202,368.00	$161,894.00	$129,516.00	$103,612.00	$35,010.00
Employee Efficiency Percent	0.25	0.25	0.25	0.25	0.25	0.25
Employee Efficiency Profit	$5,813,454.05	$6,169,379.81	$6,416,155.00	$6,672,801.20	$6,939,713.25	$32,011,503.33
Production Efficiency Percent	0.75	0.75	0.75	0.75	0.75	0.75
Production Efficiency Profit	$23,253,816.21	$24,677,519.25	$25,664,620.02	$26,691,204.82	$27,758,853.01	$128,046,013.31
Total Profit from Efficiency Gain	$14,533,635.13	$15,423,449.53	$16,040,387.51	$16,682,003.01	$17,349,283.13	$80,028,758.32
Present Value	$11,961,475.75	$13,515,062.07	$13,439,384.87	$13,353,910.28	$13,261,137.69	**$65,530,970.66**
Goods-to-Man Machine: Year	**1**	**2**	**3**	**4**	**5**	**Total**
Total Equipment Cost	$4,000,000	0	0	0	0	$4,000,000
Total Cost to Install Equipment	$1,093,120	0	0	0	0	$1,093,120
Maintenance Expense	$199,836	$199,836	$199,836	$199,836	$199,836	$999,180
Utilities Cost	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$10,000,000
Equipment Depreciation Rate	$400,000	$360,000	$324,000	$291,000	$262,000	$1,637,000
Employee Efficiency Percent	0.40	0.40	0.40	0.40	0.40	0.40
Employee Efficiency Profit	$3,606,714.35	$9,871,007.70	$10,265,848.01	$10,676,481.93	$11,103,541.20	$45,523,593.19
Production Efficiency Percent	0.80	0.80	0.80	0.80	0.80	0.80
Production Efficiency Profit	$9,617,904.94	$26,322,687.20	$27,375,594.69	$28,470,618.47	$29,609,443.21	$121,396,248.51
Total Profit from Efficiency Gain	$6,612,309.64	$18,096,847.45	$18,820,721.35	$19,573,550.20	$20,356,492.21	$121,396,248.51
Present Value	-$1,029,187.01	$14,092,527.39	$14,077,862.30	$14,053,991.25	$14,020,931.38	**$55,216,125.32**
Solution: Year	**1**	**2**	**3**	**4**	**5**	**Total**
Put-To-Light Equipment Cost	$1,264,800.00	$0.00	$0.00	$0.00	$0.00	$1,264,800.00
Put-To-Light Cost to Install	$150,000.00	$0.00	$0.00	$0.00	$0.00	$150,000.00
Put-To-Light Maintenance Expense	$22,204.00	$22,204.00	$22,204.00	$22,204.00	$22,204.00	$111,020.00
Put-To-Light Utilities Cost	$298,521.60	$298,521.60	$298,521.60	$298,521.60	$298,521.60	$1,492,608.00
Put-To-Light Depreciation Rate	$252,960.00	$202,368.00	$161,894.00	$129,516.00	$103,612.00	$35,010.00
Employee Efficiency Percent	0.25	0.25	0.25	0.25	0.25	0.25
Employee Efficiency Profit	$5,813,454.05	$6,169,379.81	$6,416,155.00	$6,672,801.20	$6,939,713.25	$32,011,503.33
Production Efficiency Percent	0.75	0.75	0.75	0.75	0.75	0.75
Production Efficiency Profit	$23,253,816.21	$24,677,519.25	$25,664,620.02	$26,691,204.82	$27,758,853.01	$128,046,013.31
Total Profit from Efficiency Gain	$14,533,635.13	$15,423,449.53	$16,040,387.51	$16,682,003.01	$17,349,283.13	$80,028,758.32

Financial Summary

Present Value	$11,947,761.46	$13,515,062.07	$13,439,384.87	$13,353,910.28	$13,261,137.69	**$65,517,256.37**
WMS Software	$5,000,000.00	$0.00	$0.00	$0.00	$0.00	$5,000,000.00
WMS Cost to Install	$34,160.00	$0.00	$0.00	$0.00	$0.00	$34,160.00
WMS Maintenance Expense	$111,020.00	$111,020.00	$111,020.00	$111,020.00	$111,020.00	$555,100.00
WMS Utilities Cost	$800,000.00	$800,000.00	$800,000.00	$800,000.00	$800,000.00	$4,000,000.00
WMS Depreciation Rate	$1,000,000	$800,000	$640,000	$512,000	$409,600	$3,361,600
WMS Employee Efficiency Percent	0.85	0.85	0.85	0.85	0.85	0.85
WMS Employee Efficiency Profit	$19,765,743.78	$20,169,126.31	$20,975,891.36	$21,814,927.02	$22,687,524.10	$105,413,212.56
WMS Production Efficiency Percent	0.90	0.90	0.90	0.90	0.90	0.90
WMS Production Efficiency Profit	$27,904,579.46	$29,613,023.10	$30,797,544.02	$32,029,445.78	$33,310,623.61	$153,655,215.97
WMS Total Profit from Efficiency Gain	$23,835,161.62	$24,891,074.70	$25,886,717.69	$26,922,186.40	$27,999,073.85	$129,534,214.27
WMS Present Value	$16,085,696.78	$21,024,992.93	$21,022,090.65	$20,978,227.30	$20,903,266.68	**$100,014,274.3**
MRP Software	$1,236,000.00	$0.00	$0.00	$0.00	$0.00	$1,236,000.00
MRP Cost to Install	$34,160.00	$0.00	$0.00	$0.00	$0.00	$34,160.00
MRP Maintenance Expense	$111,020.00	$111,020.00	$111,020.00	$111,020.00	$111,020.00	$555,100.00
MRP Utilities Cost	$800,000.00	$800,000.00	$800,000.00	$800,000.00	$800,000.00	$4,000,000.00
MRP Depreciation Rate	$247,200	$197,760	$158,208	$126,566	$101,253	$830,987
MRP Employee Efficiency Percent	0.00	0.00	0.00	0.00	0.00	0.00
MRP Employee Efficiency Profit	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
MRP Production Efficiency Percent	0.90	0.90	0.90	0.90	0.90	0.90
MRP Production Efficiency Profit	$27,904,579.46	$29,613,023.10	$30,797,544.02	$32,029,445.78	$33,310,623.61	$153,655,215.97
Total Profit from Efficiency Gain	$13,952,289.73	$14,806,511.55	$15,398,772.01	$16,014,722.89	$16,655,311.81	$76,827,607.99
MRP Present Value	$10,975,152.12	$12,424,246.30	$12,378,398.89	$12,321,727.59	$12,256,730.23	**$60,356,255.13**
ERP Software	$1,500,000.00	$0.00	$0.00	$0.00	$0.00	$1,500,000.00
ERP Cost to Install	$34,160.00	$0.00	$0.00	$0.00	$0.00	$34,160.00
ERP Maintenance Expense	$111,020.00	$111,020.00	$111,020.00	$111,020.00	$111,020.00	$555,100.00
ERP Utilities Cost	$800,000.00	$800,000.00	$800,000.00	$800,000.00	$800,000.00	$4,000,000.00
ERP Depreciation Rate	$300,000	$240,000	$192,000	$153,600	$122,880	$1,008,480.00
ERP Employee Efficiency Percent	0.00	0.00	0.00	0.00	0.00	0.00
ERP Employee Efficiency Profit	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
ERP Production Efficiency Percent	0.90	0.90	0.90	0.90	0.90	0.90
ERP Production Efficiency Profit	$27,904,579.46	$29,613,023.10	$30,797,544.02	$32,029,445.78	$33,310,623.61	$153,655,215.97
Total Profit from Efficiency Gain	$13,952,289.73	$14,806,511.55	$15,398,772.01	$16,014,722.89	$16,655,311.81	$76,827,607.99

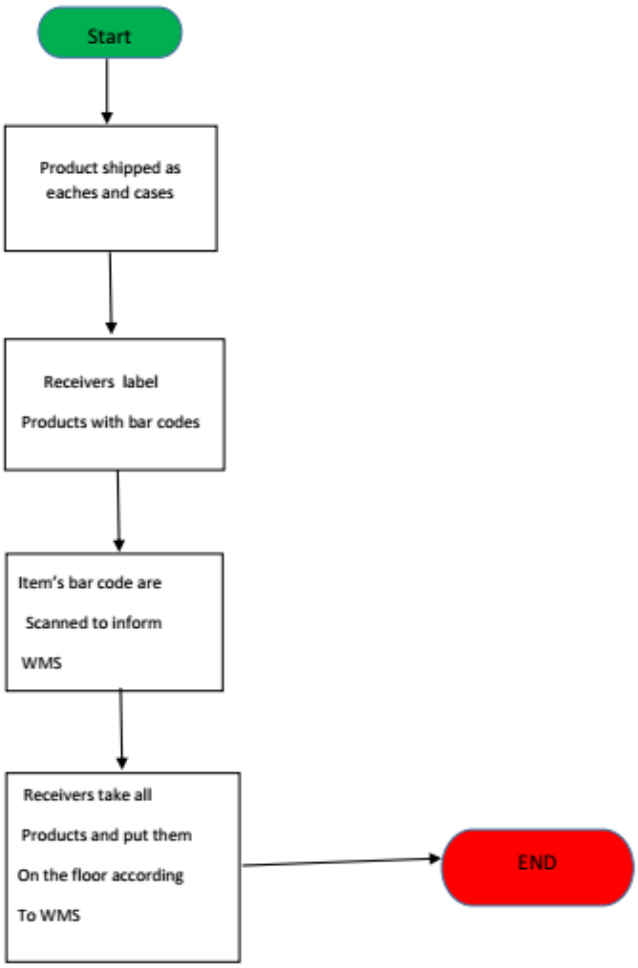
Financial Summary

ERP Present Value	$10,673,437.84	$12,385,933.38	$12,349,208.09	$12,299,486.65	$12,239,784.91	$59,947,850.86
Sortation Conveyor (West) Equipment Cost	$1,680,000.00	$0.00	$0.00	$0.00	$0.00	$1,680,000.00
Sortation Conveyor Cost to Install	$840,000.00	$0.00	$0.00	$0.00	$0.00	$840,000.00
Sortation Conveyor Maintenance Expense	$66,612.00	$66,612.00	$66,612.00	$66,612.00	$66,612.00	$333,060.00
Sortation Conveyor Utilities Cost	$840,000.00	$840,000.00	$840,000.00	$840,000.00	$840,000.00	$4,200,000.00
Sortation Conveyor Depreciation Rate	$268,800.00	$247,296.00	$227,512.00	$209,311.00	$192,566.00	$1,145,485.00
Conveyor Employee Efficiency Percent	0.50	0.50	0.50	0.50	0.50	0.50
Conveyor Employee Efficiency Profit	$2,254,196.47	$6,169,379.81	$6,416,155.00	$6,672,801.20	$6,939,713.25	$28,452,245.74
Conveyor Production Efficiency Percent	0.80	0.80	0.80	0.80	0.80	0.80
Conveyor Production Efficiency Profit	$4,808,952.47	$13,161,343.60	$13,687,797.34	$14,235,309.24	$14,804,721.61	$60,698,124.25
Total Profit from Efficiency Gain	$3,531,574.47	$9,665,361.71	$10,051,976.17	$10,454,055.22	$10,872,217.43	$44,575,185.00
Conveyor Present Value	-$156,035.74	$7,720,139.42	$7,703,576.01	$7,682,504.49	$7,657,432.12	$30,607,616.28
Total Cost of Solution						$37,956,830.00
Solution Profit from Efficiency						$431,914,375.2
Solution Net Present Value						$316,443,252.9

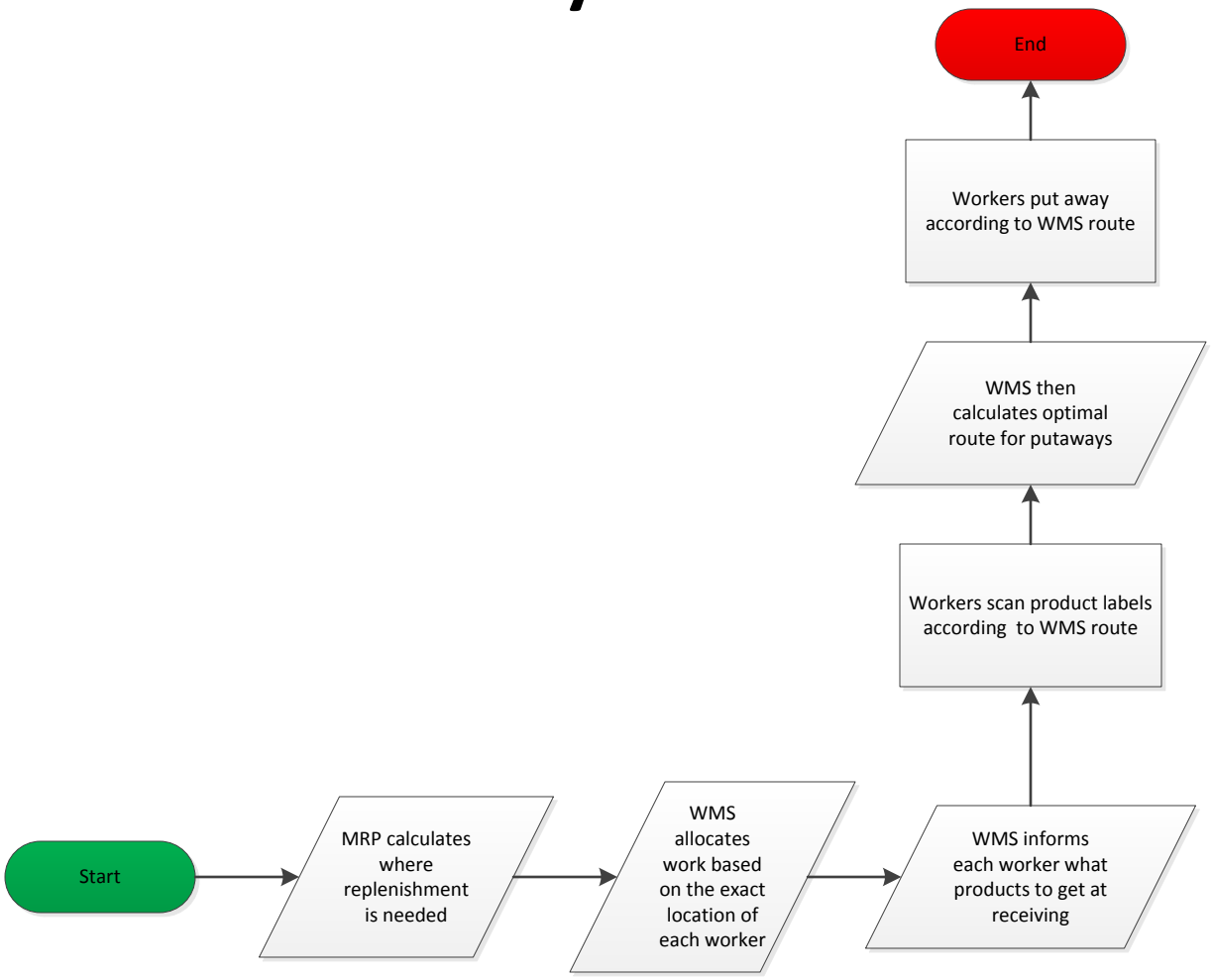
Year	1	2	3	4	5
Profit Baseline	$2,372,838,389.25	$2,467,751,924.82	$2,566,462,001.81	$2,669,120,481.89	$2,775,885,301.16
Option	Efficiency Profit	Total Cost	Net Present Value		
Automated Labeling	$31,774,219.49	$1,124,812.00	$26,378,813.38		
Voice Terminals	$57,620,705.99	$4,236,734.00	$45,942,813.95		
Put to Light	$80,028,758.32	$3,039,038.00	$65,530,970.66		
Goods-to-Man Machine	$121,396,248.51	$17,729,300.00	$55,216,125.32		
Solution: PTL, WMS, MRP, ERP, Sorter	$431,914,375.27	$37,956,830.00	$316,443,252.98		

Depreciation Calculator: http://www.calculatorsoup.com/calculators/financial/depreciation-declining-double.php

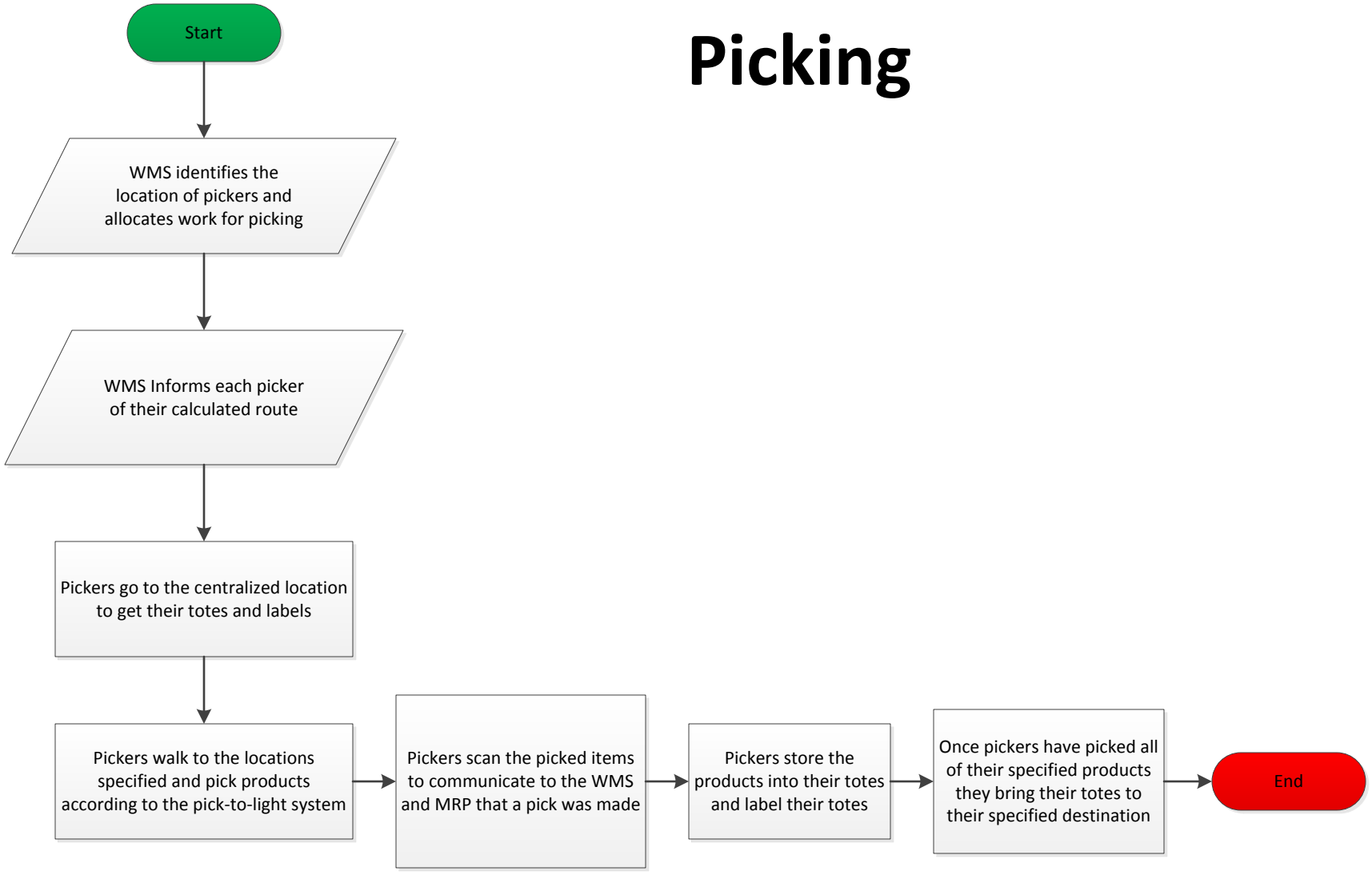
Receiving


Start
Product shipped as eaches and cases
Receivers label
Products with bar codes
Item's bar code are
Scanned to inform
WMS
Receivers take all
Products and put them
On the floor according
To WMS
END

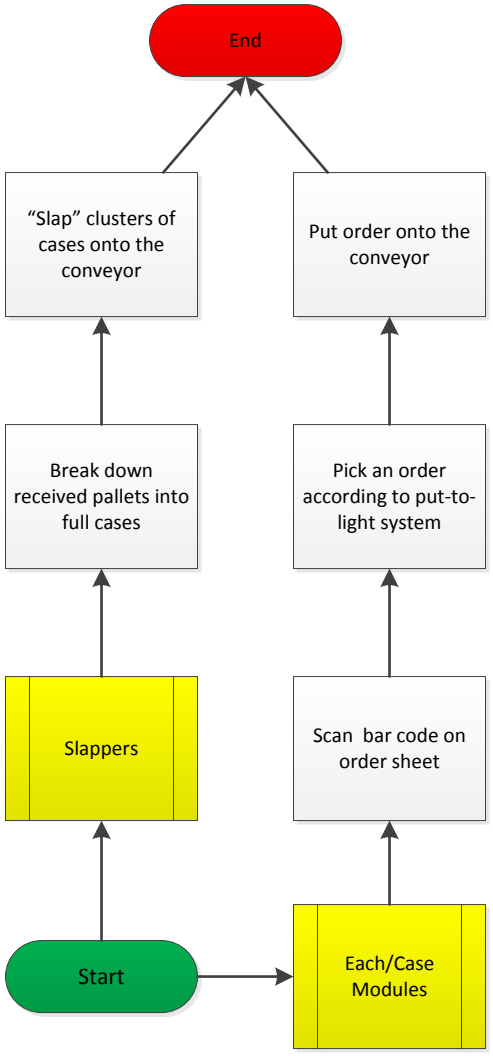
Putaway


End
Workers put away according to WMS route
WMS then calculates optimal route for putaways
Workers scan product labels according to WMS route
WMS informs each worker what products to get at receiving
WMS allocates work based on the exact location of each worker
MRP calculates where replenishment is needed
Start

Picking


Start
WMS identifies the location of pickers and allocates work for picking
WMS Informs each picker of their calculated route
Pickers go to the centralized location to get their totes and labels
Pickers walk to the locations specified and pick products according to the pick-to-light system
Pickers scan the picked items to communicate to the WMS and MRP that a pick was made
Pickers store the products into their totes and label their totes
Once pickers have picked all of their specified products they bring their totes to their specified destination
End

Waving


End
“Slap” clusters of cases onto the conveyor
Put order onto the conveyor
Break down received pallets into full cases
Pick an order according to put-to-light system
Slappers
Scan bar code on order sheet
Start
Each/Case Modules

Throughput & Labor

Receiving Parameters (Per Worker)		
Receiving Rate:	100	cases/hr (norm)
	118	cases/hr (peak)
Required Pickers:	35	(Peak Conditions)
Required Pickers:	20	(Avg Conditions)

Putaway Parameters (Per Worker)		
Stocking Rate:	85	cases/hr
Replenish Rate:	115	cases/hr (norm)
	150	cases/hr (peak)
Required Pickers:	35	(Peak Conditions)
Required Pickers:	20	(Avg Conditions)

Stock and Replenishment Rates have increased in comparision to the parameter and rates data because of the WMS and MRP software system

Picking Parameters (Per Worker)		
Get Label:	30	seconds (tower)
	56	seconds (aisle)
Set Tote:	40	seconds/tote (tower)
	60	seconds/tote (aisle)
Walking:	2	ft/second (tower)
	1	ft/second (aisle)
Picking:	10	seconds/tote
Process:	1945	seconds/tote
	35	eaches/hr
	16	cases/hr
Required Pickers:	119	(Peak Conditions)
Required Pickers:	60	(Avg Conditions)

Time rates decreased due to WMS and MRP

Waving Parameters (Per Worker)		
Slapper 1 Rate:	109	cases/hr
Slapper 2 Rate:	109	cases/hr
Slapper 3 Rate:	109	cases/hr
Each Module Rate:	210	eaches/hr
Case Module Rate:	98	cases/hr
Each Module Workers:	20	(Peak Conditions)
Case Module Workers:	10	(Peak Conditions)
Workers per Slapper:	3	(Peak Conditions)
Each Module Workers:	10	(Avg Conditions)
Case Module Workers:	5	(Avg Conditions)
Workers per Slapper:	2	(Avg Conditions)

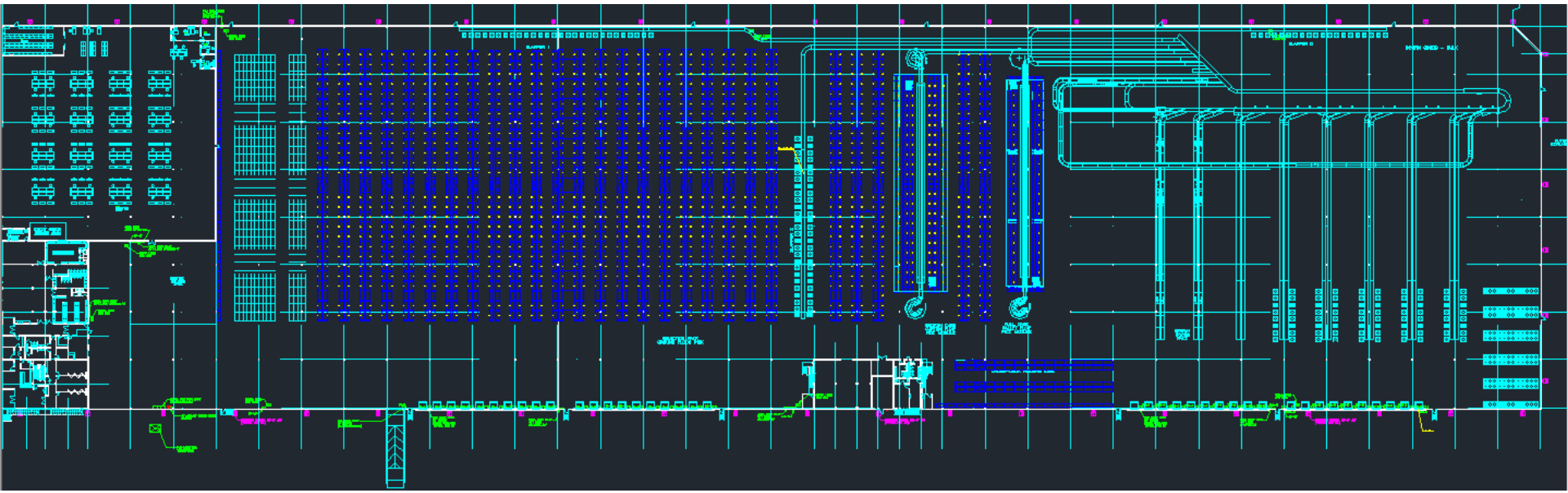
Peak Throughput Rates (Per DC)		
Receiving:	4058	cases/hr
Putaway:	4058	cases/hr
Picking:	4190	eaches/hr
	1963	cases/hr
Waving:	4,190	eaches/hr
	1963	cases/hr

Average Throughput Rates (Per DC)		
Receiving:	2029	cases/hr
Putaway:	2029	cases/hr
Picking:	2095	eaches/hr
	981	cases/hr
Waving:	2,095	eaches/hr
	981	cases/hr

Total Operation (Per DC)		
Required Operators:	204	(Peak Conditions)
Required Operators:	107	(Avg Conditions)

Nov/Dec Demand (Per DC)	
61	days
22.5	hours/day
1372.5	hours
5,172	products/hr
1,963	cases/hr
4,190	eaches/hr

East Facility AutoCAD



Key Issues

Point 1: Without conveyor diverts to pick zones in the pick modules totes need to start and complete in single pick zones. This works OK with large brick and mortar orders but it is unacceptable with smaller orders that need to consolidate product from multiple pick zones. These smaller orders cannot be processed in the facilities and they need to send them out to be processed in an outside 3PL (third-party logistics) facility.

The Sortation Conveyor System will allow various products of multiple orders in each pick zone to be put on the conveyor system which will get sorted and sent to the correct location of the facility to satisfy Brick&Mortar and small store orders. The small store orders will be sorted and sent to the shipping department for transportation to 3PL.

Point 2: Replenishment is a system and space issue. The Western DC doesn't have "finger storage" for split case module so there is not enough space to stock the overstock repack item. This results in what they call a "replenishment to bin".

The MRP software will monitor the levels of inventory and signal for replenishments, then the WMS software will coordinate employees to replenish pick locations and storage locations to minimize the overstock and level the inventory.

Point 3: No task interleaving capabilities.

A WMS software will handle task interleaving by managing the movement of employees to pick and putaway various products throughout their daily routes throughout the facility.

Point 4: Replenishment has multiple issues

An MRP software will monitor the inventory and plan for replenishments that way employees can interleave tasks to keep locations full with necessary products to satisfy orders. The MRP software will track the inventory levels of every location and give a more accurate percentage of location fullness than the "global parameter". The capacity of "finger storage" won't be an issue with efficient replenishment of storage locations. The MRP software will track the current inventory levels of "finger storage" locations. The MRP software will monitor inventory levels while the WMS software coordinates replenishment tasks so that pending transactions are minimal. The WMS software will manage the optimal placement of products for storage and act as a slotting software tool. The ERP software will manage the sales and inventory, and detect dead inventory.

Point 5: Rush orders cannot be added on the fly to store waves even when the waved stores have not started picking. They need to be picked as a separated wave.

The WMS allows rush orders to be programmed and will sort orders based on priority, customer, ship to, carrier etc. The sortation conveyor will then allow for the mixture of rush waves and store waves.

Point 6: Lead-time of replenishment orders to stores can take up to 10 days. New small stores want overnight deliveries.

The lead time will decrease because the MRP software will manage the replenishment needs and products will be ready for shipping much quicker. When products need to be shipped overnight, it will be signalled through the system, onto the sorting conveyor.

Point 7: If a worker identifies a problem with a location, the system cannot put the location on-hold. The system continues creating transactions for the problem location.

The WMS software will recognize the problem location and allocate employees and available locations to pick up the extra slack and work around the problem location until that location is available again.

Point 8: Because of store service level requirements, repack volume has significantly increased. Every time that an item is sold at a store, a replenishment transaction at the DC is created to replace the sold item at the store, resulting in too much split case processing. The facility was originally designed for 50/50 repack/full case; currently is already 80/20.

The ERP software will monitor the transactions and sales of stores, then the MRP will signal for materials and products required to replenish the completed order, then the WMS will manage the movement of materials and employees to accomplish efficient replenishment. The interconnection of these three software systems will be flexible enough to handle changes in order proportions.

Point 9: New small stores are much smaller than brick and mortar stores, but because of system limitations each of these stores need to be sorted to an individual shipping sorter divert consuming too many diverts that are significantly underutilized by these stores during the waves

The sortation conveyor system will sort the small store orders directly to shipping for transportation to a 3PL facility to be processed which will free up the shipping sorter diverts to be utilized better.

Point 10: Too many work around workflows required as a result of current system limitations.

The WMS manages the movement of employees and the flow of materials on conveyors to create an efficient system of workflow. This will decrease work around workflow, and free up congestion to optimize warehouse operations.

Point 11: MRs (emergency / rush orders) are not in the labor planning so operators must stop planned orders/labor, handle MRs and then go back to planned orders. Operators want to make decisions based on the knowledge of the current daily volume of regular orders and if they should process to the request date or push.

Some of the standard functions that the WMS include are the planning, scheduling, material flow control, labour management, management reporting and full traceability. This system will automate the picking, packing and shipping which therefore will include the MRs in their labor planning by sorting all orders based on priority, customer, ship to, carrier etc.

Point 12: Sortation. The sorter's down lanes are manually mapped daily based on the trailer load plan. The trailer load plan is a manual process, not system based, and is dependent on cube roll up and the experience of the load planner.

The WMS and the sortation conveyor implemented will allow the trailer load plan to be done by the system and not manually. The WMS manages and coordinates all operator functions throughout the warehouse including the sortation.

Point 13: System does not handle multiple units of measure. (case, each, etc.)

The WMS handles multiple units of measure as it has automatic order selection and inventory features which allows the identification of the unit of measure (each, case, etc.). WMS also enhances inventory management by increasing accuracy, improving order fulfillment and reducing order cycle time.

MATERIAL HANDLING EQUIPMENT FOR RECOMMENDED OPTION:

1) PUT-TO-LIGHT EQUIPMENT:

PRODUCT
Cardboard boxes filled with electronic components

DIMENSIONS
Min. 150*150*50 mm
Max. 1000*550*500 mm
Weight: 0.2- 25 kg

PERFORMANCE
750 cartons per hour

PALLETS
4*12 put-to-light pallet stations

OPERATIONS
18 hours/day

2) WMS Software:

Supported Platforms	Windows
Supported Operating Systems	Windows Server 2003 Windows Server 2008 Windows Vista Windows XP
Processor	Intel Pentium 4 Minimum Intel Core 2 Duo Recommended
Memory	512MB Minimum 1 GB Recommended
Disk Space	100 MB Required
Systems Requirements	CD-ROM

3) MRP Software:

SUPPORTED CLIENT PLATFORMS

Deployment Model	On Premise
Platform	Windows
Operating Systems	Windows 2000 Windows 7 Windows 8 Windows Vista Windows XP

SUPPORTED SERVER PLATFORMS

Server Platform	Windows

Form

The MRP System is in the form of hollow interlocking blocks each block measuring 500 mm deep. The basic Wall and Corner blocks measure 1000 mm long by 750 mm high. Combinations of smaller blocks are available, designed to fit this same modular size. The weight of the largest block is 33 kg. The typical wall thickness is 18mm.
Each block is provided with interlocking features on all four edges, 2 male and 2 female, with lifting/ fixing holes in the main faces. A 50 mm hole is built into the top face of the block for the purposes of filling and emptying of the chosen material (water, sand, iron or lead shot or grout).

Materials of Construction

The blocks are manufactured in black polyethylene by the rotational moulding technique and are, therefore, devoid of any construction joints. The black polyethylene has less than 2% carbon black compounded into the base polymer, providing practically unlimited UV resistance and good radiation stability.
The blocks are manufactured in two stages. The first process provides a dense outer coating of polyethylene, then a second process includes a foaming agent, giving an expansion of up to 2.5 times, providing the inner coating. Both coatings cure simultaneously and so are bonded together. This results in a total wall thickness of approximately 18 mm with a good strength to weight ratio.

Accessories

There are a number of 'add-ons' that are available, if required. A variety of external polyethylene fixing plates and nylon set screws, extract pumps, lifting grabs etc. are available. Also available

are 'over the wall' structures for facilities where wind loadings and impacts must be considered. MRP provide a design advisory service to assist clients with their applications.

Decontamination
The surface finish of the blocks is polished and free from inclusions, resulting in a product which can be easily decontaminated, for re-use elsewhere. The use of strippable coatings is recommended where heavy airborne contamination is expected. The smooth surface of the block will aid the removal of the strippable coating when required. The smooth polyethylene finish can be easily wiped over to remove loose contamination and the potential for contamination traps have been minimised.

Traceability
Each block is marked with an adhesive, metallic backed, label with a discreet bar code number that is entered in the company held database. We are, therefore, able to provide a life history of every block supplied.

4) ERP Software:

Minimum requirements Server

- Microsoft SQL Server 2005
- (Express depending on number of users)
- Microsoft Windows Server 2003
- Microsoft .NET Framework 3.5
- Required hard disk storage ERP System: min. 250 MB
- Required hard disk storage database: min. 500 MB
- (depending on data volume)
- Required hard disk storage SQL Server installation: min. 500 MB
- Processor: min. 1 GHz
- RAM (Random Access Memory): min. 1 GB

Minimum requirements Client

- Microsoft Windows XP
- Microsoft .NET Framework 3.5
- Microsoft Office 2003
- (at special reports)
- Required hard disk storage ERP-System: min. 50 MB
- Processor: min. 1,7 GHz
- RAM (Random Access Memory): min. 1 GB

- Screen resolution: at least 1280x1024

Minimum requirements network

- 100 MBit state-of-the-art network
- Server as domain controller
- Network/domain integration of all client PCs
- Database server supporting Windows authentification

Minimum requirements VPN for external access and branch networking

- VPN access with synchronous upstream and downstream
- A speed of at least 2048 kBit/s for upstream and downstream
- 99 percent availability of VPN access
- Alternatively the connection with the server can occur directly via Internet but this will exclude all advantages of a VPN (secure connection, etc.)

5) Sortation Conveyor:

Common Components

REMCON conveyors are all built from components widely distributed throughout the USA, providing quick and easy service if needed from just about anywhere in the country.

Variable Speed Drive

REMCON sorting conveyors are equipped with totally enclosed, fan cooled motors with variable speed drives.

Gear Reducer

Dodge "Torque-Arm 2", parallel gear, shaft-mounted speed reducer meets American Gear Manufacturers Association class 2 rating.

Pulleys

1. **Crowning:** The pulley crowning keeps belt tracking true, minimizing time-consuming adjustments.
2. **Self-Cleaning:** For tail pulleys on conveyors that will be carrying glass. This wing style pulley is designed to expel broken glass and other debris from between the belt and the pulley. This prevents premature belt wear and jamming.
3. **Lagging:** For head (drive) pulleys, on conveyors with heavy loads, for better traction. This heavy duty rubber layer is permanently hot-vulcanized to the pulley.

Belt

High strength, moderately oil resistant rubber (MOR), 1/8” or thicker top cover with slider surface bottom cover, tensile rating of 330 pounds per inch of belt width. 3-ply woven Polyester carcass prevents future stretching after belt is first tensioned.

Belt Cleaner Cleats

3/4 inch high cleaner cleats continually wipe debris from the return pan, and deposit it in a cleanout area at the tail of the conveyor. Only 2 or 3 cleats are required per conveyor. For certain applications where these cleats may cause an interference, idler pulleys and other options are available.

Belt Lacing

Flexco 375 XJ -- The largest, heaviest lacing available for this thickness of belt and pulley diameters. Attached with bolts, rather than staples. This lacing is long-lasting and resists damage.

Bearings

Dodge SXR pillow block with eccentric locking collar for better grip on shaft. All bearings are self-aligning, pillow-block style sealed units, requiring grease only bi-annually.

Belt Speed

4 feet per minute minimum, 150 maximum, with a variable speed range of 80% for standard controls, and a range of 180% for conveyors equipped with optional automatic speed control systems.

Motor

Teco-Westinghouse, severe duty, TEFC, 1.15 service factor, class F insulation for long motor life.

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Appendix:

General Assumptions

- For the other five 2-month periods excluding Nov./Dec, assume the profit was cut in half
- Add-ons/rush subwaves are done as dynamic picking in building A
- Bulk subwaves are done as dynamic picking in building B
- All Dynamic picking is done in full cases
- Assume system is implemented in January 2014
- Assume same number of put systems (2) in Eastern facility as Western facility
- Any dimension (length, width, height) in the item master that had a value of 0 was converted to a value of 0.1 for the sake of accurate item cubic space

Assumptions in Financial Summary

Assumptions for Put-to-light System:

- assume put-to-light uses same hardware and technology as pick-to-light
- speeds up efficiency by 25%
- Increases productivity 75%
- Need to buy 3162 lights total for both distribution centers
- Assume $200 per light bar
- Assume $75,000 to install per distribution center
- Assume 10 years useful lifetime
- Assume salvage value of 379,440 at end of 10 year lifetime
- Assume 60 Watt bulb, 8.7 cents per KWh, = $0.13 per day per lightbulb
- Assume 60 Watt bulb → $0.13 * (4416*2 bulbs) * 5 days per week * 52 weeks
- Assume 10 hours of maintenance required per week
- Assume 1 week of 8 hrs a day installation

Assumptions for Voice picking:

Averages were taken for cost ranges

- $630,000 cost for equipment: 45[operators]*7000[$/operator]*2[DC]
- Increased productivity 15%
- Increased employee efficiency by 70%

- $600,000 installation cost: $45,000[area cover] + $25,000[hardware equipment] + $40,000[Professional installers]*2[DC]
- $33,306.00 annual maintenance expense: 15[hr/week]*21.35[$/hr]*2[DC]*52[weeks]
- Assume $120,000 annual utilities cost
- Assume lifetime of equipment is 13 years
- Salvage value of $70,000.
- Assume 1 week installation

Assumptions for Automated Labeling:

- Assumption for total equipment cost: $30,000
- Assume 10,000 salvage value
- Assume 20 years of useful life
- Assume 3 weeks installation
- 10% increase in employee efficiency
- 30% increase in production efficiency
- $120,00 annual utilities cost
- $33,306 annual maintenance expense: 15[hours/week]*21.35[$/hr]*2[D.C.]*52[weeks]

Assumptions Goods-to-Man Machine

- $4,000,000 equipment cost: $2,000,000[parameter]*2[DC]
- $1,093,120 installation costs = 5[days]*16[hours]*20[workers]*32[weeks]*21.35[$/hour]*2[D.C.]
- $199,836 annual maintenance expense = 3[workers]*30[hours/week]*21.35[$/hour]*2[D.C.]*52[weeks]
- $2,000,000 annual utilities cost
- $1,000,000 salvage value
- 20 years of useful life
- 40% increase in employee efficiency
- 80% increase in production efficiency

Assumptions for WMS Software:

- Salvage value of $1,500,000
- Useful Life of 10 years
- $34,160 installation cost: 5[days]*16[hours]*10[employees]*1[week]*21.35[$/hr]
- $111,020 annual maintenance expense: 52[weeks]*10[hours]*5[employees]*21.35[$/hr]*2[DC]

- Assume utilities cost to be $800,000.00 per year
- Increased employee efficiency of 85%
- increased production efficiency of 90%

Assumptions for MRP Software

- Salvage value= $ 370800
- Useful Life of 10 years
- $34,160 installation cost: 5[days]*16[hours]*10[employees]*1[week]*21.35[$/hr]
- $111,020 annual maintenance expense: 52[weeks]*10[hours]*5[employees]*21.35[$/hr]*2[DC]
- Assume utilities cost to be $800,000.00 per year
- Does not increase employee efficiency
- increased production efficiency of 90%

Assumptions for ERP Software

- Salvage value: $450000
- Useful Life of 10 years
- $34,160 installation cost: 5[days]*16[hours]*10[employees]*1[week]*21.35[$/hr]
- $111,020 annual maintenance expense: 52[weeks]*10[hours]*5[employees]*21.35[$/hr]*2[DC]
- Assume utilities cost to be $800,000.00 per year
- Does not increase employee efficiency
- increased production efficiency of 90%

Assumptions for Sortation Conveyor

- Assume installation cost to be $1,680,000.00 and take 32 weeks
- $66,612 Annual Maintenance Expense = 3[workers]*20[hours/week]*21.35[$/hour]*52[weeks]
- Assume utilities cost to be $840, 000.00 per year
- Salvage value= $840,000
- Useful Life= 25 years
- Increases Employee Efficiency by 50%
- Increases production efficiency by 80%

Assumptions for Products

Product	Avg. Price	Cubic (Min)	Cubic (Max)
TV	$550	4900	5500
Home Theatre System	$500	15000	1000000
Camera	$400	150	200
Car Audio Equipment	$400	5500	15000
Laptop	$700	500	800
Tablet	$250	250	400
Cell Phone	$175	30	80
Landline	$50	400	500
GPS	$200	200	250
Video Games	$50	0	30
Office Equipment	$40	800	1800
Personal Audio Equipment	$200	80	150
Home Audio Equipment	$100	1800	4900

Throughput Assumptions

Receiving Parameters (Per Worker, Per DC):

Receiving Rate: 100 [cases/hr (norm)]

118 [cases/hr (peak)]

Waving Parameters (Per Worker, Per DC):

Slapper 1 Rate: 109 [cases/hr]

Slapper 2 Rate: 109 [cases/hr]

Slapper 3 Rate: 109 [cases/hr]

Each Module Rate: 210 [eaches/hr]

Case Module Rate: 98 [cases/hr]

Calculation Descriptions

Baseline Profit:

A code in C# was written to organize the SKU's in the shipping log by their total quantity of all store orders, and by their order shipment in the form of Full Cases (False) or Eaches (True). The results were put into excel along with the dimensions of each SKU from the New Item Master. Using IF and VLOOKUP statements we organized all of the SKU's with their order quantity, shipment type, and Each cubic or Case cubic dimensions. Estimations on the prices and cubic dimensions of the various electronic products that are mentioned in the overview were made to determine the product that each SKU represents based on cubic dimension and the SKU's approximate price to then calculate the November/December revenue of ABC Inc. as a whole. It was estimated that ABC Inc. would make a 30% profit off of the total revenue and estimated that ABC Inc. would make half as much profit during the other five 2-month periods other than the November through December period, which gave us the year 1 proft baseline. It was assumed that ABC Inc. would make 4% more profit each year for the next 4 years which gave us the 5 year profit baseline.

Financial Summary:

Equipment Depreciation Rate:
http://www.calculatorsoup.com/calculators/financial/depreciation-declining-double.php

The equipment costs and salvage values are in the Assumptions section.

Employee Efficiency Profit:

[Baseline Profit]*(1+[employee efficiency percent]/100) - [Baseline Profit]

Production Efficiency Profit:

[Baseline Profit]*(1+[production efficiency percent]/75) - [Baseline Profit]

Total Profit from Efficiency Gain:

([Employee Efficiency Profit] + [Production Efficiency Profit]) / 2

Present Value:

([Total Profit from Efficiency Gain] - sum(All Costs, Expenses, Depreciation)) / (1.05^[year])

Throughput & Labor:

The results from the C# code were uploaded into an excel file along with the dimensions from the New Item Master. Similar to the excel file for the Profit Baseline, IF and VLOOKUP statements were used to line up Each and Case cubic dimensions of all SKU's with their Each and Case order quantities. The total SKU for each order quantity was multiplied by its corresponding cubic dimension to get the cubic dimension for all combined Each orders of that SKU. All of the Total Each Order Cubic Dimensions were summed together and then divided by the total quantity of all Each orders to calculate the average cubic dimension of an Each, the same calculation was done to calculate the average cubic dimension of a Full Case. These calculations can be seen below:

Average Each Dimension:
sum{SKU in all SKU's }([Each Cube]*[Each Quantity]) / [Total Number of Eaches Ordered]

Average Case Dimension:
sum{SKU in all SKU's }([Case Cube]*[Case Quantity]) / [Total Number of Cases Ordered]

Using the average Each dimension, the Eaches per tote were calculated. The parameters for the Putaway and Picking process were given. The Receiving parameters were based off of the Putaway parameters. The Waving parameters were based off of the November/December demand. The demand parameters were based off of a 7 days a week, 18 hour workdays, and Total Each and Case order quantity. Throughput rates for Receiving, Putaway, Picking, and Waving were based off of the tower and aisle distances, given parameters, and then multiplied by the minimum number of workers to meet the demand. Peak throughput of each process were calculated based off of the November/December demand, whereas the average throughput were calculated using the given normal throughput rates and half as many employees for peak conditions.

C# Code

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Collections;
using System.IO;
namespace DataTrimmer {
   class Program {

      static public Hashtable ordersTrue = new Hashtable();
      static public Hashtable ordersFalse = new Hashtable();
      static public string userPath =
Environment.GetFolderPath(Environment.SpecialFolder.Desktop);
      static public StringBuilder s;

      static public void readFile(string filename) {
         StreamReader reader = new StreamReader(userPath + "\\" + filename);
         string[] line;
         int key;
         int value;
         bool isOrderType;

         try {
            reader.ReadLine();
            do {
               line = reader.ReadLine().Split('\t');
               key = Convert.ToInt32(line[4]);
               value = Convert.ToInt32(line[5]);
               if (line[6] == "true") {
                  isOrderType = true;
               } else {
                  isOrderType = false;
               }
               insertItem(key, value, isOrderType);
            } while (reader.Peek() != -1);
         } catch {
            Console.WriteLine("READ ERROR");
         } finally {
            reader.Close();
         }
      }
```

```
static public void writeResults(bool isOrderType) {
    StreamWriter writer;

    if (isOrderType) {
        s = new StringBuilder();
        writer = new StreamWriter(userPath + "\\resultsTrue.txt");
        writer.WriteLine("SKU   Quantity");
        foreach (DictionaryEntry e in ordersTrue) {
            s.AppendLine(String.Format("{0}\t{1}", e.Key, e.Value));
        }
        writer.Write(s.ToString());
    } else {
        s = new StringBuilder();
        writer = new StreamWriter(userPath + "\\falseResults.txt");
        writer.WriteLine("SKU   Quantity");
        foreach (DictionaryEntry e in ordersFalse) {
            s.AppendLine(String.Format("{0}\t{1}", e.Key, e.Value));
        }
        writer.Write(s.ToString());
    }

    writer.Close();

}
static public void insertItem(int key, int value, bool isOrderType) {
    int oldValue;

    if (isOrderType) {
        if (ordersTrue.ContainsKey(key)) {
            oldValue = (int)ordersTrue[key];
            ordersTrue[key] = oldValue + value;
        } else {
            ordersTrue.Add(key, value);
        }
    } else {
        if (ordersFalse.ContainsKey(key)) {
            oldValue = (int)ordersFalse[key];
            ordersFalse[key] = oldValue + value;
        } else {
            ordersFalse.Add(key, value);
        }
    }
```

```
        }
        static public void writeTest() {
            StreamWriter writer;
            s = new StringBuilder();
            writer = new StreamWriter(userPath + "\\test2.txt");
            writer.WriteLine("0     1         2         3         4         5         6         7         8");
            for (int i = 1; i < 200000; i++) {
                s.AppendLine(String.Format("a\tb\tc\td\t{0}\t{1}\t{2}\th", i%100000, 5, (i % 2 == 0) ?
"true" : "false"));
            }
            writer.Write(s.ToString());
            writer.Close();
        }

        static void Main(string[] args) {
            Console.WriteLine("Make sure the file you want to read is the same folder as this
project.");
            Console.Write("Input file name(with .txt at the end): ");
            string filename = Console.ReadLine();
            readFile(filename);
            Console.WriteLine("File read success!");
            writeResults(true);
            writeResults(false);
            Console.WriteLine("Results saved to your desktop.");

        }
    }
}
```

External Resource: Steven Godlewski

Case Overview Notes

Introduction

- ➢ Objective: Redesign the picking process of ABC Inc. (East and West)
- ➢ ABC has 200 retail (B&M) stores
- ➢ ABC has 2 distribution centers (east and west).
- ➢ East and West are designed to handle just B&M stores
- ➢ New order profiles:
  - o Online orders
  - o Type I small stores
  - o Type II small stores
  - o Type III small stores

Brick and Mortar Stores

- 30,000-50,000 [Sq Ft]
- Carry 11,000 [SKUs]
- Their orders are shipped to them as full cases in plastic totes (reusable bins that are given back to East or West)
- A truck carries 3 different B&M store orders. Mixing of containers for different stores in the truck not allowed. Loaders use plastic curtains to separate containers for different stores in the truck (loaded reverse stop order 3-2-1). Loading of a store cannot start until all the containers for the previous store in the truck have been loaded.
- Number of stores, shipment volume, and SKUs won't change.

Online Orders

- 15,000 [SKUs].
- Daily orders will increase by 20% each year for the next 5 years.
- Largest portion of orders shipped is November and December.

Type 1 Stores

- 1,200-2,000 [Sq Ft].
- carry 430 [SKUs].
- T1 orders need to be ready by 3:00pm for shipment on that day.
- Number of T1 stores will increase 75% each year for the next 5 years.
- Currently there are 30 T1 stores.

Type 2 Stores

- 300-400 [Sq Ft].
- carry 200 [SKUs].
- T2 orders need to be ready by 3:00pm for shipment on that day.

- Number of T2 stores will increase 175% each year for the next 5 years.
- Currently there are 5 T2 stores

Type 3 Stores

- Vending Machine Size
- carry 80 [SKUs]
- T3 orders need to be ready by 3:00pm for shipment on that day.
- Number of T3 stores will increase 150% each year for the next 5 years.
- Currently there are 10 T3 stores

Design Criteria

- Payback period based on current requirements
- New MH equipment can be acquired as long as there is room for it in the existing facilities
- Solution Lifetime: 2014-2019
- January-October: Two 7.5 [hr] shifts per day
- November-December: Three 7.5 [hr] shifts per day
- FTE's work 7.5 [hr] and are paid for 8 [hr]
- Eaches must be consolidated in a minimum # of shipping containers, even if picked in different areas of the facility
- Assume you have enough storage capacity

Deliverables

- Descriptions of options considered (Word)
- Financial summary (AMPL)
- Description of recommended options (Word)
- Required labor for peak conditions of recommended options (AMPL/Excel)
- Flow process charts (Visio)
- CAD layouts (AutoCAD)
- Material handling equipment spec (AMPL/Excel)
- Explanation of the proposed solution (Word)
- Assumptions (Word)

Current Operation

➢ Eastern DC operates from two buildings, building “A” and “B”.
➢ Building “B” processes full case portion of the orders.
➢ Building “A” processes the eaches portion.
➢ Western DC operates from one building in same way as Eastern unless otherwise indicated.

Receiving

- ➢ Product shipped as eaches is received in building “A”, and product shipped as full cases is received in building “B”.
- ➢ All received cases are labeled with bar codes to identify SKU in the case.
- ➢ Cases with the same SKU always have the same quantity in the case (full case quantity).
- ➢ Facility can receive pre-allocated products.
- ➢ If the store for which the product is allocated is active at the shipping sorter when the pre-allocated product is received it can be sent straight to the shipping sorter. If the store is not active at the time the product is sent to stage in a priority bin (super-sized mail box cubby holes for the stores – one per store).
- ➢ After products are received, it is labeled for putaway, one label per “container”. Container can consist of multiple boxes.
- ➢ Items of same label have to be put in the same location.

Putaway

- ➢ This process is sytem suggested, where any operator can override the suggestion without the system creating a historical log of who did it and why it was done
- ➢ Putaway operators scan the label on the container to initiate the putaway process: the system tells the operator what location to put the product, then the operator scans the location to tell the system where the product was putaway, then the operator takes the label off of the product and attaches it to a piece of paper with their name on it (this is the only log that keeps track of who did what)
    - o The operator cannot split containers that are full of multiple boxes, these product containers will go to the same location
    - o Same SKU with multiple labels are put in the same location
- ➢ Conveyable products are putaway as pallets to reserve.
    - o But small quantities of cases (<10) are sent directly to its FPL. If there is not enough room for entire product, excess is left behind the flow rack.
- ➢ Most of the time operators putaway products at locations as suggested but sometimes the system doesn't choose the optimal location and the operator will putaway in a better location
- ➢ FPLs are static locations whereas reserve locations (replenish FPLs) are random locations
- ➢ System allows for 1 FPL (forward pick location) per product
- ➢ In Building A, theres not enough shelves to map all FPLs ???
- ➢ The system is not aware of shelves behind FPLs; these shelves only replenish FPLs, they are not for overstock

Allocation/Waving

- ➢ The WMS manages allocation and can allocate product the day after it was received (regardless if the product has or hasn’t been putaway)
- ➢ There are two main waves of products that are processed throughout the day, the day and the evening wave
    - o Each wave has subwaves processed independently in different areas of the facility: fullcase, repack, add-ons/rush orders, and bulk
    - o Replenishment of the FPLs is done after the second wave has been completed
- ➢ East has up to 6 clustered store orders per Repack-subwave

- East has a shipping sorter with 48 diverts
- 2 repack-subwaves are continuously processed concurrently in 12 diverts (6 diverts for each)
- While 2 repack subwaves are processed in their 12 diverts, the 2 previous repack-subwaves are tailing off in the other 12 diverts (6 diverts for each)
- Repack subwaves are processed in advance of full case subwaves, repack waves are then picked one wave ahead of the corresponding full case subwaves
- Full-case subwaves have 23 - 36 store orders
    - Full-case Wave One has 36 store orders
    - Full-case Wave Two has the remaining stores on the schedule
    - Full-case subwaves have up to 36 store orders for 36 diverts because the previous repack subwaves take up 12 diverts
- For a product to be waved, it needs to be in a pick-able location (FPLs)
    - reserve locations are pickable by dynamic picking
- Building A dynamic picking:
    - Occurs when a stores demand is larger than the product full case quantity
    - The system will allocate as much as possible to be picked as full case
        - This is more efficient than picking from the module's flow rack
    - There is an area for place pallets of fast movers where the picker can pick from by item and by case
    - Dynamic picking is always welcomed in Building A
- Building B dynamic picking:
    - Occur when a FPL runs out of stock before all of the days demand for the product in the location is satisfied
    - The system will allocate from reserve locations (replenishment of FPLs isn't allowed until the picking for the day is completed) with a stock picker which is less efficient than picking the cases from the FPL
    - Operators take whole pallets of dynamic picking items and stage them by the conveyor, stick labels on the cases, and then put them on the conveyor when the wave comes
    - After finishing the pallet, they put the pallet back on the shelf but may not put it back in the same spot it was before
    - Dynamic picking is never welcomed in Building B
- West has up to 5 clustered store orders per Repack-subwave
- West has no shipping sorter
- West full-case store orders are picked to a pallet one at a time

Each Picking

- 8,000 [SKUs] are shipped as repack products (eaches)
- East has two 3-level repack modules with 4,600 FPL's each
    - Along the center of the aisles there is a power takeaway conveyor which starts at the bottom level and serpentines (snakes) through the 3 levels and exits at the top level.
    - There is a gravity conveyor on each side of the power takeaway conveyor

- ➢ Store orders are cluster-picked in batches up to 6 stores and put on the gravity conveyors
- ➢ Levels are divided into pick zones
    - o Totes must begin and complete in the same zone
    - o 1 picker per pick zone. More than one is possible but causes congestion.
- ➢ 1 aisle for fast moving, and multiple aisles for slow moving repack products. Each aisle (or floor location) has 3,500 FPLs
- ➢ 1 aisle for T1 store products with 400 FPLs
    - o T1 Store orders are picked directly into their shipping cartons (they are not sorted through the sorter, they are taken to the carrier door from the pick walkie {the walkie is designed for the operator to walk along with the truck as they move loads})
- ➢ Store orders are cluster-picked up to 6 stores from aisles (floor locations) with pick walkies
- ➢ All picking is directed by RF hand terminals (scan guns)
- ➢ Before each wave, pickers go to a central label printing desk to get master labels for the wave
    - o the picker labels each tote with a master label and scans the label, then the system tells the picker which location to pick from
    - o the picker scans an item from that location and the system tells the picker how many items to pick, once the tote is full the picker scans another master label and starts the process again with a second tote
- ➢ At Building A, pallets are picked
    - o When the demand of a store order exceeds the quantity of a pallet (pallet is made up of different products), the pallet is taken to a de-pal module to be inducted directly into the sorter
    - o When the demand of a store for a particular product exceeds the product case quantity, that product is picked as a case from overstock, this is called dynamic picking
- ➢ A takeaway conveyor from slow moving aisles merges with a takeaway conveyor from one of the repack modules, then the merged conveyor crosses to Building B from Building A through the conveyor bridge and connects to the main merge before the sorter.
- ➢ Another takeaway conveyor from the super-fast moving aisles and de-pal module merges with a takeaway conveyor from the other repack module and follows the same path to the main merge in Building B
- ➢ West has one 3-level module
- ➢ No overflow shelving behind flow rack in the pick module → capacity issues when day's demand exceeds FPL slot capacity
- ➢ Store orders are cluster-picked in batches up to 5 stores at the pick modules
- ➢ Store orders are picked one order at a time from the aisles

Full Case Picking

- ➢ 2,000-3,000 products are handled in Building B
- ➢ East has one 4-level pick-to-belt full case module
- ➢ Building B has 3 de-pal stations
- ➢ Building B has a small portion of repack picking which are picked to a store pallet and taken to the shipping area by a vehicle

- ➢ Building B does dynamic picking transactions which is picking cases with a stock picker from overstock to satisfy the missing cases of a full case store order
- ➢ Crossover or Pre-allocated products are processed in Building B:
    - o If a store is active (demands an order) when the pre-allocated product is at the shipping sorter, then the product is sent straight to the shipping sorter. If a store isn't active, then the product is sent to stage in a priority bin (a big mailbox to hold pre-allocated products, each store has one mailbox) until the store is active.

Pain Points

- Lead time of replenishment store orders take up to 10 days
- East and West were designed for 50/50 repack/full-case ratio but currently deal with 80/20 repack/full-case ratio
- The system doesn't handle multiple units of measure (case, each, etc.)

Required Options to Evaluate

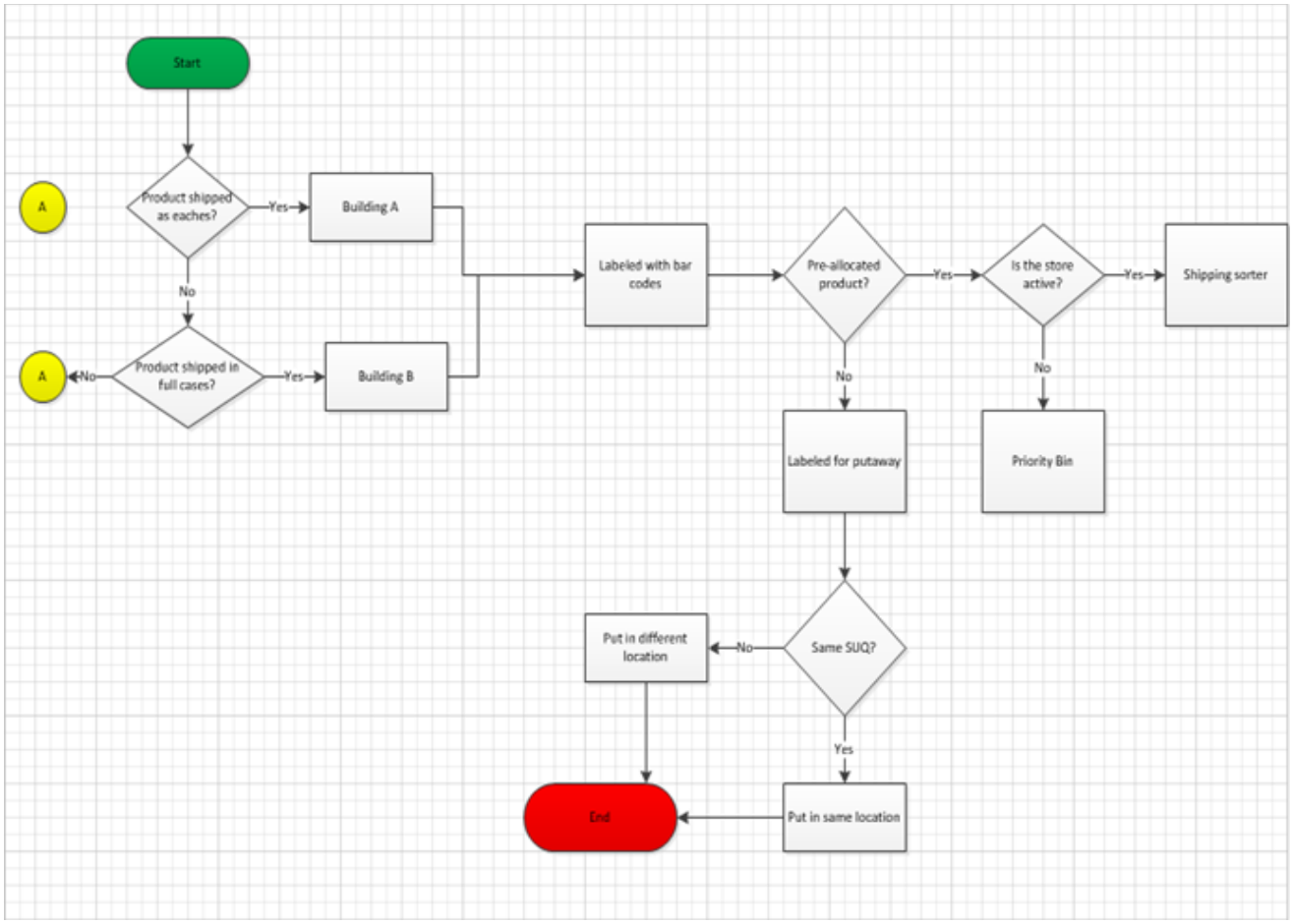
Option 1: Current option is ⅝ order cluster picking with automated print and apply labeling.

Option 2: Current option is ⅝ order cluster picking directed with voice instead of radio frequency terminals.

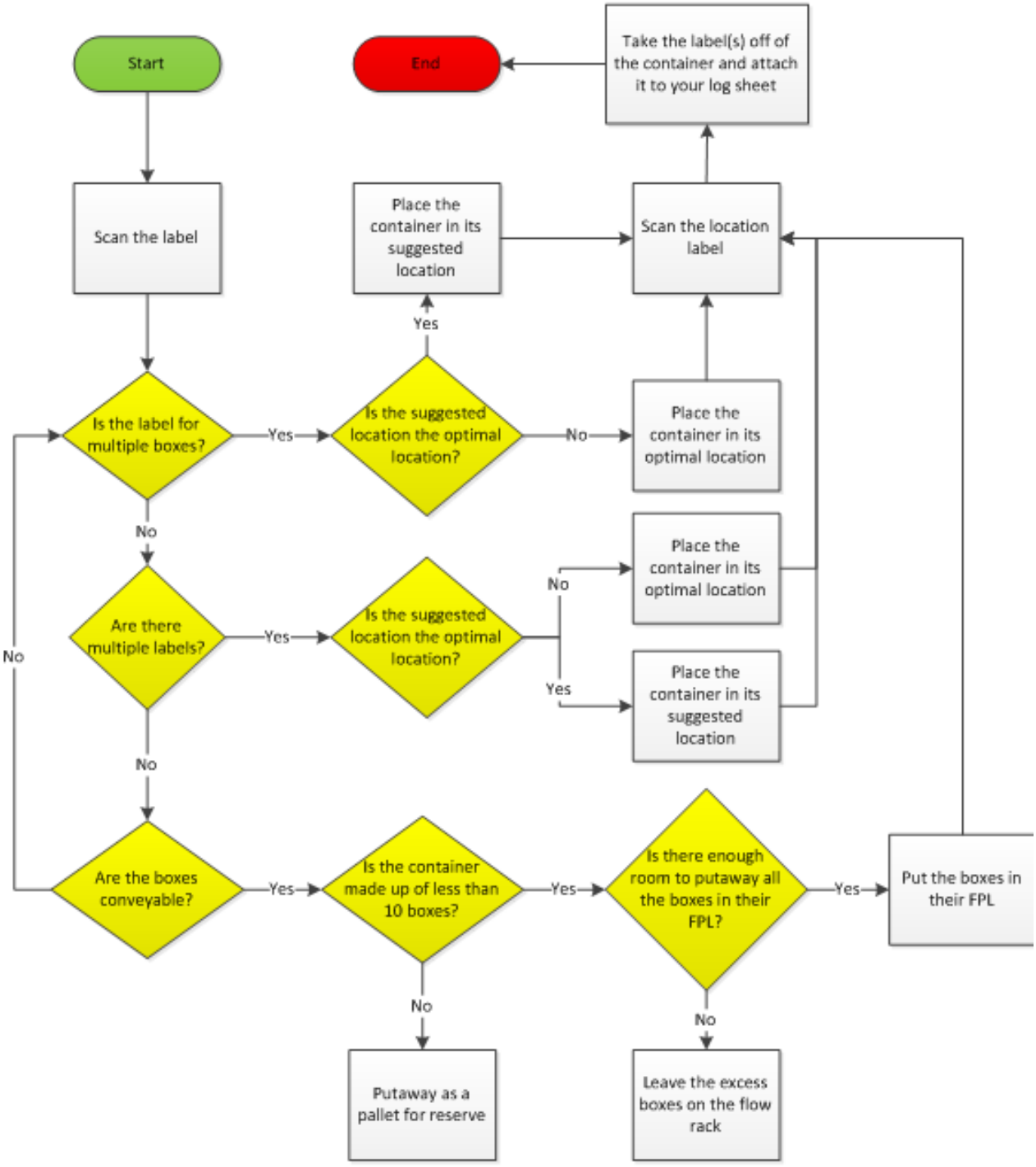
Option 3: Batch-pick-to-put with non-automated picking.

Option 3: Batch-pick-to-put with automated picking

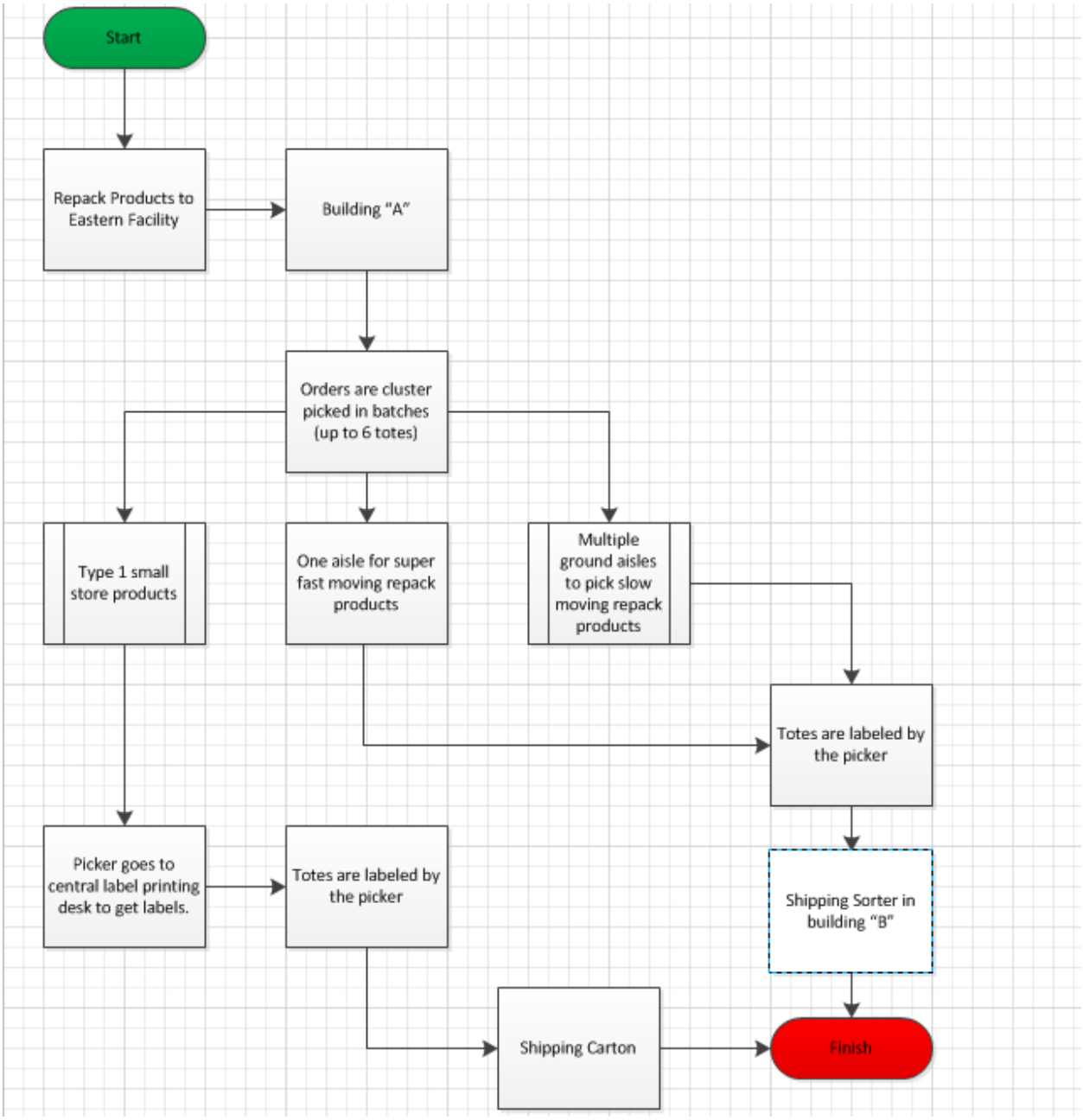
Initial Receiving



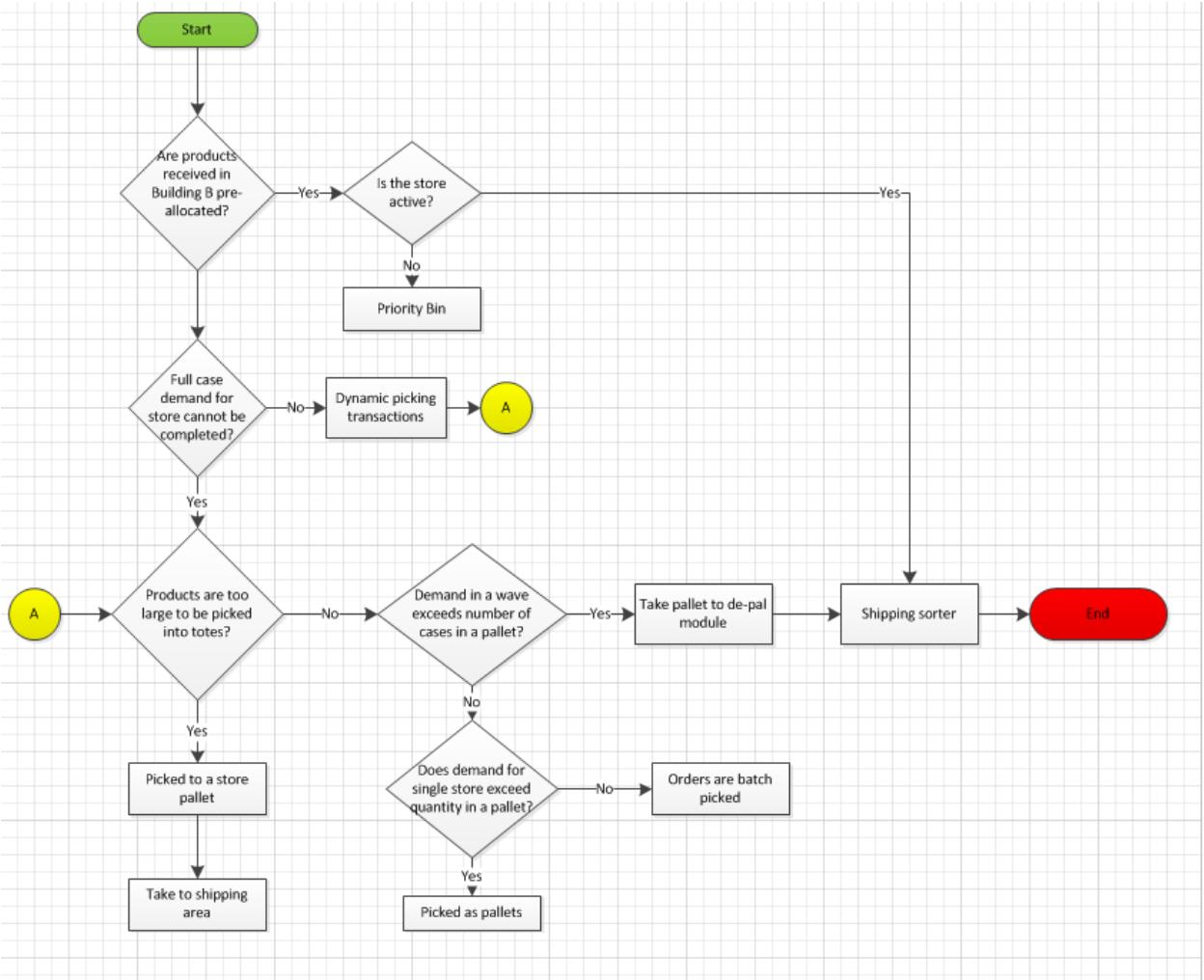
Initial Putaway



Initial Each Picking



Initial Full Case Picking



Initial Waving