

Case study documented by James R. Holt
Washington State University, Vancouver

1 Background

Premier Audio Systems Inc. (not its real name) produces top-of-the-line audio systems for automobiles and recreational vehicles. They employ 60 people in the plant that includes nine engineers (a huge number for a small firm). Their pricey products (ranging from \$100 speakers to \$10,000 full systems) sell in specialty shops where technicians do the installations. PAS grossed about \$10 million a year for the past ten years.

Things were getting tough for PAS. Sales were not increasing. It was harder and harder to sell the pricey products to the small shop owners. PAS enlisted a network of 30 sales distributors to make personal visits to shops throughout the US. Sales volumes increased but mostly due to volume discounts negotiated by the distributors.

The factory floor in Big City assembles circuit boards and components purchased in bulk. There are 60 main products including all kinds of speakers, pre-amps, tuners, post amps, balancers, and signal enhancers. The plant was operating as a team building different parts on different days (batches of 30 to 100) to be efficient. Production processing with the large batches and sporadic demand made scheduling difficult. In-Plant inventory for some products was high while other products were on back-order.

In the Spring of 1998, the General Manager decided to reduce batch sizes to better control the inventory. To do so, he chose to implement work cells dedicated to different products. The implementation of his conversion plan required a lot of rearranging of the plant layout and purchases of new equipment (including a second wave solder machine costing \$115,000). The General Manger rearranged most of the factory and purchased many new small equipment items. But, the President (a financial type) wouldn't approve the second wave solder machine.

Over the next three months (the high demand months), the factory had a terrible time producing. Much was attributed to the changeover confusion. Plant inventory declined and back orders increased. Money became tight without the normal sales. PAS increased and extended its loans. They laid off several employees and also slowed payment to some of their suppliers (which upset their dedicated, sole source agreements). In turn, raw materials were not dependable. The factory focused on making things it could make with the parts on hand. Things got worse and worse. When a request for another loan was denied, the General Manager left the company.

The President was at a loss. Production was a shambles. Sales though at high season are the worst in years. Suppliers are undependable. We make the best audio systems in the world but customers think the products are too expensive. Shops won't buy the products. Distributors can't sell them. Engineering seems to be off in a cloud somewhere. We have so many debits for our sales our credit rating is at rock bottom so we have to pay

Premier Audio Systems Inc.
Big City, Arizona

It's Just NOT FAIR!

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Washington State University, Vancouver

premium rates on loans. Not only have we had to layoff some really good people, the only person with any plan at all, the General Manager, walks away with almost no notice. How was he going to attract someone good enough to turn around such turmoil fast enough to prevent bankruptcy? PAS is in a serious downward spiral! It would take months to find a good General Manager and months again to convince the candidate to come to such a small troubled firm. In four months, PAS could be history. They needed a miracle. Then, he remembered Bart.

Bart Penrod. Bart visited PAS just a few months earlier as a guest of the President. Bart, a member of the TOC Center based in Chicago was consulting with another firm in Big City and had met the President casually. The President still remembers Bart's advice, "A \$115,000 investment is a lot for a company your size. Go look at the wave solder machine and see if you think you need another one. Take all day if you need to. This is an important decision." The President did go watch the wave solder machine. After 30 minutes, the President was sure he didn't need another.

The time was just right for Bart. He was tired of making tons of money for everyone else and wanted to make some of his own. He took the job.

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2 The Solution

Premier Audio Systems Inc. is a Theory of Constraints consultant's dream. Lots of capacity artificially constrained. A quality workforce motivated to improve. Willing management, looking for breakthrough solutions. Problems with production, suppliers, workers, engineering, distribution, sales, marketing, culture, people and money. Bart, a Jonah-Jonah, loves these kinds of problems.

Bart arrives a week later (the first week of July 1998) without family. A quick analysis shows they need money fast. They need sales fast. They need production fixed. They need suppliers on line. They need a miracle this month. Bart cancels \$40,000 in equipment ordered by the previous General Manager. That is not enough.

They can't get supplies without payment. And they can't get another loan. Bart analyses PAS's expenditures to see which ones don't contribute to throughput. He finds an unlikely source of money. The distributors!

The distributors cost \$1,500,000 per year. These traveling salesmen golf the first two weeks of the month, visit shops the third week and start "Dialing for dollars" the last week. Bart called the owners of several of the shops. "When was the last time you saw our distributor?" The answers were nearly unanimously vulgar replies. It seems the distributors try to strong-arm the shops in the third week of the month. The shop owners know the fourth week of the month always includes heavy discounts to move products. The distributors require large orders to get the discounts. That forces the shop owner to buy large volumes of very expensive stuff. The shops don't have to pay for 30 days, but it is rare to sell such high priced products within 30 days of the order. And, delivery from the factory is taking three weeks (for stuff not backordered).

On Tuesday, Bart fired all the distributors. He took their pay and paid some on every supplier's account.

The next challenge was the factory. Luckily, the old equipment removed to make the cells was still in a back room. Bart returned the production line to traditional flow. By the end of Tuesday, the line was running manual Drum-Buffer-Rope.

On Wednesday, Bart taught the production people the difference between process batch and transfer batch. They were building several products of the same kind (large batch) because that is all the material they had. The factory had several large carts to move material between stations and from the factory to the warehouse. Bart asked, "How long does it take from the time a part is finished here [end of production] until it gets to the warehouse?" A worker answered, "It depends. We always push the carts to the warehouse at the end of the day." Bart replied, "Take my stop watch and time how long it takes to walk to the warehouse. Then come and tell me." The employee returned.

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"One minute and 10 seconds." "Good, that's how long I want it to take each part to take to get to the warehouse," Bart instructed.

What was Bart going to do without the distributors? Well, he had two weeks to think about it. The distributors produced almost no orders in the first two weeks of the month anyway.

Thursday was inventory day. Here was a real culture. A culture focused on reducing costs. Ed, the head of the warehouse group explains how they hold orders for a single shop to cut shipping costs. Sometimes, orders were held for days (never longer than a week) to try and get as many items together in one box. Ed's people are proud of their efficiency. Changing this culture would have to wait. How was Bart going to recover from the over stocks in some products and catch up on backorders. "Ed, how accurate is your inventory?" A fair but delicate question for warehouse people. "Well, it's not perfect." Bart teaches, "I want to know if you have ANY of the items we have on back order. I don't care what the computer says. I want to know if we have any. That's all. And another question. You're the expert here. I want you to tell me everything we have in stock that exceeds an average one week supply. Can you do that for me?" Sure Ed can. What warehouse guy couldn't? He can see the piles and he knows what's on backorder.

Friday, Ed visits Bart and reports on the physical search. "We discovered quite a few items that had been back ordered and were misplaced in the warehouse. Don't worry. They are already shipped out. Also, here is a short list of overstock items." Bart compliments Ed on following instructions. Before Ed can leave, Bart calls in Ben, the production scheduler. "Ben, from now on, you schedule production according to what Ed tells you. Ed, I want you to build a one-week inventory for every product we sell and then only order what you ship. What you ship on Monday, you tell Ben to build on Tuesday. Got it?" Got it? Wow! What power! Ed was elevated from the lowly warehouse manager to controller of the whole production line! "Oh, and Ed, I want you to ship every day. Ship every order you have the day you get it. No waiting." No waiting? This would destroy his efficiency measures. What kind of a boss was this new Bart?

Nice end to the week. Production has an idea of what to do. All of the suppliers received a little money. Hopefully, they will respond next week to our urgent requests for raw material and parts. Factory sales are still messed up. Bart asks the factory sales people (in Big City) to call a few shops and offer discount prices on the overstock products selling them one at a time. They are to promise overnight delivery to the shops as well. But, shipping and scheduling really don't know what they have been asked to do. Things are on shaky ground. Nevertheless, they shipped more products this week than in any week in the previous two months.

Case study documented by James R. Holt
Washington State University, Vancouver

3

Bart returns to Chicago for a week to arrange for the family to move to Big City. A week later, Bart is back in the Plant.

Monday of the third week in July. Good news! Raw materials were beginning to come in. Not all, but a good variety. With two more weeks of distributors' wages, they were starting to catch up on past due bills. Production is in chaos. All the changes in the past four months are taking their toll. Some people just can't adjust to Drum-Buffer-Rope. The inefficiency of so many people is against all their training. Ed, in the warehouse, is catching on. But, Ben doesn't cooperate very well at scheduling. How can Ben schedule as many as 60 different products per day? It's outrageous!

In the afternoon, Bart meets with the Big City salesman. He wants to hear how the shop owners responded to calls from the factory. The response is good. That is, after the salespeople apologized for poor service in the past. They were able to move almost all the excess inventory. "But, the price of overnight shipping was high!" Bart replied, "For \$1.5 million per year, I can ship a lot of overnight packages."

Then, Bart instructed the in-factory sales reps to call every shop owner and tell them there were no distributors any more. Tell them they can order any item they want directly from the factory any time they want. Just fax the order to the 800 number and the product will be delivered the next day. There are no quantity discounts any more, but they have ninety days to pay. And, if they want to send back any undamaged item any time, they can and PAS will pay the shipping.

Tuesday starts the training for the plant. First, 10 key people for the first two-day class on the Production Simulator. Most start to understand. During the second two-day class, a few from the first class try to get the production line under control. There is still a lot to learn.

At the end of the day Friday, production made new record for the quarter. But, there are problems.

Monday of the last week in July. The factory sales reps report average sales for last week. That is, average for the third week of the month, without the distributors. The shop owners were responsive but not enthusiastic yet. But, there are still problems.

More training this week for production. At least one supervisor is helping do the training now. Three trouble makers are just too much for the new supervisor trainer. The trouble makers just don't seem to get it. Bart invites them in one at a time.

Premier Audio Systems Inc.
Big City, Arizona

It's Just NOT FAIR!

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Washington State University, Vancouver

"Bernie, I know you've worked here for years and you're very proud of your achievements. You are a good person and you try really hard. I'm new here and am trying to change the way we run the line. It's obvious I'm not going to change you. And you're not going to change me. I'll be glad to write you the best recommendation you have ever received. Something like, 'Bernie is an efficiency expert! He dedicated all his actions to balancing our production line and keeping every machine as efficient as possible.'" Bernie accepted the recommendation, as did the two others. They all went to the competition. "That should keep the competition behind for at least two years," chided Bart.

Tuesday's report shows the suppliers are coming through but are sporadic. Their quality is no better than before. Bart instructs, "Over the next two weeks, I want you to find a second supplier for every one of our raw material parts. Set up a grading system for each supplier, reporting on their delivery and quality. Give the better supplier 60% of our orders and the other supplier 40%. Give them the grade report for themselves and their competitor. Tell them the best vendor will get 60% of our business. Follow up with new grade reports each month."

Case study documented by James R. Holt
Washington State University, Vancouver

4

Wednesday, its engineering's turn. "Our products are ugly," Bart complains. "They look like mufflers." The engineers try to justify their 'stealth design' as anti theft. "No dice. The people who buy our systems do so as a status symbol. They lift the trunk and point to 'a muffler'. They stick our decal in their window. If a thief wants it, he'll find it, black or yellow. Can't you do something to make it look better on the shelf?" Turns out, they still have a 15th anniversary power amp in chrome plated 'muffler'. "That's good enough for now. I want every 'muffler' chrome plated. Now, priority one is for all of you to go down to Performance Sound and spend the day. All of you watch the technician there install our systems and our competitors. Spend two days. Then, come back and redesign our system so it installs in one hour not three to eight. Tell me when you're done. Don't do anything else until you're done. Got it?"

The rest of the week proceeded in its normal chaotic manner.

Monday, the first week in August 1998, the President comes to visit. "Bart, I see you had a great week last week! I looked at the records and we shipped more than any week on record. Orders increased and we shipped them right away. Congratulations!" "Hey, I rode in a 34 foot HumVee Limo yesterday. They had our sound system," Bart interjects. "Yes, I heard about it. I also heard you gave them the \$10,000 system." "Yes," Bart replies, "and it sounded great. It was so good the couple in the limo stopped the driver on Cruiser Blvd, opened the doors and started to dance in the street. Other cars soon stopped and started dancing with them! It's hard to believe \$2000 of raw materials can make such a big, quality sound. Oh, the limo company liked it so much, they ordered 30 more \$10,000 systems and they will pay the full price." "On the contrary, there is a near unlimited demand for the right system delivered in the right way. Do you know how many limos there are in the USA? There are 514 in Big City alone."

"Well, Bart, I actually came to talk to you about your 'no payment for 90 days' offer to the shops. We can't carry the shops for 90 days. That will kill us. This one \$300,000 sale is good but we can't expect to get any more of those."

"You're worried about the 90 days. I say the shops need it. We treated the shops so bad for so long.... These are Mom and Pop stores. They can't afford major investments. And if these shop owners are not happy with us, who'll buy the record number of products we'll make this week?"

Actually, there's a lot more to this offer. Our customers can't afford to carry our entire product line, so they only carry a few items, just like they do with our competitors' products. Shelf display space is at a premium and it's a big fight to get more display space. To get the 90 days, our customers must agree to dedicate shelf space to display our full line of our products. Their customers will see our full line of products and be

Case study documented by James R. Holt
Washington State University, Vancouver

less likely to mix and match products with our competitors. Also, since we have the biggest display in the store and our competitors' shelf space is squeezed smaller, it means our competitors are at a distinct disadvantage. As sales of our products increases, the shop owners are thrilled and will push our products even more."

"Bart, how can they afford to do this since they're already struggling with the inventory we and our competitors are shoving at them?" "Remember, we're not forcing them to buy lots of everything, just to carry one of everything. Since they can't afford to pay for this up front, we give them 90 days. We had a 30 day policy before. The books show most shops were 10 to 30 days late anyway. Now they feel that we're more customer oriented. Now, back to the inventory issue. If a unit is sold sooner than the ninety days, they have to pay for it immediately. How do we know when they sold it? They immediately order a replacement unit for the display because they know the display sells. They know that the replacement product will be there the next day, since we take orders by fax and provide overnight delivery, and they only have to carry one or two extra units of just the fast movers to keep the display as complete as possible.

There's another big advantage that none of our competitors will have. We know the actual demand for our products as it happens. Remember, I told production to only build today what we sold yesterday! Now, just like our customers, we don't have to carry lots of finished goods of every item. Just a few of the slow movers, and more of the fast movers. Just think of the excess finished goods inventory we have because of large forecast errors. Now our forecasting is just for planning replenishment of raw materials so we can build what we need as we need it. This is a great deal for both us and our customers."

"Besides, we've got two months before we have to worry any way." "Two months? Bart how do we have two months? You're shipping record orders today with no money coming in for 90 days." Bart explains, "We just started this offer last week. For the next two months, we will have the same income from the shops as in the past. In two months, we'll have our suppliers all paid current. And if we need to, we have a 30 day deal with our suppliers and that should hold us for the full 90 days. No matter. Our shops will be so pleased with our display offer, they won't be waiting 90 days to pay."

The rest of the week was one normal emergency after another. Except for Friday. Friday, the engineers came in with their QuicInstal System. In a little over a week, they redesigned wire harnesses and had bought some special connectors and worked with production on the changes. They would be shipping the new QuicInstal Systems at the end of next week complete with beautiful installation instructions (even though they are not needed). Several suppliers are scrambling to get a steady supply of the new connectors. "That's good," compliments Bart. "Now you're ready for your next priority. We don't have any products for the low-end market. We're top quality audio. But there is a big market where young guys just want BOOM. I've seen the competition's speakers

Premier Audio Systems Inc.
Big City, Arizona

It's Just NOT FAIR!

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Washington State University, Vancouver

and they move about 3/4th an inch. I want you to make some speakers that really boom. We want the biggest boom in the business. See what you can do. When you finish, come back and see me. Don't do anything else. Got it?

Monday again. Orders set another record. This time, at the first of the month. Suppliers are delivering better and with fewer problems.

Friday, the engineers bring in their speaker contraption and stack it on a table. There are wires everywhere. "Boy that's ugly," says Bart. But, the prototype boomer performs. The speaker moves 3 inches! That is, until it booms itself right off the table. "Approved! Order anything you need to produce it. Maximum budget \$100,000! Next priority. In two months is the Consumer Products Show in Las Vegas. I want the most beautiful, best sounding display booth that has ever existed. I want to display all our products in their best light (acoustic light). I want to see it and hear it in three weeks. Can you do it? And, don't do anything else. Understand?"

Case study documented by James R. Holt
Washington State University, Vancouver

5

Two more record weeks go by. The record orders of raw materials are costing much more than the revenue that is coming in. Bart begins to worry. How can he turn off such a successful sales campaign just as it begins? But, he must do something. Otherwise, it's 'death by cash flow.' The president visits. Bart is ready to cut back on sales calls to slow the orders. "Bart, I've checked and in the last two weeks, we shipped more than we have ever shipped in any month before." "Yes. But now I must say you were right. We are record-shipping ourselves into a cash flow hole." "Bart, you just keep up those orders. Bankers like record shipments and love to give short term loans on Due-In receipts."

TOC education continues in production. Work in process is drastically reduced. The average time from raw materials to finished goods is 42 minutes. Production flow and finished inventory levels are very stable. Still, Bart holds the inventory level at the level established two months ago (with very little changes) but now it is only two days supply of finished goods, not a week.

It's October 1998. Throughput rates are nearly triple the previous standards, almost \$2 million in gross sales. Suppliers are top quality and never late. PAS's products are literally pushing the competition products off the shelves. The people in the plant love the magic of TOC. Efficiencies have never been so high. They still depend a lot on Bart the magician. That will have to change.

The President visits, smiling. "Bart, I paid off two loans and I'm told every supplier is paid the day they deliver. We get preferential treatment from every supplier. Now to the point. Bart, I came to talk to you about goals. You have done well for the short term, but I want it to continue. At today's rate, we are at \$24 million per year but profits are not high. If you can get us to \$40 million per year by Dec '99 AND be above 10% profit, I'll buy you a new house--\$250,000 clear and free. And to sweeten the pot, I'll buy you any car you want under \$40,000. And, soon, we need to talk stock options."

Bart accepts the challenge. He is at first afraid to tell the President of his plan to be at \$60 million by July with no more people--somewhere near 50% profit. Guess he will have to sit down with the staff and show the plan. Bart jots down the outline: Accept \$40 million in July 1999 (the President's target), \$80 million in two years, \$160 million in three. He will include several of his marketing ideas to catch the vision and help the management team to know that more magic is just logical, common sense. Bart quietly decides to hold out for a \$300,000 house. He needs it for all his kids. Should be no problem. Profits will hit 20% by December and will be increasing after that.

Engineering demonstrates their high tech/audio extravaganza display for the Consumer Products Show two weeks before the show. It doesn't work as well as expected. And,

Case study documented by James R. Holt
Washington State University, Vancouver

some of the products are not there. No worry, the engineers buffered themselves for these contingencies. They have plenty of time to fix the minor points. "Next priority," says Bart. I want you to integrate our products together into one mega entertainment center: Tuner, Amp, multi CD changer, Car Phone, DVD, Global Positioning, Alarm System, Computer, 110 Volt AC Outlets and any thing else you can think of. I want this thing full of artificial intelligence. Not only does it know the driver's favorite songs from any of the CDs, it reminds you to buy gas and change the oil. If anyone tries to steal any part of this system, it silently phones the police and constantly tells them the exact location of the car. Got it? You know not to work on anything else. You will come and tell me your plan on how to do this next week. Right?"

The Las Vegas Consumer Products Show was the first week of January 1999. They rented a 50X50 space (HUGE) and built the most beautiful display. It looked like a \$500,000 set-up (the creative engineers and craftsmen built it at nearly \$150,000). The CFO about choked. The CFO nearly disapproved the money. Previously, they had attended this show and had a small booth for presence only. Nothing good ever came from it. Well, this time, Bart took his folks all dressed up in matching blazers, slacks, ties. They had everyone convinced they were a huge company. They also took as much excess inventory as they could carry. Over the three days, they sold all the products they took and took orders for more. Sales and orders totaled \$600,000. Not bad for three days.

If you went to the last APICS Constraints Management Conference in Big City, you could have toured the plant to see for yourself. But it might surprise you. TOC plants are boring. Nothing seems to be happening EXCEPT AT THE CONSTRAINT where there is a flurry of activity. They are on a three minute cycle. They use egg timers for the Rope. Put in a product, turn the timer. When the sand is gone, put in the next product.

Another fine touch. Bart has the best engineers in the market. His PhD electrical engineer did his dissertation on D-Class audio amplifiers. Bart went to him, "John, when people go to 'Total Audio' and talk to the purple haired salesman, he suggests our amp, someone else's pre-amp, some strange speakers and our competitors balance panel. When people go down the street to 'Power Audio', the spiked-hair guy suggests someone else's amp, our speakers and one other strange combination. Both salesmen claim they are giving the customer 'the best sound possible.' Is that true? The challenge was clear. John was not going to let high school drop-outs upstage all his work. John is now in the process of developing minor changes to their product to make it clear to the buyer exactly why they should buy the total system from Premier Audio Systems Inc. if they want 'the best sound possible.'

Bart is right, "**It's just not fair**" to the competition for a Jonah-Jonah to run the company."

Case study documented by James R. Holt
Washington State University, Vancouver

6 Several interesting occurrences since the first writing of this case.

In March of 1999, the two banks that carry Premier Audio Systems' credit lines merged. The resulting larger bank reviewed the two credit lines and said they should only have one and the size should be the size of only one of the credit lines. Murphy hits. Premier Audio Systems' cash was just cut in half. For two weeks, they could not buy any materials. This occurred just as they had trimmed down their inventory and developed Just-in-Time delivery and payment. This stopped production for nearly two weeks. Amazingly, the plant prepared for when the money would be available. That month, they produced almost the same as the previous month. Amazing.

Premier Audio Systems contracted with an outside service to insert parts on the circuit boards and solder them. The quality and mass capacity of the outside firm could produce better boards at much less cost than the in-house people. No in-house people were laid off.

By the Spring of 1999, Premier Audio Systems was producing about 300% of its previous capacity. The sales people, however, had not learned how to take advantage of the tremendous improvement. To sell the high volumes, the salesmen were reducing their prices. Much of the margin gained by increasing capacity with the same resources was eaten away by reduced prices. Still, Premier Audio Systems was more profitable than ever before.

Case study documented by James R. Holt
Washington State University, Vancouver

7 Epilogue

In the Summer of 1999, the absentee owner noticed the tremendous change in Premier Audio Systems and the huge profit potential. He was overheard by an employee to remark "Finally, I've got it right!" He sold three other businesses he owned (that were all losing money) and returned to Premier Audio Systems to manage it himself. The "new" president noticed the excess capacity in the plant and laid off about half the people. This included letting the president go. "Who in their right mind would offer a new house to an employee as an incentive?" Obviously, the owner withdrew the president's offer for the incentive house and car. He also moved Bart from 'employee' status to 'consultant' status. The remaining employees were very worried about the future of the plant. The actual future is yet to be seen.

Bart Penrod is now available for more challenging work.

8 The Future Unfolds

In the summer of 2004, curiosity got the best of me and I looked up the real company on the internet. They have moved from Arizona to Southern California.

This product review by a customer was very revealing. He had a problem with his old, high quality product and had it fixed at the factory. *"Luckily this was back when PAS was still its own company and they were built right here in Big City". "The new model PAS' suck, the name PAS has been bought and sold a lot recently and they are no longer even the original company."*

Another website carried this banner regarding PAS products. *"We regret to inform you this line is currently unavailable!"*

A wise man learns from others mistakes. While there are silver bullets, don't forget to gain the cooperation and understanding of others about the changes to be made.

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Notes:

- 1) This case was embellished a bit to show the methods used with the Throughput-Operating Strategy, but the facts are accurate as far as I could ascertain.
- 2) Chuck Gauthier visited Bart at PAS. Bart showed him all the fun he was having and explained his display offer. This was finally added to the case study in 2004.

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Big City, Arizona

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[Minor editing by Skip Reedy, sanitization and the 'display offer' added by Chuck Gauthier]