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The Economics of Sharing Inventories

by

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1 Introduction

The system presently used by General Motors does not provide service parts to its dealers at the right time and at the right price. The inventory management policies and the physical facilities are not designed to have parts at the place they are needed and at a cost that is competitive. This system requires both GM and its dealers to carry too much inventory. The PDCs are very expensive to operate; furthermore, they do not provide the service dealers require. Presently, many projects are underway to improve this system's performance. These initiatives will improve operational effectiveness and will reduce cost; however, even when implemented, these initiatives will not result in a competitive system. Important factors that cause the system to perform inadequately—both operationally and financially—are not being addressed. The pattern of customer demand drives the entire system's operation. Yet, the nature of this demand process is not considered properly in either the current or the revised GM and dealer inventory management systems. The policies and supporting infrastructure used throughout the system must be revised substantially for GM to be the industry leader in the service parts segment of its business.

Our primary goal in writing this paper is to describe the fundamental characteristics that GM's system must possess for it to compete effectively. We will first discuss the logical flaws found in the current system. Second, we will propose an alternative system design that meets the needs of both GM and its dealers. Finally, we will demonstrate why this proposed system will provide much better customer service and will reduce inventory investments for both GM and its dealers. We believe that the principles, upon which the proposed alternative is based, must be implemented for GMSPO to achieve its goals.

2 The Demand Data

One reason the present system is both costly and ineffective in providing high fill rates is related to the nature of the demand process for parts. By examining the aggregate 1995 demand data for electrical and mechanical parts, we see a very fundamental reason for the present difficulties. Basically, these data show that for the vast majority of parts it is virtually impossible to determine when and where a part will be required. Hence it is unlikely that dealers will have the right parts in their inventory to meet their customers' needs immediately without increasing their inventory investment to levels that are prohibitively high.

Two key factors affecting stock levels at a location are unit costs and demand rates. Table 1 was constructed using invoice data for the electrical and mechanical parts shipped in 1995. The columns represent a range of annual unit sales; the rows represent ranges of GM unit costs for various parts. The entries in the table for a particular row and column combination indicate the number of parts that have the corresponding unit cost and annual demand rate. For example, the data show that there are 43 part numbers whose unit cost is approximately $2 (row) and whose 1995 dealer demands totalled about 8500 units (column).

The data show a number of interesting and important facts. Out of the 155,860 electrical and mechanical part numbers, 47,782 had no activity last year. That is, about 31% of the parts had no demand; another 71,989 had less than 100 demands per year. Thus about 77% of the parts had either no demands or an average demand of less than .01 units per dealer last year. Only 1604 part numbers had an average demand of 1 or more units per dealer in 1995. Therefore, only about 1% of parts had, on average, 1 demand or more per dealer.

Thus one might conclude that by stocking just these parts we could achieve very high service levels. In fact, these higher demand rate parts account for only about 38% of the

Distribution of Mechanical/Electrical Parts

Number by Cost by Volume

$/unit	1E+05	95000	85000	75000	65000	55000	45000	35000	25000	15000	9500	8500	7500	6500	5500	4500	3500	2500	1500	950	850	750	650	550	450	350	250	150	95	85	75	65	55	45	35	25	15	5	0	non-0	all
2100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	51	4	55
1750	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	72	481	73	554
1250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	72	253	76	329
900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	45	178	51	229
750	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	7	7	64	113	89	202
650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	2	4	0	0	0	1	1	0	0	7	7	64	113	89	202
550	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	1	2	4	6	5	3	9	2	2	3	5	2	4	8	10	22	119	204	211	415
450	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	0	2	2	7	2	0	7	0	2	5	4	9	25	189	388	259	647
350	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3	0	5	11	32	7	8	8	11	17	14	27	45	78	10	9	5	24	22	26	35	39	58	233	341	727	1068
250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	2	1	2	5	5	8	10	26	45	8	11	13	11	19	33	30	53	87	550	922	927	1849
150	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	1	2	11	33	8	9	16	11	15	29	53	70	157	25	36	48	58	78	83	127	205	404	2174	3831	3657	7488
90	0	0	0	0	0	0	0	0	2	2	1	1	2	1	1	8	10	15	48	11	15	13	19	29	36	84	80	166	25	29	26	52	76	65	111	172	311	1072	1424	2465	3889
72.5	0	0	0	0	0	0	0	0	0	1	0	1	1	1	4	4	10	14	31	9	9	10	8	12	19	45	49	123	24	24	38	42	33	54	58	128	209	804	1211	1761	2972
57.5	0	0	0	0	0	0	1	1	3	2	1	2	3	4	11	6	17	33	82	20	17	35	24	46	47	88	119	248	30	65	42	69	78	100	124	155	327	1102	1533	2902	4435
42.5	0	1	1	0	2	1	1	6	9	26	7	7	14	24	22	40	47	107	173	36	33	36	51	71	94	110	170	375	60	78	74	93	116	145	198	282	428	1464	2511	4402	6913
30	0	0	0	1	1	1	0	0	11	25	8	9	8	15	13	26	45	53	105	25	49	43	67	79	91	147	233	465	63	67	96	110	128	144	167	267	443	1226	3263	4309	7572
22.5	0	0	0	1	0	0	1	4	3	10	7	7	4	6	7	12	28	55	169	36	32	33	41	75	73	97	182	341	52	84	68	83	102	118	139	201	305	981	1767	3351	5118
17.5	1	0	1	0	1	1	1	3	5	18	4	7	6	13	15	29	45	91	227	33	38	60	80	73	137	188	320	638	116	109	150	128	167	228	284	445	676	1789	2111	6127	8238
12.5	10	3	1	1	2	4	4	9	18	50	21	17	15	13	30	38	64	110	286	58	54	92	102	127	182	271	405	797	147	162	216	242	241	313	373	549	906	2635	3109	8568	11677
7.5	3	1	2	1	4	3	7	8	13	90	25	28	33	48	59	90	134	211	619	96	120	168	183	272	363	505	750	1428	256	271	285	339	412	530	674	918	1531	4401	4846	14882	19728
4	8	1	0	1	1	6	4	9	36	88	13	24	32	42	65	52	111	151	493	89	95	115	171	198	345	382	524	1041	151	153	207	228	238	334	412	497	959	2534	3095	9680	12775
2	35	2	5	5	8	8	14	23	50	134	23	43	53	86	77	115	194	349	828	149	186	223	233	377	415	535	980	1782	291	317	388	474	548	711	894	1236	2100	6265	6631	20236	26867
0.75	12	1	1	3	3	6	5	14	23	65	16	13	19	28	38	54	80	130	306	63	65	93	103	131	192	207	374	681	139	114	123	200	243	293	381	541	902	2497	3460	8139	11599
0.4	27	2	3	3	9	6	8	21	32	69	20	14	21	16	26	43	64	128	249	46	41	53	77	88	105	148	235	418	77	87	92	130	158	178	245	376	622	1500	2257	5437	7694
0.2	18	5	6	8	3	5	16	23	28	81	10	20	25	33	42	54	80	148	332	60	63	73	89	115	130	205	281	654	105	114	131	158	218	271	365	521	1014	1982	3133	7466	10599
0.05	3	1	2	0	1	4	4	4	9	39	8	5	11	10	19	31	40	66	125	13	21	28	38	31	43	70	99	177	29	28	38	42	78	66	113	121	248	607	442	2268	2710
	117	17	22	24	35	45	66	126	242	682	160	198	247	323	423	603	976	1686	4247	758	858	1104	1314	1766	2230	3259	4949	9614	1812	1740	2049	2489	2980	3702	4743	6732	11592	34370	47782	108078	155860
demands	1E+07	2E+06	2E+06	2E+06	2E+06	2E+06	3E+06	4E+06	6E+06	1E+07	2E+06	2E+06	2E+06	2E+06	2E+06	3E+06	3E+06	4E+06	6E+06	7E+05	7E+05	8E+05	9E+05	1E+06	1E+06	1E+06	1E+06	1E+06	2E+05	1E+05	2E+05	2E+05	2E+05	2E+05	2E+05	2E+05	2E+05	2E+05			
dir stock	117	17	22	24	35	45	66	124	228	624	138	184	194	195	202	182	184	214	125	tot:	2900																				
dir satisf	1E+07	2E+06	2E+06	2E+06	2E+06	2E+06	3E+06	4E+06	6E+06	9E+06	1E+06	1E+06	1E+06	1E+06	1E+06	8E+05	6E+05	5E+05	2E+05																						
hub stoc	117	17	22	24	35	45	66	126	242	682	160	198	247	321	418	590	939	1599	4012	682	715	905	998	1212	1130	1285	989	1249	134	28											
hub satis	1E+07	2E+06	2E+06	2E+06	2E+06	2E+06	3E+06	4E+06	6E+06	1E+07	2E+06	2E+06	2E+06	2E+06	2E+06	3E+06	3E+06	4E+06	6E+06	6E+05	6E+05	7E+05	6E+05	7E+05	5E+05	4E+05	2E+05	2E+05	12730	2380											
total dir s	5E+07		tot hub satisfy		8E+07																																				
tot dmd	8E+07																																								
dir fill rat	0.648		hub fill rate		0.919																																				

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Table 1

dollar sales and 59% of the unit sales. The lower demand rate parts in total account for most of the dollar sales, although a smaller fraction of the units that are sold. Furthermore, the 1604 parts account for only about 18% of the dollar investment in these electrical/mechanical parts. That more than 80% of GM's investment is in the lowest demand rate parts results from several factors. Obviously there is a belief that most of these parts will experience some demand in the future. Consequently, some inventory will be needed. But where, when and if demands will occur is clearly not known for almost all of the part numbers. Forecasting which parts will likely have high aggregate demand rates may not be too difficult; however, it is not easy to determine accurately how much will be demanded by each dealer. Estimating requirements by dealer or PDC region for almost all parts appears to be difficult to do with a high degree of accuracy. Given the high GM inventory levels for low demand items—about 1/2 of the investment is in items having less than 1000 system wide demands per year—it is reasonable to conclude that demand forecasts were over-stated for many items.

Simply put, the lesson is that the inventory management problem is extremely complex and cannot be solved using the conventional approaches used today. The data provide a valuable insight into why the system is so difficult to control. Demand occurs in substantial quantities for a relatively small number of part numbers. But, there are also many units needed to satisfy demand for low demand rate parts. Parts having demand rates of .01 units or less per dealer in 1995 had a total sales of about 1.8 million units. Obviously, individual dealers cannot stock these very low demand rate parts; even items that are not too costly and have an expected annual demand of one or two units are not likely to be stocked by a dealer. If a dealer is unable to justify stocking almost all part numbers and these part numbers, in aggregate, account for about 30% of the dealer's demand, then it is impossible to ever get high fill rates directly from a dealer's own inventory!

3 Some Observations Concerning the Current System

Dealers compensate for their relatively low off-the-shelf fill rates by getting stock from a variety of sources. They frequently purchase stock from other dealers, typically from larger dealers that run profitable parts businesses. They may buy non-GM parts from some other source. In some cases they remove parts from other cars on their lot and reorder the parts. If they are unable to obtain the part on the day it is requested, they get it from GM through some emergency replenishment. In any case, dealers have found ways to meet their needs. However, even with all the methods used, same-day dealer fill rates are generally well below 90%. It is highly likely that more than 25% of the repair orders requiring more than one electrical or mechanical part will not be satisfied on the day the repair is initiated.

Satisfying much more than about 90% of demand within a few hours is very unlikely to occur in the current dealer-GM supply structure, except in very few regions. It is highly unlikely to ever occur nationwide. But, it is possible to achieve 90-92% same day fill-rates if a highly coordinated system is employed. It is also likely to get extremely high fill rates within 24 hours. To do so requires PDC processes to be radically changed. Premium transportation must be used in many situations, too.

4 Computation of Stock Levels

One of the impediments to achieving high fill rates within a region is the algorithm used to calculate inventory levels. Typically dealers require a part to have a specified number of demands within a period of time before they will consider stocking it. Lower demand rate parts can frequently move on-to and off-of stocking lists. (A study performed for the Air Force found that 38% of the repairable items stocked at a base moved on-to and/or off-of the stocking list in a two year period when using this type of rule).

Furthermore, different dealers servicing similar types of cars will probably have demands for many of the same part types. Consequently, they will all stock similar parts. Different dealers may have had varying experience with lower demand rate parts and therefore one may stock some parts not stocked by others. This occurs frequently. Thus in some instances dealers can help each other out in emergencies.

The point, however, is the following: dealers will tend to stock the same range of parts. Only if some dealer believes a business opportunity exists for selling to other dealers or to independent garages will he stock beyond the range or depth of parts needed to meet the dealership's own needs. When this happens the system provides better service. That this occurs is a fortuitous and not a planned event.

Even if a more sophisticated mathematical approach is used to compute dealer, PDC and Parts Plant stocks, it is again unlikely that the right decisions will be made. Mathematical approaches, such as those developed by R.G. Brown (which are imbedded in some GM processes), have as a goal the minimization of the cost of achieving a given system fill rate, or some other performance measure. While this may seem appropriate, it isn't.

The data used to make the stocking decision at all locations are similar. High demand rate items are high demand rate items at all locations; low cost items are low cost items everywhere as well. To achieve the best service levels for a given investment at a location will tend to produce similar stock lists at all locations. The trade-off curves look similar. Consequently, there is a significant duplication of safety stocks across levels of the supply chain. However, the higher a location is in the supply chain, the higher the demand rates will be. Therefore more items will naturally be stocked at these locations. Thus the range of stock tends to increase the higher the location is in the supply chain. But, the stock level calculations are not designed to coordinate the range and depth of stock at each level of the system. Hence stocks are unnecessarily high for some items and too low for others.

5 Two Key Principles of Inventory Management

There are two key principles that should be followed when managing inventories in multi-location systems. First, the majority of the system safety stock for an item should be carried at only one level of the supply chain. Second, there should be as few stocking locations as possible at each level in the system. As the number of locations goes up, so does the safety stock. Cycle stocks usually go up as well. We will illustrate these ideas subsequently. Remember, the present methods do not coordinate decisions across levels or between stocking locations within a level. This results in higher investment levels and lower service levels.

6 An Alternative System

Our observations all lead to the conclusion that an alternative method for operating the system could reduce inventory levels for both GM and its dealers. We will first describe the elements of such an alternative system and then illustrate how investment in stock and customer service would change.

The basic structure of the alternative system would look like the present one. There would be Parts Plants that would process parts on demand and send them to PDCs, which would order parts in lot sizes. The PDCs would then ship parts on request to dealers either to replenish their stocks or to satisfy their emergency demand. The way information is generated and shared in the proposed system and the number and function of each location, however, are very different from those found in the present system.

First, we do not need as many PDCs as exist today. For illustrative purposes, suppose there are only 5 geographically dispersed locations which perform functions similar to those found in the present PDCs. In addition, Lansing would exist as the stocking location for the very slow-moving parts. Consistent with the key principles, Lansing would carry both cycle and safety stock for a broad range of items that would not be stocked at any other location.

The 5 PDCs would each be responsible for supplying approximately 1700 dealers in their respective regions. The dealers in each region would be further divided into resupply clusters. The number of dealers in each cluster would depend on the geography, the highway system, and travel times. For the sake of discussion, let us assume that there are about 100 dealers in each cluster. One PDC would provide the inventory to each of its 17 "facing clusters."

The inventory stocking policy at each PDC is presently based on what is called installation stock, which measures the amount of inventory on-hand and on-order less backorders at the PDC. In the proposed alternative system, inventory stocking policy will include that installation stock plus all installation stocks held by dealers in facing clusters, including shipments enroute to these dealers. The decision to order at a PDC will be based on this entire stock, which is called the PDCs echelon stock. Furthermore, decisions to ship inventories to a particular facing cluster will be based on its relative need, the amount of PDC stock available at the time, the future anticipated demand on that stock by other facing clusters, and the arrival time of any resupply stocks to the PDC.

Rather than picking by dealer, the PDC will pick and ship regular replenishments to facing cluster break-bulk points. Thus the bulk of a PDCs shipping and picking requirements will be made to only 17 locations. Emergency shipments for inventories may be made directly to a dealer, although it would likely also be sent to the corresponding facing cluster's break-bulk point.

For the PDC to order based on its echelon stock, an accurate up-to-date record of inventory transactions at each dealer will be needed. Thus as parts are consumed (sold), the inventory record at a dealer would be adjusted. At the end of a day, or at some other pre-specified time during the day, inventory transaction records from all facing dealers would be transmitted to the appropriate PDC. Then, based on the resultant inventory level, the PDC would place orders as required.

The proposed system requires a very different information system. Information would become extremely valuable since it could be used throughout the supply chain to forecast demand for parts and to smooth workloads through time.

Second, we assume a different structure in each facing cluster. As indicated, one or more locations in each cluster will receive replenishment inventories. These locations, called break-bulk points, would be used to send inventory to the proper places within the cluster. A key to the system's operation is that all inventory stocked by the 100 dealers would logically be jointly held by all dealers. The inventory would be a virtual inventory. Allocation to each dealer would be made based on actual consumption; prepositioning of stocks at most dealers would largely exist in relatively small amounts to meet demands in the near future. Large amounts of stocks would exist only for low cost, higher demand rate parts. Each part would have a primary stocking location in the cluster. Safety stocks for the cluster would be held at this location for the part. Replenishment to the cluster would depend on the cluster's total virtual stock for a part. Thus the ordering policy is based on the cluster's virtual inventory rather than on dealer installation stocks. Furthermore, the order quantity will be based on cluster economics rather than on dealer economics.

Shipments of material between dealers within a cluster would be triggered by an actual need for the part which is not on-hand at the dealer or by the requirement to replenish the dealers stock. Thus a logistics system would exist within the cluster to facilitate the timely flow of material so that all material within the cluster could be made available within a few hours to any other dealer in the cluster.

To make this system work, dealers must work together, share information, share inventories, and share some infrastructure costs for handling and transporting material. In return they would have immediate access—within a few hours—to a much greater pool of stock and would have a much lower investment in inventory. This would occur because both cluster cycle and safety stocks would be reduced.

The range of stock each dealer would carry would not be too great. However, the range of cluster stock would be much broader than any dealer would carry. The depth of cluster stock would be less than the total amount currently carried by all the dealers for many items. The reduction in the depth of stock for these parts allows investments to be made in a broader range of stock for the cluster. Given short lead times, the value of cluster stocks will not be prohibitively high.

Overall, the setting of stock levels for parts should be coordinated between all facing clusters and the corresponding PDC. The majority of the safety stock should be held at only one level of the system. If an item is planned for stocking at the cluster level, safety stock should primarily be held there. Cluster stocks will be allocated by the PDC to meet service performance targets. On some occasions when demands are unusually large, reallocation of stock among clusters will occur.

If an item is stocked primarily at the PDC, then the safety stock will be largely held there. This would occur for most low demand rate items.

A diagram describing the system's operation is given in Figure 1.

7 Illustrations

In the previous section we outlined the essential elements of an alternative structure that differed in several important ways from the present one. Throughout we conjectured that inventory investments could be lowered and service levels raised in this proposed system. We will now illustrate why this will occur using data for the electrical/mechanical parts.

Let us first illustrate why having fewer PDCs reduces both cycle and safety stocks. Consider one of the 90 parts that has an average cost of \$7.50 and an annual system demand rate of 15,000 units. A PDC would have an averge demand of 1000 units per year, assuming demand is spread equally among the PDCs. If the PDC fixed order cost is \$10 and the

MATERIAL FLOWS IN ALTERNATIVE SYSTEM

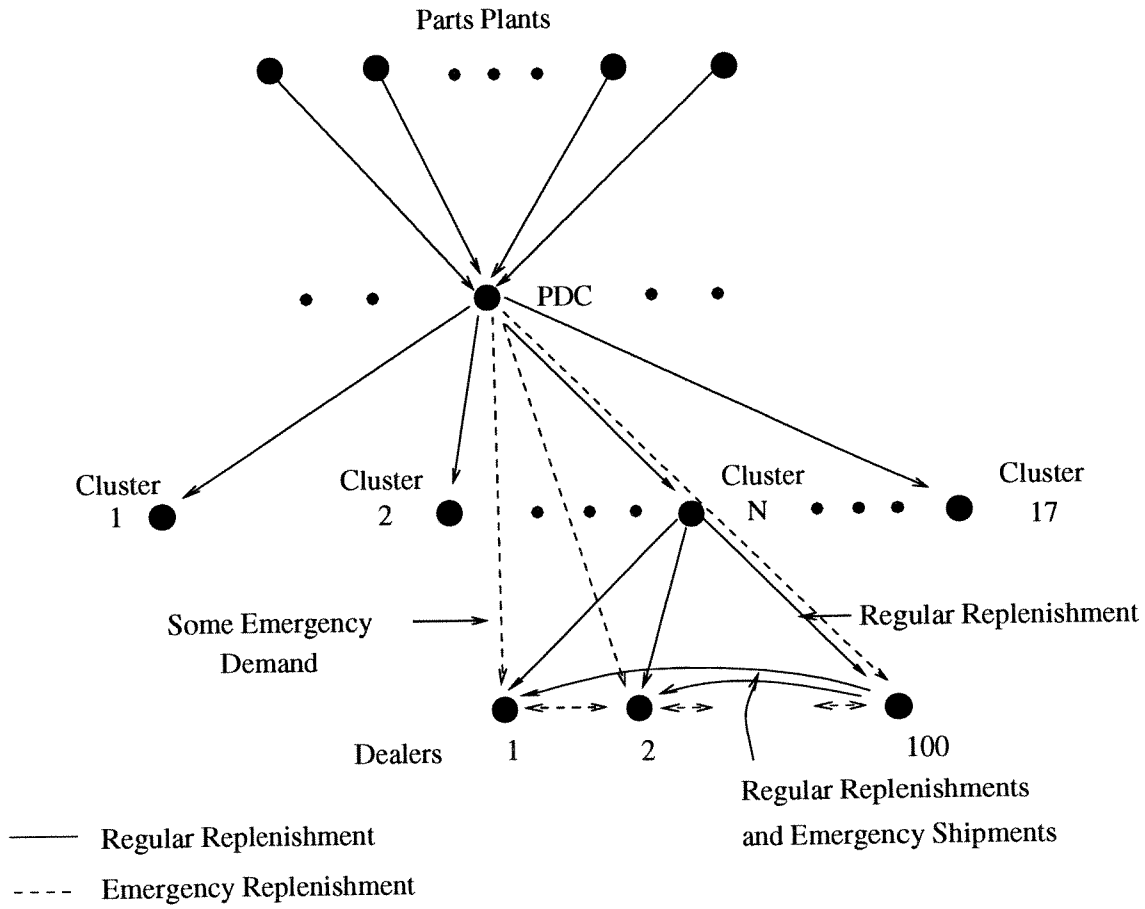

Figure 1

holding cost rate is \$.30 per dollar held for a year, then the lot size at each of the 15 PDCs would be

$$Q = \sqrt{\frac{2 \times 1000 \times 10}{(.3) \times (7.50)}} = 94 \text{ units}$$

and the average cycle stock would be $\frac{Q}{2} = 47$ units. Hence the average cycle stock would be $15 \times 47 = 705$ units for all PDCs.

Now suppose there are only 5 PDCs so that the annual average PDC demand rate would be 3000 units. Then

$$Q = \sqrt{\frac{2 \times 3000 \times 10}{(.3) \times (7.50)}} = 163 \text{ units}$$

is the lot size per PDC and the average cycle stock would be 81.5 units at each PDC for a total of $5 \times 81.5 = 408$ units. Thus average cycle stock would be only about 58% of that required in the 15 PDC system.

Likewise, the safety stock requirements would drop. Suppose, for example, that the PDC replenishment time is 20 days, or 1/12th of a year. Then the expected demand over a lead time would be $1000 \times \frac{1}{12} = 83.3$ units. (In the past, GM has assumed that demand follows a specific probability distribution called the Poisson distribution. Assuming this is the case, the standard deviation of demand over a lead time is 9.13 units.) If the goal is to not run out of stock during a cycle with a probability of .95, then the system safety stock is $15 \times 9.13 \times 1.64 = 225$ units.

If there are only 5 PDCs, then the expected lead time demand is 250 units and the standard deviation of demand is 15.8. Then the safety stock would be $5 \times 1.64 \times 15.8 = 130$ units, a reduction of 95 units.

Since there are 90 parts in this category, there would be a reduction of $90 \times (705 - 408) + 90 \times 95 = 35280$ units of stock, or a reduction of $264,600 in average inventory investment. Obviously, similar results would hold for other parts as well.

Let us now see how dealer stocks would be affected by the change. Using the system data on mega dealers (those with more than $4 million in annual sales), large dealers (those with more than $1 million but less than $4 million in annual sales), standard dealers (those with $200,000 to $1,000,000 in annual sales) and small dealers (the rest) we would have 1 mega dealer among the 100 dealers in a cluster, 9 large dealers, 65 standard dealers and 25 small dealers. Using the same example item examined earlier, this group of dealers would expect $15,000 \times \frac{100}{8,500} = 176$ demands in a year, assuming there are 8,500 dealers in the system. Each

small, standard, large and mega dealer would expect .33, 1.65, 5.52 and 11 units demanded per year, respectively. Assume the fixed ordering cost is $2 and a lead time is 3 days. Then the small dealers would not stock the item; the standard dealers would stock the item (one unit); the large dealers would have a lot size of 3 units and a safety stock of 1 unit for an average on-hand stock of 2.5 units; and the mega dealer would have a lot size of 4 units and a safety stock of 1 unit. Then, on average the system would have about 90.5 units of stock on-hand. This set of stock levels will provide a fill rate of approximately .95, assuming no sharing of stock.

Now suppose there is just one virtual inventory. Then the lot size would be 18 units and the average cycle stock would be 9 units of stock. The expected demand during a lead time would be 2.2 units. The safety stock would be less than 1 unit to achieve an approximate system fill rate of .96. This is about a 90% reduction in stock.

If sharing occurred in the original system, a fill rate of well over 99% would be achieved. A 99.9% fill rate in the alternative system would be achieved with a safety stock of 2 units.

Another important question could be raised. How many items would be stocked in this cluster to achieve a given fill rate? We have roughly approximated this quantity if the fill rate target is .90. Again refer to Table 1. For items carried in inventory, assume stock levels are set to achieve a 99% fill rate. Then if we stock the items in the cells below and to the left of the right most line in the table, we will achieve an average cluster fill rate of about .90. This requires 19,145 different parts to be stocked. Calculating an "average dealers" stocking list would require the dealer to carry 2900 different items (those below the left diagonal line) from which the dealer would achieve only about a 65% off the shelf fill rate. The rest of the stock needed by a dealer to achieve the 90% fill rate would come from the cluster's pooled, virtual stock. We have not attempted to find an optimal pooled stock; but, it is apparent that without a significant amount of pooling a dealer cannot expect to achieve a high service

level unless a very large amount of stock is carried. The cost effective way to carry this stock is through the pooling of inventory, that is through the creation of a virtual inventory.

8 Summary

The current PDC and dealer inventory management system is seriously flawed. As the demand data indicate, it is not possible for dealers to add inventories to improve their customer service. To achieve 90-92% off-the-shelf fill rates from dealer stock for the electrical and mechanical parts would require dealers to increase their aggregate investment in inventory by billions of dollars. Clearly, this is not a reasonable alternative.

To achieve the goal of better service while reducing inventories requires a different inventory management system and a totally redesigned PDC system. The key principles of inventory management should form the intellectual foundation for design of the new system. The alternative system we described is based on these principles. This system addresses the fundamental flaws found in the current one.

In our description of this alternative system, we hypothesized that there would be 5 PDCs. The number 5 was used only for illustrative purposes. The optimal number could be either greater than or less than 5. However, we believe the optimal number is much smaller than 15. Fewer PDCs will be better. Although the size of the new PDCs would increase, they can operate efficiently and effectively. They must be organized and managed in ways that differ significantly from the ones used today.

In our illustration we assumed 100 dealers per cluster. This number was chosen simply to demonstrate the operational characteristics of our proposed system. The goal in our discussion was to show how the cluster concept would operate and why it is superior to the system in place presently. The optimal number of dealers will vary by cluster depending on a large number of factors.

We believe that the concepts we have presented, which are based on the principles of coordination and communication, will provide better service at lower cost. We believe it is possible for GM to reduce inventory investment by more than 30%. Dealer inventories could be reduced by even a greater amount. At the same time, we believe it will be possible to improve same-day fill rates to well above 90%. Using these ideas, GM will have the right part at the right place at the right time at the right price.