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NOVA INCORPORATED: A-CASE
THE REBIRTH OF AN INTERNATIONAL CORPORATION

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NOVA INCORPORATED: The Rebirth of an International Corporation

Nova (*nō′və*) n., A variable star that suddenly increases in brightness to several times its original intensity.

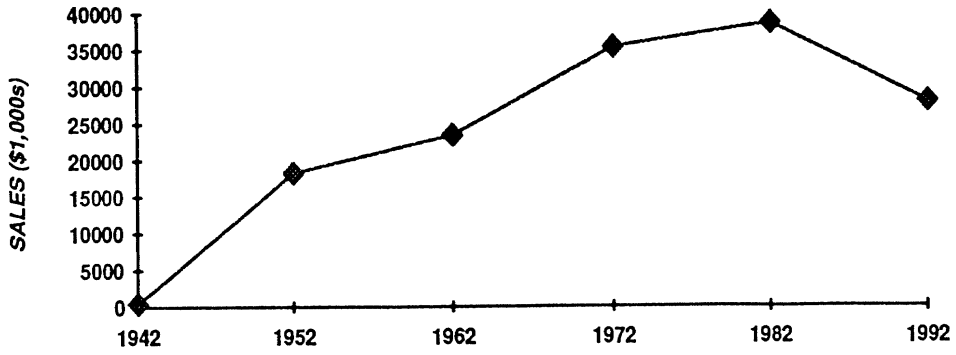
The word "nova" seemed to describe this corporation that had grown out of a radical reorganization of American Products Incorporated (API) in the early 1990s. The new corporate name had been selected by John Fisher, Nova's president and CEO, to highlight the goals he set for the company in 1990 and to focus organizational attention on the magnitude of the task before them. When Fisher arrived at API in September 1989, he found a company teetering on its laurels. The incumbent management could see from the steady erosion of their financial statements that something fundamental was wrong at API; but, none of the corrective actions that they had taken over the past five years had produced the desired effects. Fisher reflected upon that period:

> "For nearly fifty years, American Products had been the acknowledged market leader. They offered a 'Cadillac' product and commanded a premium price in the market. In the 1950's, 60's and 70's they owned a virtual money machine. But then slowly, almost imperceptibly, customers needs began to shift, service expectations grew and lower priced competitors closed the quality gap. By the time that I arrived in 1989, American was offering a 'me too' product line in an industry that had 50 percent excess capacity. I decided that the only way to rejuvenate our product offerings was to 'blowup' the company as we knew it. The solution to API problems would not be found in the modest attempts of the past five years to marginally improve product quality, time to market, and cost structure. API's management needed to rethink fundamentally who they were, what they sold and what their customers ***really*** valued. I was convinced that in order to survive, we would have to improve operating performance by at least an order of magnitude. Not only the product line, but also the operating procedures, organizational structure and management philosophy of API would have to be challenged. We needed to reinvent American Products if it were going to remain a viable industry player in the 21st century. I chose the new corporate name of ***Nova*** to symbolize the nature of the journey before us."

Company History

American Products Incorporated was founded in New York City in 1942 as the first manufacturer of widgets in the United States. It has remained the market leader until the early 1980s. As shown in Figure 1, the 1942 sales of $500,000 grew to nearly $40 million by 1982. As product demand had grown, API expanded capacity, first adding equipment to their New York facility and then opening additional plants in Cincinnati (1955), London (1956), Milan (1964), Sao Paulo (1969) and Taiwan (1973).

TABLE 1.
GROSS REVENUES



International operations began with direct sales to a few select customers in Europe in the late 1940's, and blossomed in 1954, when a British expatriate (wanting to return home) proposed opening a London sales office. Eventually a manufacturing facility and distribution center were established outside London in 1956. A second European factory was added in Milan in 1964 and a distribution center was opened in Frankfurt in 1969.

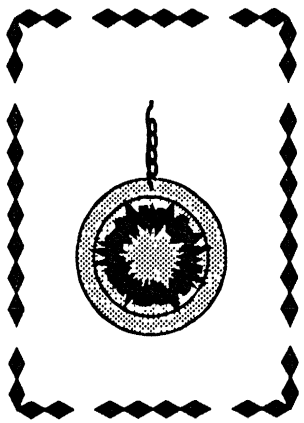
Expansion into South America was likewise serendipitous. Spiguel Manufacturing, a family owned Brazilian company, approached API in 1963 with a request to license the API product line. Spiguel had a well-developed distributor network in South America and a partnership arrangement with a large distributor in Mexico. API viewed their offer to be a low risk opportunity to gather market intelligence in an important emerging market. The original patent licensing agreement evolved over the years into a wholly owned subsidiary with a warehouse and manufacturing facility in Sao Paulo and sales offices located in Monterey and Santiago.

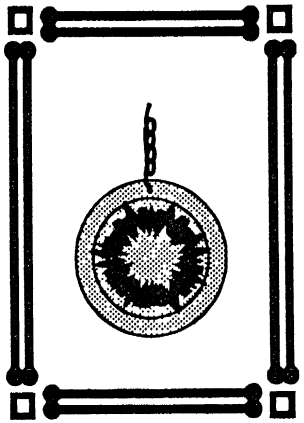
Finally, the Asia Pacific operations were begun as an experiment after API had decided to move the New York manufacturing operations to Cincinnati in 1970. They took this opportunity to make a major capital investment in new manufacturing equipment. After the move was completed successfully, the old equipment had little salvage value and was shipped to Taiwan for an "experiment" in low labor cost, off-shore production. The initial results were disastrous. Poor supplier quality, high process scrap rates and long and unreliable lead times nearly sank the operation. In time, however, the supplier and process problems were largely resolved, and a local market for variations of the API product line grew. Eventually API settled into a strategy for using the Taiwan facility largely to supply the Asia Pacific market. In times of need, however, there was an agreement among all plants and distribution centers to support each other "as practical" and with "fair compensation." In practice, this was easier said than done. With differences in tax codes, fluctuations in exchange rates, and the lack of a meaningful market price, the setting of "fair" transfer prices was problematic within API.

The Widget Product Line

The ten widget assemblies in Nova's 1993 product line are illustrated in Figure 1. Their component parts are shown in Figure 2. Each widget consists of one or two base "jewels" that are assembled to support one, two or three action "stars." Depending upon its application, an

THE NOVA PRODUCT LINE


PRODUCT 1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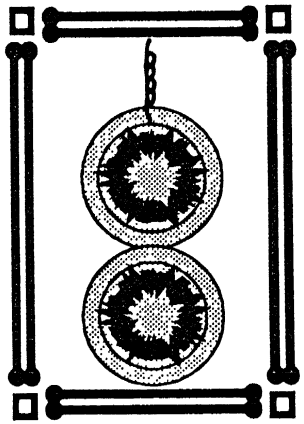
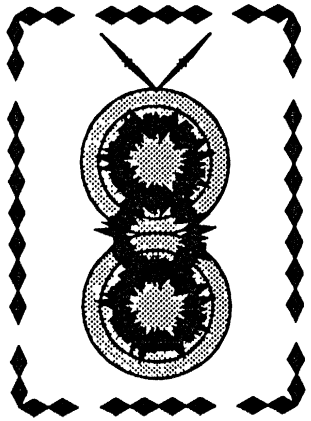

PRODUCT 3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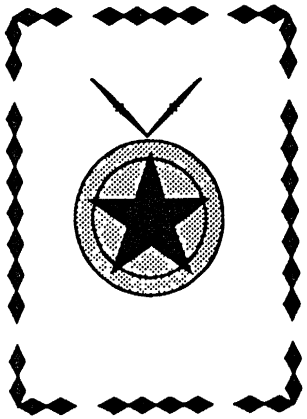
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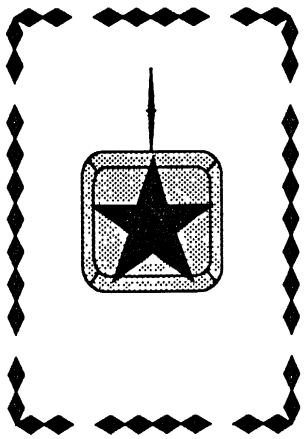
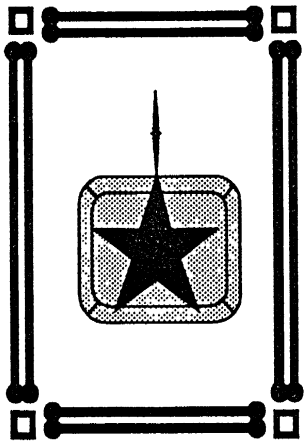
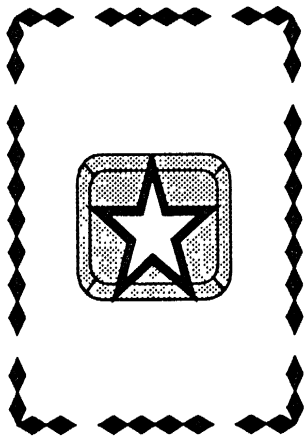
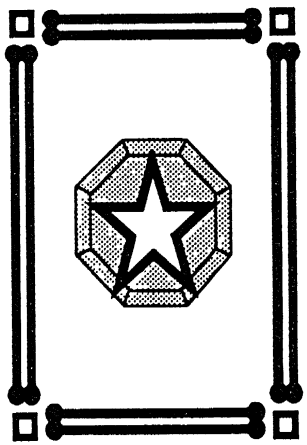

PRODUCT 6


PRODUCT 7


PRODUCT 8


PRODUCT 9

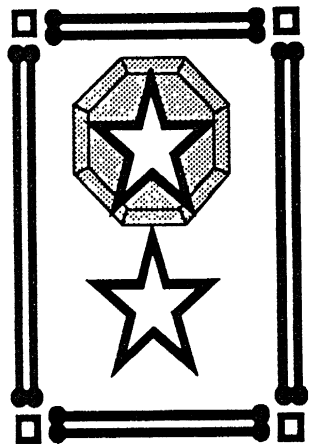
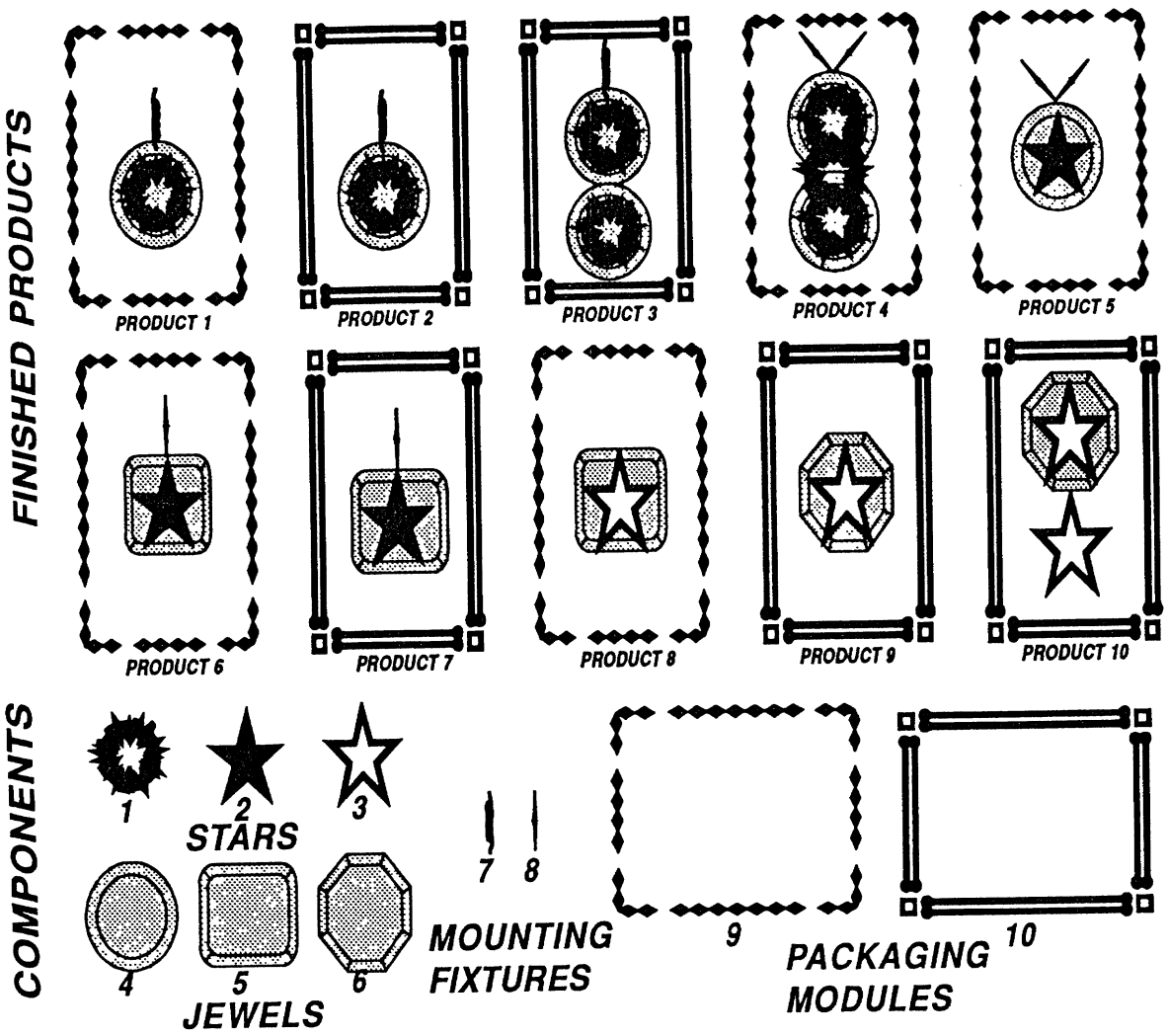

PRODUCT 10

Figure 1

THE NOVA BILL OF MATERIALS



	COMPONENT NUMBER									
PART NUMBER	1	2	3	4	5	6	7	8	9	10
1	1	0	0	1	0	0	1	0	1	0
2	1	0	0	1	0	0	1	0	0	1
3	2	0	0	2	0	0	1	0	0	1
4	3	0	0	2	0	0	0	2	1	0
5	0	1	0	1	0	0	0	2	1	0
6	0	1	0	0	1	0	0	1	1	0
7	0	1	0	0	1	0	0	1	0	1
8	0	0	1	0	1	0	0	0	1	0
9	0	0	1	0	0	1	0	0	0	1
10	0	0	2	0	0	1	0	0	0	1

Figure 2.

assembly may require up to two mounting fixtures; once tested, the assembly is protected in a packaging module.

The manufacturing cost of a widget assembly ranges from $350 to $850 per unit. While the profit margin varies by product and depends heavily upon the intensity of competition in a particular sales region, the selling price of an assembly ranged from $460 to $930 in 1993, and averaged $700. Tables 2 and 3 summarize current prices and historical demand in each of the five sales regions in which Nova currently operates.

Table 2
Current Retail Price List ($)

	1	2	3	4	5	6	7	8	9	10
North American	460	470	585	660	660	650	750	725	750	N/A
Europe	480	495	600	640	650	720	740	750	740	N/A
Eastern Bloc	495	560	620	655	700	710	750	760	745	815
South America	525	600	640	680	720	745	770	780	740	850
Asian Pacific	610	685	750	790	800	800	805	830	785	930

Table 3
Average Demand Rate per Day for the Past Year (units)

	1	2	3	4	5	6	7	8	9	10
North American	35.7	19.3	3.1	5.9	1.1	0.6	0.3	0.2	0.1	0.0
Europe	23.2	14.9	4.2	3.6	4.2	2.3	0.9	0.1	0.1	0.0
Eastern Bloc	17.3	11.2	4.4	3.0	3.1	1.3	0.8	0.2	0.2	0.1
South America	11.5	7.8	5.1	3.1	1.1	2.9	1.8	1.0	0.5	0.3
Asian Pacific	3.4	2.3	7.5	1.3	0.7	1.3	3.3	2.2	1.3	0.9

A New Management Philosophy

When Fisher arrived at API in September 1989, he initiated a revitalization process he named "Born Again." His message to the organization was simple: API's organizational structure, operating policies and management control processes were exactly the right ones for the company when they were designed in the 1950s. They were, however, the wrong ones for this company in the 1990s. During the past 40 years, improvements in country infrastructures, emergence of global competitors, and advances in materials, process and information technologies have changed the rules of business competition. API would have to adapt quickly, or it would die!

Adaptation to Fisher meant a return to basics. API had to reestablish itself as the premier manufacturer and supplier of widgets on a worldwide basis. First and foremost, this meant a commitment to "best-in-class" service to the customers in their chosen market segment; API would then have to become the "best-cost-producer" of that service. Best-in-class in this industry meant fast, reliable delivery of defect free products at a competitive price. Best-cost-producer implied tight control over material, labor and equipment costs, and the elimination of all non-value-added operations and expenses from the company.

Fisher knew that API would need to reduce its customer lead time (see Figure 3) by (1) shortening its own manufacturing lead time, (2) improving coordination with customers and suppliers, and (3) redesigning its warehousing and distribution system. Improvement in these areas would require significant investment in equipment and process technology, and it would also require the commitment of API's management and workforce. Fisher believed that changes of the magnitude that he envisioned could not be dictated by a headquarters staff; renaissance would only arise with a renewal of individual responsibility fostered by employee involvement, team empowerment, and business unit entrepreneurship. The role of the corporate headquarters, he felt, was to provide competent people with clear objectives, the right tools, and sufficient time and resources; they then had to get out of the way.

Fisher started taking actions almost immediately. He first instituted an employee involvement program to learn what the organization itself knew about the current problems and to surface suggestions for improving the situation. To deal with the flood of proposals that this elicited, he organized eight internationally staffed, inter-functional and multilevel "task forces" to study revitalization initiatives ranging from labor relations and supplier partnerships to factory modernization and Six-Sigma quality. By the end of the year, he had eliminated 40% of his corporate staff, closed two of APIs six manufacturing plants, and commissioned a study by Caterpillar Logistics Systems to evaluate the outsourcing of API's distribution function. Finally, to emphasize his commitment to fundamental changes, he announced the new corporate name of **Nova** on January 1, 1990.

By mid- 1990, a revitalized Nova management had actually come to believe that the industry wide "problem" with product delivery was actually an opportunity for Nova to reestablish itself in the market place. Management reasoned that if they could guarantee customers fast product availability and consistently deliver on that promise, then they might recapture market share or command a premium price, or both. With this strategic objective in mind, they set off to "re-engineer" their manufacturing and distribution operations. Rallying around the banners of "Worldclass Customer Service" and "Total Quality Management," they began experimenting with electronic data interchange (EDI) with customers, just-in-time (JIT) delivery scheduling from suppliers, and pull manufacturing of small lot sizes driven by KANBANs in focused factories. Some changes were accomplished quickly; others were taking forever; some were easy; and, others were painful.

The Velocity Initiative: Focusing Activity with Purpose

Up until 1990, each API factory produced all products and was re-supplied independently by their own collection of local vendors. Factory operations were scheduled by a material requirements planning (MRP) system using a six-month demand forecast. Lot sizes were determined using economic order quantity (EOQ) logic, and production runs of 2 to 6 months of supply were typical. While flow time through the factory was normally measured in weeks, a "hot" job could move through in a day or two under the watchful eye of a plant expediter. These experienced "fire fighters" met weekly with plant management to decide how best to react to marketing's current list of hot orders, those to be given "special priority" in order to gain or hold a key account.

The operating impact of this "customer focus" within the plants was disastrous. When planning weekly production, frequently a third or more of the orders were behind schedule. As the production controller rushed these past-due jobs to completion, in-process jobs were

COMPONENTS OF LEAD TIME

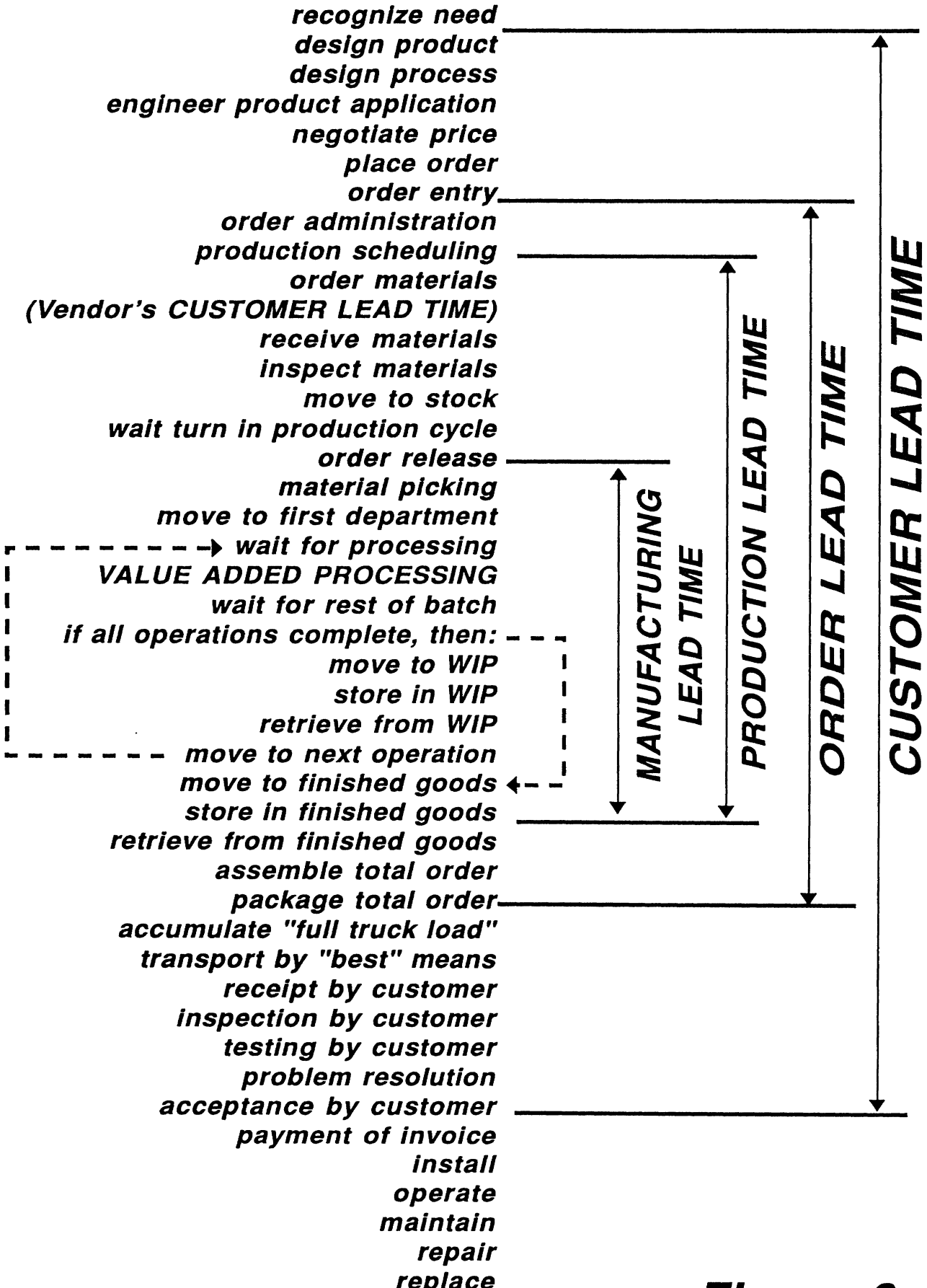


Figure 3.

interrupted, which then made them late as well. Multiple setups for a single job were common. Weeks of work-in-process inventory accumulated in the factory aisles. Overtime costs ran at 12% even though the factory operated at 70% of its theoretical capacity. In 1989, API held 107 days of finished goods inventory and absorbed $250,000 in express transportation charges. Yet, customer service, as measured by order fill rate at the 13 regional sales locations, was only 60%. Furthermore, 3% of API's shipments were being returned by customers as defective. Sales representatives spent more time resolving product complaints than they did booking new orders; there were more clerks dealing with credit adjustments than there were posting invoice payments.

Fisher, reflecting on this early period, observed, "API was full of dedicated people who were knocking themselves out to do the best job they could for the customer. They were working hard, they were working fast, they were working long hours. They just weren't working very smart. I realized that to focus the organization's energy, I needed to provide a clear vision for the corporation to strive toward. It was as much to tell them what they should ***not*** do at all as it was to tell them what they had to do perfectly. In physics when you add a direction to raw speed you get ***Velocity***. So that's what I decided to call our re-engineering initiative." Fisher subdivided the Velocity project into three primary task force initiatives: marketing, manufacturing, and distribution.

A Focused Marketing Strategy

First, Fisher turned to the marketing system, forcing his management team to define Nova's marketing strategy clearly. For the first time in years, they wrestled seriously with some basic questions, "who are Nova's customers, what is important to them, what are they currently buying from us, what does it cost us to provide them with these products, which of our products are the most profitable, what is the total cost to our customers of purchasing and using our products, what might current or potential customers buy from us if we could deliver our products reliably, and what prices might they be willing to pay for these products and services?"

A customer market survey and an Activity Based Costing (ABC) study were commissioned to provide facts as a basis for critical decisions to be made by the marketing task force. The ABC study was designed to get a handle on the sizable allocation of "overhead" expense that appeared in API's income statements. Overhead had grown from a modest 8% in 1950 to nearly 40% in 1989. The study documented the significant inventory holding and transportation costs required to support many of the low volume parts in API's product line. Once expenses were directly assigned to specific products, it became painfully clear exactly what it cost to keep some "small volume, but very profitable" products in the API catalog. Similarly, the considerable expenses associated with regional management of suppliers and local purchase of raw materials became obvious for the first time. With specific assignment of charges to products and operational decisions, the need to allocate overhead was materially reduced.

The market survey of current and potential customers concluded that Nova was unlikely to gain market share through price reductions because competitors would simply be forced to match them. It found, however, that customers were very sensitive to improvements in product quality and delivery reliability. And if improvement in these dimensions could be achieved, they would be difficult for competitors to duplicate.

The recommendation that eventually emerged from the marketing task force was a plan to prune the product line to 10 products by dropping 12 low volume parts that constituted just 5% of total sales. (A detailed analysis showed that the key customers affected by the cuts could be serviced with premium products at an "adjusted" price. The analysis suggested that if this change were applied to last year's operations, API would have freed up 20% of its manufacturing capacity and would have *increased* net profits by 30%.) The task force proposed that Nova hold current prices on the modified product line and guarantee that defect free product would be shipped FOB from regional warehouses to any customer location on 24 hour notice with an average fill rate of 99%. They felt that if manufacturing and distribution could deliver on the marketing guarantee, Nova could quickly reacquire the market share that API had lost over the past 12 years. Fisher embraced the task force proposal, making it a corporate goal for 1992.

With a specific marketing plan established, the manufacturing and distribution task forces focused on how to support it operationally. They wanted to know what facility, equipment and tooling would be required; what level and timing of investments were implied; what information systems were needed; where inventories would be kept, at what levels they would be stocked, and how they would be resupplied.

A Rapid Response Manufacturing System

Nova had ample worldwide capacity in 1990 to meet forecast market requirements. It was not obvious, however, exactly how that capacity should be allocated to provide the promised customer service in the most efficient way. The manufacturing task force believed in principle that efficient and reliable production capability was best achieved by:

(1) focusing each factory on a limited portion of the product line,
(2) providing each factory with appropriate and well-maintained equipment,
(3) placing factories on predictable cyclic production schedules,
(4) providing them with adequate visibility of upcoming delivery requirements, and
(5) loading them with achievable production requirements.

Continuous improvement within the factory could then be achieved by:

(1) organizing its workforce into teams,
(2) charging them with responsibility for product quality, and
(3) empowering the team to make process changes as they saw fit within their workcell.

After a detailed analysis of factory capacity and customer demand forecasts, the task force proposed closing two of Nova's four factories. The remaining plants in Cincinnati and London would be modernized and all production would be consolidated into these facilities. Needed investment included new equipment for bottleneck operations, added tooling and fixtures to speed machine setup, overhaul of existing machines to improve their reliability, and improved inspection with new test equipment to assure the shipment of defect free products. The manufacturing goal was to assure sufficient capacity so that any customer order received at a factory by 8:00 am would be shipped that day. Eventually, Products 1, 2, 3, 6, 8 and 9 were assigned to production in Cincinnati, while Products 1, 2, 4, 5, 7 and 10 were manufactured in London. Both plants currently run a single 480 minute shift with the opportunity for as much as 120 minutes of overtime when required. Production and yield rates are summarized in Table 5. Transfer prices in US dollars for the products available at each location are given in Table 6. Current and forecast exchange rates are given in Table 7.

Table 5
Finished Product Production and Yield Rates

Cincinnati	1	2	3	4	5	6	7	8	9	10
Set up Time (min)	5	5	12	15	15	15	16	15	15	17
Run Time (min/piece)	2.9	3.1	3.1	4.7	5.2	3.4	5.4	3.7	4.0	6.7
Scrap Rate (scrap/piece)	0.01	0.01	0.02	0.02	0.05	0.04	0.05	0.04	0.04	0.05

London	1	2	3	4	5	6	7	8	9	10
Set up Time (min)	25	25	30	30	30	30	33	30	30	35
Run Time (min/piece)	2.8	3.0	4.6	3.2	3.5	4.9	3.6	5.5	6.0	4.5
Scrap Rate (scrap/piece)	0.02	0.02	0.03	0.02	0.05	0.05	0.05	0.05	0.05	0.06

Table 6
Transfer Prices for Finished Products ($)

	1	2	3	4	5	6	7	8	9	10
Cincinnati	365	383	479			476		550	628	
London	355	372		551	471		488			856

Table 7
Current Exchange Rates and Projected Inflation by Region

	U.S. Dollar	Europe Deutschemark	East Europe Zloty(10,000)	S America Cruzeiro(10,000)	Asia Pacific Yen (100)
Exchange in U.S. Dollars	1.00	1.62	1.50	1.17	1.23
Inflation Rate	5%	11%	20%	2,300%	6%

A key to success of the new manufacturing strategy was a lean production system in which little inventory was maintained. Inventory reduction was important for two reasons. First, for product to move through the factories in a single shift, the production lot itself had to be small

and its flow could not be blocked by some other large job ahead of it. Second, new capital could not be made available to support the Velocity initiatives, so funding for investments would have to come from reductions in inventories or other working capital. Fortunately, at least from this perspective, the 107 days of inventory which existed within Nova's logistics chain in 1989 could support the most ambitious of investment programs. "Twenty Days Is Enough" became the goal for a joint effort between the manufacturing and distribution task forces to reduce inventories.

Getting Control Over Inventories

In 1989 there was a total of $10.6 million invested in raw materials, work-in-process and finished goods inventories. Initiatives emerged to reduce each. First, a "vendor partnership" program was instituted to reduce the cost of raw materials, which existed in four forms: **cycle stocks** resulting from "economic" order quantities calculated to reduce both the transaction costs and the exposure to stockout that occurred with each order; **safety stocks** maintained to protect against variations in raw material quality, vendor delivery lead time, and customer demand during this lead time; **anticipation stocks** ordered either to support a projected surge in product demand or to hedge against raw material price increases; and **pipeline stocks** which "flow in transit" between the time that material is picked by the supplier and available for use in the plants.

Nova decided to strike exclusive and long term purchase contracts with suppliers who were willing to work with them to find opportunities to reduce Nova's material cost. Eventually, the number of vendors was cut from twenty-three to five. Those who remained agreed to a price reduction program for 1991-1993. In addition, they agreed to ship materials in smaller lots, with higher frequency and shorter lead times than they had historically. They now do this. Table 8 provides current raw material prices for each supplier; and Table 9 provides demand statistics for each component over the past year. Historical transportation times and costs both in and out of the factories are shown in Table 10.

Table 8
Raw Material Price List ($)

	Component Number									
Supplier	1	2	3	4	5	6	7	8	9	10
ACME	49.46	61.23	81.67	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lyon	51.03	N/A	N/A	18.06	23.35	30.53	6.28	N/A	N/A	N/A
Polski	50.24	N/A	80.07	18.65	24.25	31.71	6.53	8.16	N/A	N/A
Bianca	N/A	N/A	N/A	17.27	22.45	29.36	N/A	N/A	7.85	8.64
Sumi	51.34	63.68	84.87	19.00	24.70	32.29	6.59	8.49	8.56	9.41

Table 9
Daily Component Demand for the Past Year

Component Number	North America		Europe	
	Average	Stdev	Average	Stdev
1	125.95	41.98	121.77	40.59
2	17.26	5.75	8.36	2.79
3	2.50	0.83	6.83	2.28
4	118.94	39.65	121.77	40.59
5	6.49	2.16	12.67	4.22
6	1.25	0.42	0.00	0.00
7	72.61	24.20	97.34	32.45
8	63.59	21.20	8.36	2.79
9	72.17	24.06	59.96	19.99
10	36.73	12.24	52.57	17.52

Table 10
Transportation Price List & Delivery Lead Time

			Cincinnati			London		
			Cost ($/box)	Min Time (days)	Max Time (days)	Cost ($/box)	Min Time (days)	Max Time (days)
FROM	ACME	(regular)	50	2	5	75	3	7
		(expedite)	75	1	2	150	2	3
	Bianca	(regular)	100	4	8	150	4	8
		(expedite)	150	2	3	210	2	3
	Lyon	(regular)	110	3	7	45	2	4
		(expedite)	170	2	3	70	1	2
	Polski	(regular)	145	4	8	90	2	6
		(expedite)	250	3	4	200	1	2
	Sumi	(regular)	165	6	9	170	3	6
		(expedite)	250	2	3	270	2	3
TO	N Amer	(regular)	50	2	5	75	3	7
		(expedite)	75	1	2	150	2	3
	S Amer	(regular)	100	4	8	150	4	8
		(expedite)	150	2	3	210	2	3
	Europe	(regular)	110	3	7	45	2	4
		(expedite)	170	2	3	70	1	2
	E Bloc	(regular)	145	4	8	90	2	6
		(expedite)	250	3	4	200	1	2
	Asia Pac	(regular)	165	6	9	170	3	6
		(expedite)	250	2	3	270	2	3

Work-in-process inventories at the plants were reduced through smaller lot sizes. While reluctant at first, factory management agreed to an experiment with a modified version of Just-in-Time manufacturing. Starting in January of 1991 they began producing no more than two weeks of supply for any high volume product and no more than four weeks supply of anything else. This dramatically cut inventories in the plant and flow time through it, but simultaneously increased the number of machine setups, which in turn reduced the time available for production. Recently, lot sizes had been reduced once more and nearly all of the factory's reserve manufacturing capacity had been consumed. Production control has warned management that either more equipment and operators or a second shift would be needed to run the factory reliably in the future .

A Fast Flow Distribution System

Opportunities to reduce finished goods inventories emerged from the distribution task force. They proposed a redesign of the central warehousing facilities in Cincinnati and London, and a consolidation of the 13 regional warehousing locations to the 5 shown in Figure 4. New warehouse layouts were designed to reduce the time required to receive and store materials. Automatic equipment for picking high volume products and for assembling and packaging customer orders was acquired. And these machines together with new picking, packing and shipping procedures were expected to speed the flow of orders to the regions, while improving shipment accuracy (from .8 errors per 100 units picked to 1 per 10,000 units).

The consolidation and automation efforts were projected to reduce the system-wide fixed costs for distribution by a factor of 4, while allowing more frequent shipments of parts to each of the remaining regional locations. Automation was expected to compress distribution center space requirements to permit the consolidation of order processing without a need to expand the two central distribution facilities.

Roadway Express, Nova's transportation carrier, had approached several regional managers with an offer to provide them with access to information on shipments moving between the plants and the distribution centers. Furthermore, if London and Cincinnati were willing to cooperate, the regions could receive up to date information on inventories in the plants themselves - all for the cost of a personal computer and some modest telecommunications charges. Such an EDI (electronic data interchange) system between the plants and Nova's warehouses and suppliers, could cut one to four days out of the historical customer order cycle when fully operational. Moreover, a combined picking/packing/information system would allow orders to be shipped from a regional distribution center on the day they were received, and by the next day at noon from the plants. The half day delay in Cincinnati and London would allow manufacturing time, if needed, to produce low volume parts which were not stocked on a regular basis. The task force believed that the consolidation would not only reduce finished goods inventory (in cycle stock, safety stock and pipeline stock), but would simultaneously cut operating expenses and increase customer service levels.

A New Manufacturing Control System

The combined objectives of lower inventories, more rapid customer response and higher order fill rates required changes to Nova's manufacturing system. A new production system was designed to operate on a recurring one week cycle in which every part could be built at least

THE 1993 NOVA LOGISTICS CHAIN

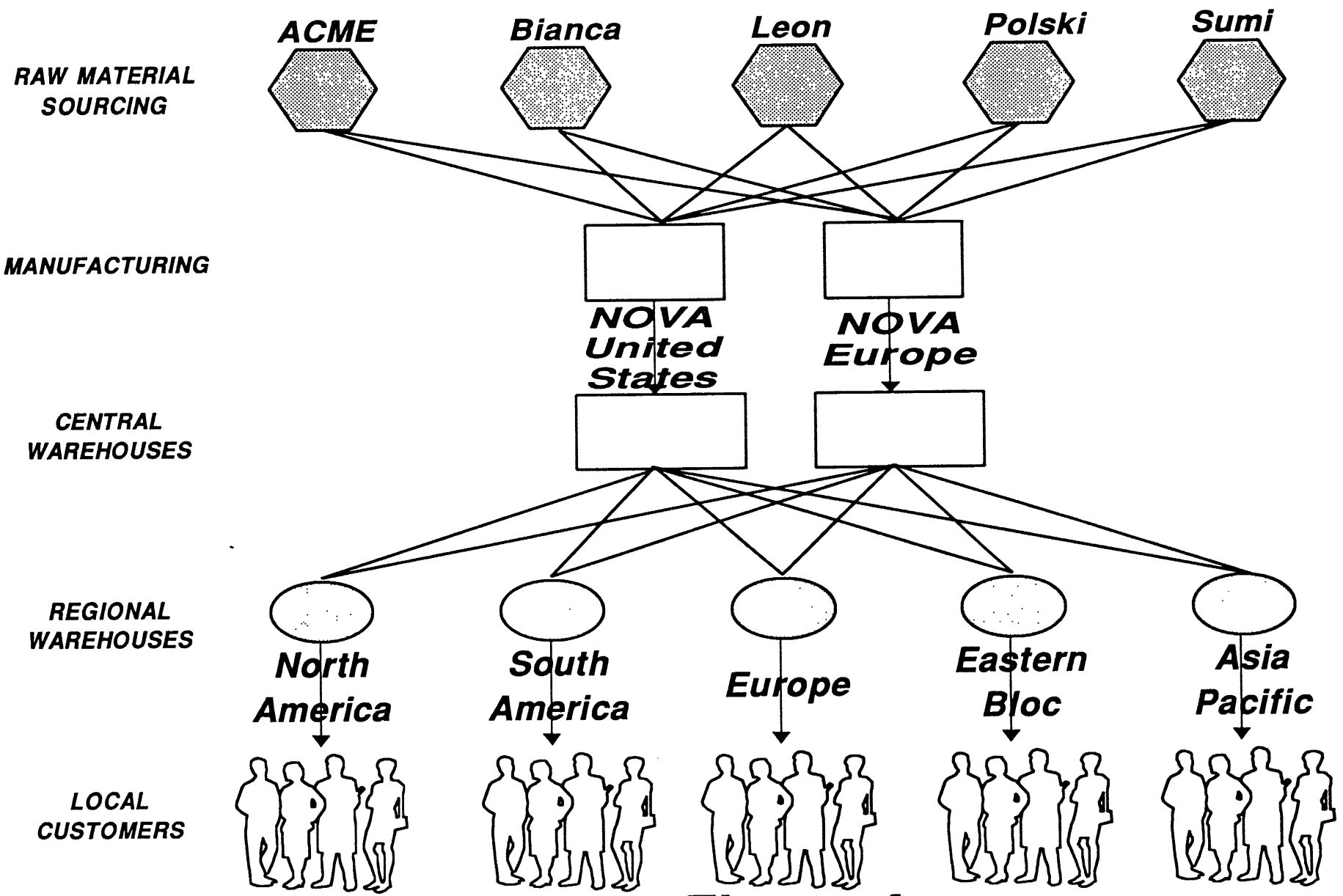


Figure 4.

once per week. Cycle stocks were thus kept at half a week, while a customer would never wait for more than one week for the production of a part to begin. With production lot sizes cut to reduce work-in-process, the number of machine setups increased dramatically and substantial investments were made to reduce setup times. Likewise, with little or no safety stock, a weekly MRP production schedule based upon historical demand could not support Nova's service level objective on low demand parts. Consider in Figure 5 for example, the low demand rate Part 7 which has a weekly demand of .73 units. A safety stock of even 1 unit is excessive in weeks with no demand and is generally inadequate on a day when an order does arrive. To provide high order fill rates, without substantial (multi-month) safety stock, manufacturing was required to respond to orders for low demand items immediately upon request.

An analysis of the order lead time that customers were experiencing revealed additional opportunities to drive down safety stock in the system by reducing both the average lead time and variability in Nova's delivery cycle. It was discovered that during periods of heavy plant activity when Nova's factory managers were under unusual time pressure or stress, they were much more likely to make poor production scheduling, order shipment and inventory reordering decisions. Customer service rates would fall and safety stock would creep back into the system.

It was decided as a result to equip factory managers with a computer based decision support system (DSS). The computer system today provides an easy to use graphical user interface (GUI) that permits fast access to current levels of raw materials and finished goods. It also allows rapid review of the open orders and a demand forecast for any part, as well as, a history of shipments of that part over the past year. When needed, an "expert system" is available to make production, shipment and reordering recommendations quickly. The recommendations can be implemented directly, or reviewed and modified by the plant manager. Reactions to the DSS have been quite positive:

> "The DSS allows me to get at the data that I need to make sound decisions.... I am no longer forced to fly by the seat of my pants.... On days when I simply don't have time to reorder raw materials, I can count on the system to alert me to possible problems and even to make reasonable choices for me.... While it isn't the same as having a really experienced purchasing agent working for you, the system never proposes anything really out of line".

When news of the success of this DSS spread through the company, several regional managers lobbied Fisher for development of a scaled down version of the factory purchasing system that could be loaded onto a personal computer and moved into their regional distribution centers. The system was delivered in Spring 1992 and is now used in all locations to facilitate reordering of finished goods from the two central warehouses.

Concerns About the Future

Reflecting on his concerns for the future, John Fisher realized that support for the Velocity initiatives had not been unanimous. The closing of plants had gone down hard with both the work force and the communities affected. The severing of long standing supplier relationships had been resisted by local manufacturing and purchasing staffs. The decision to close eight distribution centers thereby "abandoning Nova's local marketing presence with the closing of their customer service facilities" drew strong opposition from the sales force and their customers; the concept of providing *better* customer service with *fewer* distribution locations

100-DAY DEMAND FOR PRODUCT-7 in REGION-2

Region: 2
Part: 7

Std Dev: 1.4203
Mean: 0.7300

Day	Demand	Day	Demand	Day	Demand	Day	Demand	Day	Demand
1	0.00	21	0.00	41	0.00	61	0.00	81	4.00
2	0.00	22	2.00	42	2.00	62	1.00	82	0.00
3	6.00	23	0.00	43	1.00	63	0.00	83	1.00
4	2.00	24	0.00	44	0.00	64	3.00	84	0.00
5	0.00	25	0.00	45	0.00	65	0.00	85	3.00
6	7.00	26	0.00	46	0.00	66	0.00	86	5.00
7	0.00	27	0.00	47	0.00	67	0.00	87	0.00
8	0.00	28	0.00	48	0.00	68	0.00	88	0.00
9	1.00	29	0.00	49	0.00	69	0.00	89	3.00
10	0.00	30	3.00	50	1.00	70	0.00	90	1.00
11	0.00	31	0.00	51	3.00	71	0.00	91	0.00
12	0.00	32	0.00	52	0.00	72	0.00	92	1.00
13	0.00	33	0.00	53	0.00	73	0.00	93	0.00
14	0.00	34	0.00	54	1.00	74	0.00	94	0.00
15	0.00	35	1.00	55	0.00	75	0.00	95	0.00
16	0.00	36	0.00	56	0.00	76	1.00	96	1.00
17	0.00	37	0.00	57	0.00	77	3.00	97	0.00
18	0.00	38	5.00	58	1.00	78	0.00	98	1.00
19	1.00	39	1.00	59	0.00	79	0.00	99	2.00
20	4.00	40	0.00	60	1.00	80	0.00	100	0.00

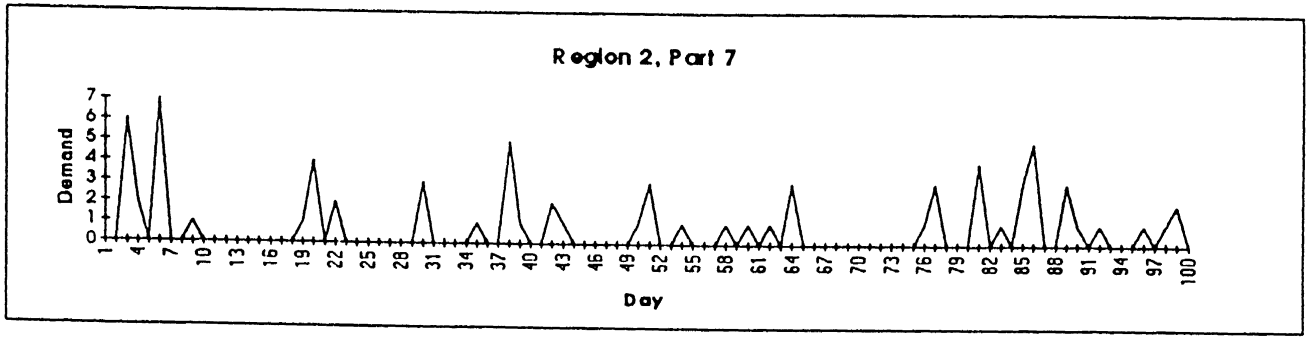


Figure 5.

simply made no sense to them. Additionally, Nova's country managers, who had become accustomed to a certain level of operating and accounting "independence" that was afforded by local suppliers and local control of key products, resisted their loss of autonomy. And finally, a long time consultant to API had warned Fisher that the sizing of the plants and the setting of safety stock levels by the task forces had naively focused on average demand and capacity values: "John, you still have too much unmanaged variability in your processes to meet the aggressive service rates that you are promising. Variability is an enemy that will reach back and bite you if you go forward with these plans".

John Fisher understood that in any change process there are "boo birds" who sit on the fences along the runway and explain why planes can't fly. He also realized however that successful implementation of the Velocity initiatives would not be easy. For the new systems to work, the sales, manufacturing and distribution functions of Nova needed to communicate, coordinate and cooperate in ways they had never considered before. Sales could no longer promise customers more product than reasonably could be produced and shipped in the requested lead time; they would have to track inventory availability and plant capacity and then "manage customer demand" to manufacturing's ability to deliver the product; they would also be required to act as a listening post for manufacturing and provide early warning of increasing or decreasing demand patterns in the regions. Manufacturing, on the other hand, would have to produce defect-free product on a predictable build schedule, while providing visibility to sales on the amount of uncommitted capacity currently available to promise. Moreover, to support marketing commitments, manufacturing would have to move production through the plant consistently in a single day. Distribution, finally, would need to assure that sales and manufacturing were accurately appraised of current finished goods inventory levels, and then guarantee that available products were quickly and reliably picked, packed and shipped once released to a customer. Thus three groups who rarely talked to each other professionally within API, would now need to cooperate on a regular basis for his vision of Nova to be successful. Difficult or not, it was time to execute the remaining Velocity initiatives.