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Manufacturing Focus—A Comprehensive View

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Chapter 15

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15.1 Introduction

Focused manufacturing links manufacturing facilities to the competitive factors of the business. It enables a company to gain greater control of its competitive position and centralizes focus on its relative competitive advantage.

Among the most difficult of manufacturing tasks is responding to many disparate market demands. Manufacturing system complexity often exaggerates the difficulty. Rather than blaming manufacturing for its problems, the company should recognize that manufacturing is complex and has profound influence on corporate strategy. There are ways to reduce this complexity with subsequent benefits for doing so. Focused manufacturing is one such way.

A simplistic view of focus is 'variety reduction' and market sector reduction. This option may not be a wise one. A narrow product or process range alone is not necessarily focus. The key is to concentrate the entire plant on the fundamental tasks demanded by the plant's overall strategy and marketing objective. This is a first approach.

A meaningful level of focus is rarely understood let alone achieved. Examples will be drawn from our consulting experiences.

Focused manufacturing limits activity in an organization to a manageable and consistent set of tasks. These tasks directly support the firm's marketing strategy. Doing this concentrates expertise and promotes superior performance albeit in a narrow range.

15.2 Scope and Scale

Scale refers to the size of a given plant or manufacturing unit. Scope refers to the number of significantly different products, processes, markets and regions that the facility serves.

Early experience in the basic and mass production industries illustrated the economies of scale. Larger equipment and larger plants appeared to bring lower cost. As Hayes and Wheelwright (1984) point out, there are also diseconomies of scale. Large factories are difficult to manage and control. Overhead costs often rise as factories grow larger. If increased size also brings increased numbers of processes, products or markets, the undesirable effects compound.

Making several small factories from a large one does not necessarily improve performance. If the same scope just exists on a smaller scale, performance is, in fact, likely to decrease.

15.3 Focus Criteria

Reducing scale is easy; reducing scope is more difficult. It requires some basis for segregating operations. This basis or focus criteria may take several forms. The more common are:

1. **Process—**a particular process may require high investment and large volume for economic operation. Alternatively, special skills may dictate a concentration based on a particular process. Process focused plants concentrate technical expertise but are difficult to coordinate and control.
2. **Product—**a dedicated facility manufactures a product or group of similar products. Product focus promotes quality, reduces inventory and improves

response to changing demand. It often requires broader skills and may reduce new product flexibility.

3. **Market—** Market segments are a basis for focus when customer demands differ substantially. Quality, delivery, option variety and order size may differ between market segments. If so, these market criteria provide a basis for focus.
4. **Volume—** Similar products (or identical products for that matter) may require separate processes and infrastructure for high and low delivery volumes. Production volume can therefore dictate focus.
5. **Geographic—** Physical proximity to customers supplies or to special skills may be necessary. Here, geography may be a basis for focus. This often arises where delivery speed is mandatory. It also occurs internationally when import restrictions apply.
6. **Infrastructure—** Support systems are, by definition, peripheral to the manufacturing process. However, they and other dominant site factors can impact organizational structures and associated facility requirements.

15.4 Focus Levels

Although the concept of manufacturing focus originally evolved at the site or factory level, it also applies at other levels. Focus dictates (or should dictate) which site addresses each product, process, market, geography or volume. Each site would specialize along the selected focus dimension.

At the regional or global level, particular countries or regions might specialize. For many years, the large automobile firms built their large cars in North America and small cars in Europe. Just below the site level, a facility might have two or more plants-within-a-plant (PWP). Each PWP is an independent factory with its own infrastructure.

Focus also applies below the PWP level. A layout cell is a space which contains a set of complementary machines, fixtures, activities or people. Layout cells often (but not always) correspond to organizational departments. Departments or cells may specialize by process, product or other suitable focus criteria. This topic will be discussed later in more detail.

Focus can develop at the workstation level. Individuals may specialize by product, process, customer or (again) any suitable focus criteria.

In planning manufacturing strategy, focus issues should be examined at each level since they often differ. A company may decide, for example, on a geographic focus at the site level. At the cell level, it may choose a functional focus.

15.5 Focus and Plant Layout

The plant layout, site plan or map reflects manufacturing focus (or lack thereof). The special case of a plant or site is particularly important and warrants additional discussion.

Site-level focus decisions may involve the full range of focus criteria. The plant layout designer must eventually arrange machines and equipment. Such arrangements require decisions between product and process focus.

15.6 Production Modes

Production mode is the fundamental arrangement and method for manufacture. Fixed location, job shop and mass production were early versions. Plant layout writers of the 1950s recognized the connection with plant layout and referred to it as "layout style."

Production mode is characterized by several key features:

- Physical arrangement,
- Focus,
- Product flow,
- Pattern of resource flow,
- Task sequence,
- Task cycle,
- Task repetition,
- Task balance,
- Task synchronization,

While many combinations of key features are possible, only a few have practical consistency. Within a facility, however, several modes may exist simultaneously in separate areas. The usual modes are project, functional, Toyota, cellular, line and continuous. The modes and their characteristic features are illustrated in Fig. 15.1, and the flow characteristics in Fig. 15.2.

1. Project mode is usually associated with a fixed position layout. The product is completed or essentially completed in one location. Products are usually large, e.g. a building or a ship. Resources are brought to the one point and the product is immobile or relatively so.
2. Functional modes are characterized by groupings of functional specialties. Similar machines and equipment form a functional department. Materials move from one functional area to another. The result is a complex material movement pattern. Labor typically possesses one functional skill, with operators concentrating on their own efficiency. This and inter-functional moves retard material velocity.
3. Cellular modes have work cells processing families of parts. In a group technology cell, a small number of work locations each have a primary group of operators. The emphasis is on group effort and individuals may move with the work piece from machine to machine through the cell. Machine utilization is not emphasized. Small batch sizes and quick throughput are the benefits. The flow patterns may be straight through, L or U-shaped.
4. The Toyota system incorporates linked cells with minimum in-process inventory and a pull system of material flow control. Just-in-time inventory, Kanban production control, total quality concepts, scientific maintenance and Vendor families are considered part of the Toyota system.
5. The line or Detroit method is a sequenced flow pattern with fixed work stations and short cycle operations linked by a moving line. Material is delivered to the beginning of the line or to work stations in batches. Products are completed by the time they arrive at the end of the line. Flow line work is characterized by high-volume, repetitive, short-cycle work.
6. Continuous flow patterns have few system entry points. Materials flow through a linked sequence of unit processes with fixed means of transfer. The process operates continuously, products are homogeneous, the system is saturated and volumes are high. Oil refineries and steel mills are examples.

Mode		Continuous	Line	Toyota	Cellular	Functional	Project
Arrangement		Sequential					Random
Focus		Product				Process	
Product Flow		Simple/Direct					Complex/Mixed
Resource Flow		Fixed					Very Flexible
Task	Sequence	Fixed					Very Flexible
	Cycle Time	Very Low					Very High
	Repetition	Very High					Very Low
	Balance	Very High					Very Low
	Synchronization	Very High					Very Low

Figure 1 Production Modes & Characteristics

Flow patterns become less complex with cellular, Toyota, line and continuous plant configurations. Material velocity increases with movement away from a functional layout. This has important implications for the material handling designer.

Figure 15.3 is typical of many product—volume profiles. On this chart, each bar represents a product or group of highly similar products. The vertical axis represents production volume. This chart overlays the typical range of application of each mode on the P-V plot. With few products and high volume, continuous and line production are normal. At the opposite extreme, high variety and low volume suggests project or functional production.

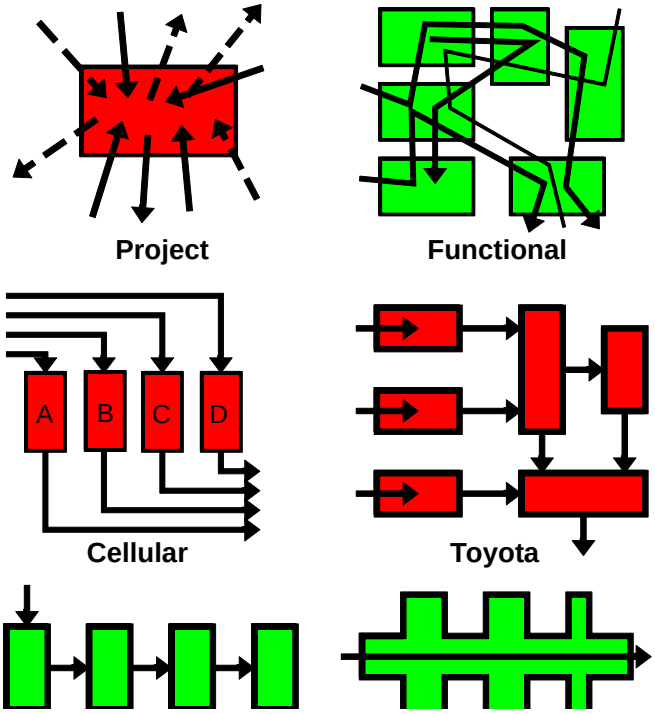

Figure 2 Production Modes & Material Flow Patterns

15.7 Degrees of Focus

Only line and continuous production can achieve pure product focus. Only the functional mode can achieve a pure process focus. Cellular and Toyota modes are intermediate. Line and continuous modes can be intermediate between product and process focus when they produce more than one product. The project mode is a special case which fits neither the product nor the process category.

There are many ways to mix focus. Parts and materials may move through a process focused machine shop, for example. Product focused assembly lines might then perform final assembly. In Table 15.1, the advantages and disadvantages of product and process focus are illustrated.

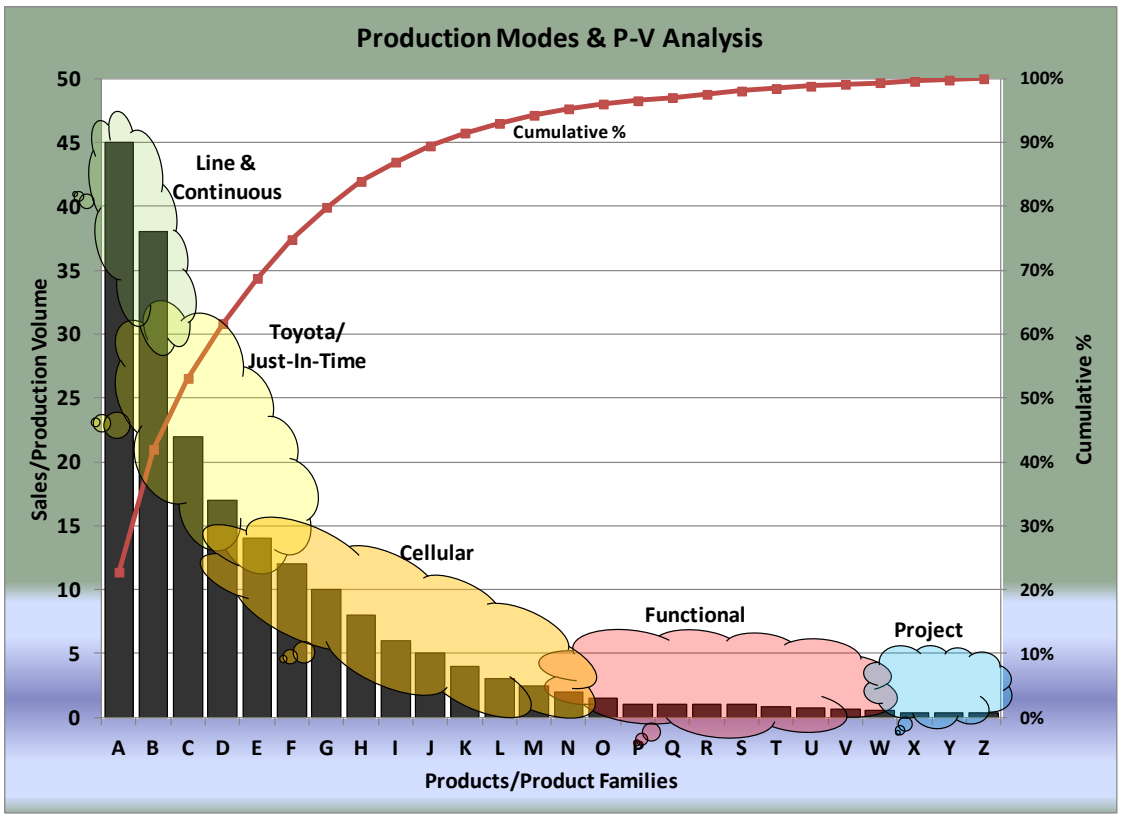

Figure 3 Production Modes & Product-Volume Analysis

	Product Focus	Process Focus
Advantages	• Simplified cost control • Greater cooperation across functional disciplines • More responsive purchasing and support services • Flatter organization structure • Greater accountability and responsibility lower in the plant • Simpler plant controls • Faster product velocity through greater inventory turn, hence, reduced cost • Simplified and more focused quality improvement efforts • Used in situations with lower 'economies of scale' • More responsive to customer needs • Overall overhead typically reduced More amenable to being managed as a profit centre	• Traditional managers comfortable with this approach • Ability to share scarce resources and increase utilization • Typically used in industries like chemical processing • Suited to situations with a heterogeneous labour force Usually, the units are cost centres
Disadvantages	• Some duplication of key management positions • Potential for lower machine utilization • Traditional managers are often uncomfortable with this focus • Sometimes has trouble handling very different new products • Shop floor 'monuments' must still be shared	• Increased friction between functional managers • Higher control costs and increased probability of error • Product costing difficult • Effective quality improvement efforts are more difficult • Difficult to downsize • In practice, process focus is usually less flexible than a product focus

Table 1 Comparison of Product & Process Focus

15.8 A Focus Algorithm

In the author's consulting practice, inappropriate manufacturing focus is frequently seen built into plant layouts. In the usual case, a functional layout is producing high or medium volume products. An example is a manufacturer of minicomputers. This company had five basic models and assembled 3-10 of each per day in a large functional assembly area. Its new plant was arranged with a small assembly line for each basic model. A smaller functional area built prototypes and replacements.

Most manufacturing (and other organizations as well) display a strong bias for the functional mode. The reasons for this bias are unclear but some possibilities are:

- Functional layouts are often easier to design.
- Accounting systems do not discourage the large inventory of functional layouts.
- Financial policies emphasize high equipment utilization and favours functional layouts.
- Engineers favour high-tech, costly, large-scale equipment which demands high utilization. This, too, favours the functional layout.

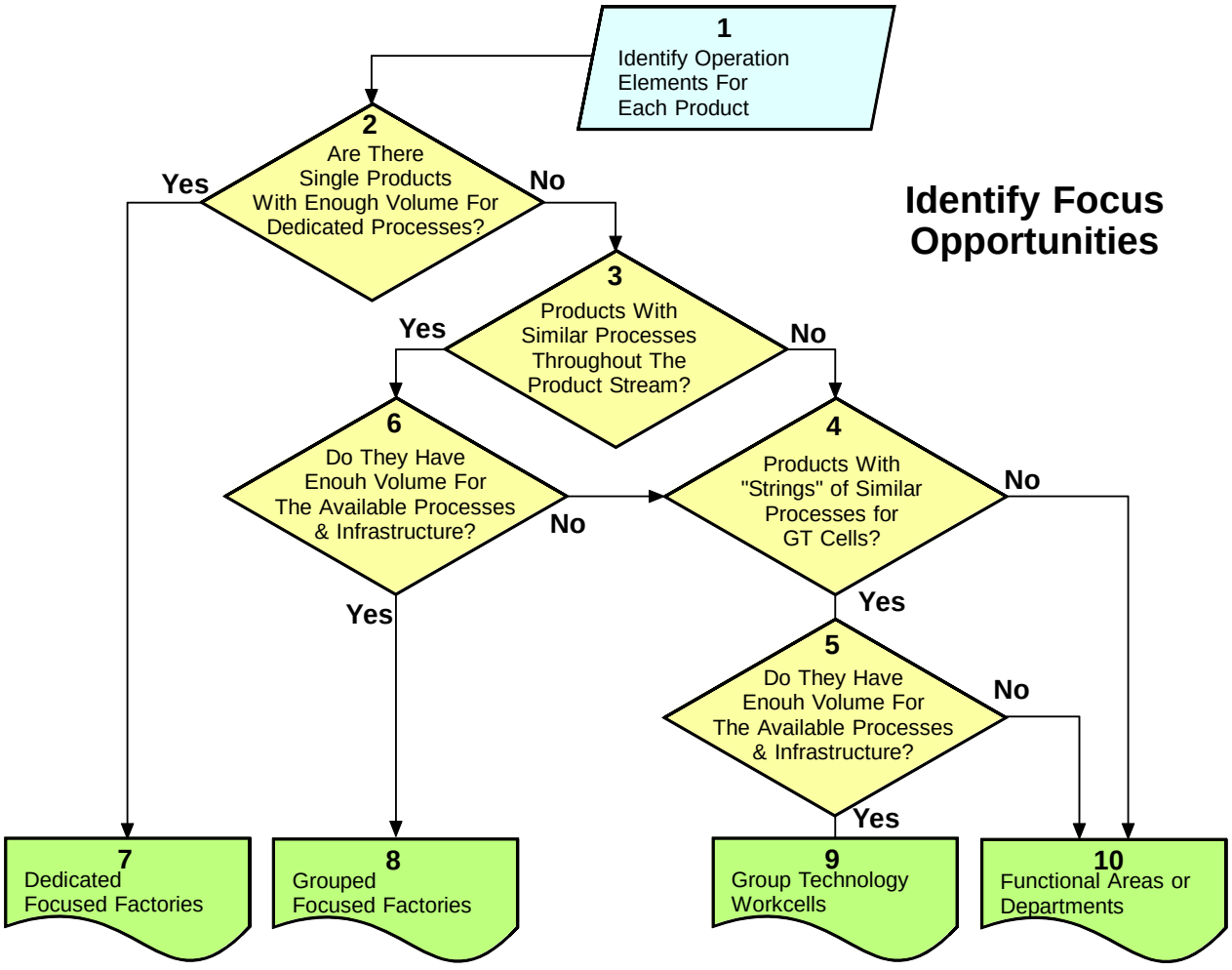

Figure 4 A Focus Algorithm

Manufacturers misuse the functional mode most often. However, any mode has the potential for misapplication. In one situation, a Detroit-style assembly line builds massive, off-road vehicles at 1.5 per day. The results are poor.

How can the layout designer achieve an optimum degree and mix of manufacturing focus? The algorithm given in Fig. 15.4 can help. The product focused modes, especially line and continuous, offer many advantages in quality, low inventory and efficiency. The Process focused functional mode is most frequently misapplied. For these reasons, the algorithm starts with a pure product focus and line production. It then backs away through the Toyota, cellular and functional modes towards a feasible alternative.

Start with an operation process chart for each distinct product. Any industrial engineering handbook or text shows the conventions for constructing these charts. Line the charts up, side by side as shown in Fig. 15.5. Each operation on a product is a product operation (PO). In the typical situation, a single PO requires too little time and equipment for a dedicated workstation or department. The layout designer must somehow group various POs.

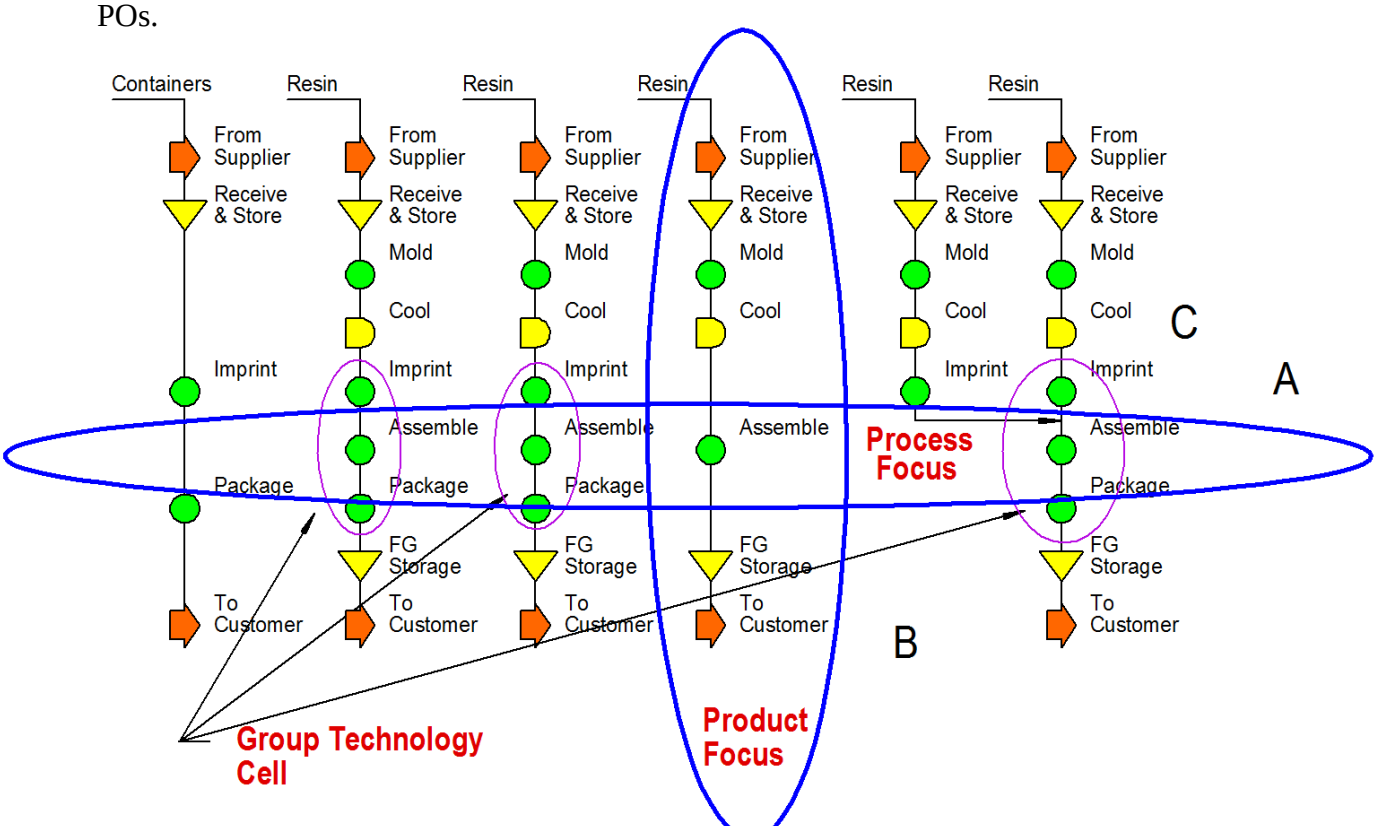

Figure 5 Process Charts as a Conceptual Tool for Focus

One method is to group all product operations which require the same equipment or type of process. Envelope “A” Fig. 15.5 illustrate this. Such grouping provides a pure Process focus. At the other extreme, a designer might group all operations required by a single product. He would then locate these in a single product department or workstation. Envelope “B” in Fig. 15.5 illustrates this. This is a pure product focus.

In Step 2, the designer examines each product for a trial product focused grouping. There are only two valid reasons for rejecting a pure product focus:

1. The available feasible processes have a large scale with respect to product volume. They cannot economically process a single product; for example, a small turned pin requires only 0.25 machine hours per week for the anticipated product volume.
2. Some element of infrastructure has a large scale with respect to product volume. It cannot reasonably serve a single product; for example, a highly skilled electronic technician calibrates a circuit board. Production only requires his skills about two hours per week.

If a trial product passes both tests, it should have its own manufacturing area and possibly its own PWP. Remove such products from further consideration.

In Step 3, the designer examines each remaining product. He identifies subsets of the manufacturing operations (strings) which are common between two or more products. When such a string occurs, the designer tests it for adequate volume vis-à-vis process and infrastructure scale. If it passes the test, such operation strings become group technology cells, as illustrated in Fig. 15.5.

Step 4 aggregates all remaining operations into functional areas.

The identified areas become basic cells for developing layouts. Such layout cells may be GT cells, functional cells or product cells.

An analyst might perform this focusing task on paper as illustrated. More often, the algorithm structures the thought process and may arrive at a cell definition without formally drawing all operation process charts.

The designer may also use the production flow Analysis technique developed by Burbidge or the techniques of a coding and classification approach. These techniques are particularly useful when dealing with hundreds or thousands of parts or products. Such traditional grouping techniques should supplement rather than displace the above algorithm.

15.9 Examples of Manufacturing Focus

The following are examples of manufacturing focus. Names and some facts have been modified to preserve client confidentiality.

15.9.1 Northstar Aluminum Products

Northstar is an aluminium foundry. The company makes about 4400 distinct castings for many customers in several industries. Their castings are used in products ranging from lighting fixtures to decorative bowls and portable pumps. They specialize in medium-precision sand castings using green-sand and jolt-squeeze moulding equipment. Hand ramming produces moulds for prototype or very low-volume work. Northstar offers five alloys to its customers; several alloys may be stress relieved.

Other processes such as die casting, investment, automatic moulding and lost-foam are feasible. These other processes are more labour efficient. However, they also require a high capital investment and have long setup times that are more suited to higher volume than the jolt-squeeze process.

Northstar might also offer other metals. Irons and steels require much higher melting temperatures, and have different moulding requirements. Brasses and bronzes have similar pour temperature and mould requirements, but their lead content requires sophisticated ventilation systems.

Casting metal in sand is an ancient art and is simple in principle. Execution, however, requires skill, experience and close control of many variables. Technically, it is more difficult than many so-called 'Hi-Tech' processes. These technical demands are so severe that few foundries can master more than two or three processes.

Northstar has chosen to focus its plant on a *single casting process* and a small range of similar alloys. As a result, they have earned a reputation as the lowest cost and highest quality medium production aluminum foundry in the upper Midwest. *Process focus has enhanced their expertise in a technically demanding business.*

15.9.2 Commercial Fixtures

Commercial Fixtures Corp. manufactures a variety of lighting products which incorporate numerous precision, low-volume castings. These fixtures also require sheet metal parts, electrical components, glass lenses and plastic shrouds. All products are painted to a high-quality gloss finish. The Commercial Fixtures catalogue shows six major fixture groups. Each group has 6-10 styles and 4-8 sizes. Each style is available with high-intensity discharge (HID) or incandescent light, and four voltages.

Until recently, Commercial Fixtures operated an aluminum foundry to supply its casting requirements. Their foundry, however, was too small to purchase supplies effectively. Neither could it support the pattern makers and process engineers required for cost-effective operation. High cost, quality and productivity problems caused Commercial Fixtures to close its casting operation. The firm then contracted with Northstar Aluminum for its cast components.

As a result of this action, Commercial Fixtures reduced the range of their processes. The firm thus achieved a higher degree of *process focus at the site level*. They concentrated their efforts on assembly, paint and sheet metal forming. Cooperation between the two companies resulted in more cost-effective, focused operations for both of them.

Below the site level, Commercial Fixtures implemented GT workcells in the sheet metal area and dedicated cells for final assembly. The company thus moved towards a higher degree of product focus at the department level.

This *combined focus approach* has been highly effective. It requires Commercial Fixtures to master only three types of processes, yet it achieves most of the quality, throughput and productivity advantages of a pure product focus.

15.9.3 Inter-Defense Industries (IDI)

IDI manufactures armoured vehicles. During the Cold War IDI supplied many Western armies from its factories in Western Europe. Through the 1960s, high-variety, low-volume and the unpredictable fortunes of politics and war had led the firm towards a process focus. In the mid 1970s, the Mark VIII Heavy Tank was a major success with long-term contracts and stable delivery schedules.

In the first two years of production, IDI encountered difficulties. Despite the high volume and predictable schedules which they had always desired, manufacturing could not cope. High inventories, poor quality, delays and coordination problems threatened an 82-year reputation.

The crises in manufacturing forced an organic restructuring. IDI rationalized manufacturing and rearranged accordingly. The Mark VIII had higher volume and production stability than IDI's other vehicles. It was also more complex and had a higher level of technology. This led to a segregation of the new Mark VIII in its own facility, a focused factory, with a single product.

Within this overall product focus, some components had dedicated processes such as welding, machining and assembly. They were physically arranged in proximity to the assembly areas. Like a river, the final assembly line was fed by branches where major components were assembled. These branches were, in turn, fed by the confluence of smaller production streams.

One major tributary of the final assembly stream was the turret. The turret had guns, missile launcher, fire control, command systems and armour. It is the most complex single sub-assembly with the exception of the hull itself.

Turret production was segregated in a plant-within-plant (PWP). All equipment and operations necessary to make the turret, its subassemblies and many components were in this *product-focused PWP*.

The turret factory was organizationally independent as well. It had its own maintenance, production control and industrial engineering support.

Before the restructuring, production at the workstation level fluctuated wildly. After the changes, day-to-day schedules stabilized as each operation produced only enough for immediate downstream requirements. Inventories shrank and quality problems surfaced quickly. Significant improvements in quality, productivity and delivery resulted.

15.9.4 Kansas Steel Foundry

Kansas Steel grew from a small grey iron foundry which served the repair and replacement needs of the transcontinental railroads. In the early 1980s, Kansas Steel was one of a handful of foundries that could make very large castings. The foundry poured about seven basic alloys from two electric arc furnaces and two coreless induction furnaces.

Several years ago, Kansas steel examined its mix of customers and products. While all of its castings were similar in size, alloy and mouldability, market segments differed in other significant ways. Market segments included:

- Construction equipment,
- Oil-field equipment,
- General industrial equipment, and
- Military armour.

The largest of these segments was military armour. These castings became part of various armoured vehicles. They included armour pieces as well as mechanical and structural

parts. The armour segment represented about 40% of total production but only 20% of profits. This was somewhat disconcerting to Kansas Steel's management. Competition in armour was not aggressive and, pound for pound, armour castings sold for significantly more than the industrial castings.

The plant had great difficulty with the military quality standards as well as the documentation and testing requirements. Rework, repairs and delays were excessive. Management was also concerned about the excessive management support required since it increased overhead for all products.

Kansas Steel decided to split operations into market-focused factories. Fortunately, the site and buildings suited this arrangement. Each factory had separate facilities with the exception of the melt department. Here, two furnaces were dedicated to the new Armor Division (KSAD). The remaining furnaces served the new General Industry Division (KSGID).

The Armor Division enjoys stable production schedules and long-term contracts. Quality standards are very high. The smallest speck of dirt or defect introduced in the moulding department generates massive welding and grinding in the cleaning room.

Those employees who work on documentation with government inspectors have learned to deal effectively with both. The Armor Division hires experienced foundrymen, pays well and has a stable employment policy.

General Industry Division must cope with erratic delivery schedules and economic cycles. KSGID has many new products. However, the quality standards are less stringent and external paperwork is minimal.

The GI Division pays lower wages than KSAD and frequently changes employment levels as production varies. Only a cadre of senior workers can depend on steady employment. Quality standards are lower and procedures different.

As a result of these differences in apparently similar castings, the Armor and GI Divisions evolved different production control systems, quality assurance organizations and suppliers. *They have focused two divisions with similar products and volumes around different markets.*

15.9.5 Grandma's Pies, Inc.

Grandma's Pies manufactures fresh pies for restaurants. Their drivers deliver many varieties of high-quality pies to medium-sized, upscale restaurants who special order 24 hours in advance. Requirements for freshness and personal contact led Grandma's to a *geographic focus bringing all customers within 150 miles.*

15.10 Infrastructure Focus

Equipment, systems or people may support production without processing the product directly. Such elements are part of the infrastructure. Infrastructure may be physical (facilities) or non-physical (people--information—organization). While somewhat unusual, *infrastructure can also be a focus criteria.*

Specialized and expensive facility requirements may necessitate facility focus. Aircraft manufacturers (for example) bring together operations requiring high bay facilities. Such

disparate operations as assembly, welding, machining and test may require such high headroom facility for specific parts or products. Such a requirement may bring together dissimilar processes, products and activities which share only a common need for headroom.

Non-physical infrastructure is occasionally a basis for focus. A world-wide manufacturer of toiletries concentrated perfume blending at a single site. The specialists there possessed olfactory skills essential to both new product development and production quality control.

As mentioned before, an argument can be made that only market focus is acceptable since customer satisfaction is the primary goal. However, a pure market focus may not account for the real limitations of manufacturing processes and infrastructure. Moreover, it provides little basis for the planning and layout of a production facility.

15.11 Matching the Layout and Organization

Organizations have a focus or lack of focus just as plants and departments do. When the reporting structure groups people with similar job functions, the organization has a functional focus. Product-focused organizations group people according to the products they manage. The criteria commonly used to focus sites and cells also apply to organizations.

Unfocused and inappropriately focused plants, layouts and organizations have handicapped many Western manufacturers. An even more serious situation exists when the focus of the layout differs from the organizational focus. This can happen when, for example, manufacturing departments focus on product lines while the supporting organization has a functional focus.

For facilities planning work, a useful tool has been developed to test the consistency between organization and layout focus. The analyst first prepares a detailed and up-to-date organization chart. Every person at the site is represented. The analyst then draws an envelope around those persons whose normal workstation is within a given contiguous area.

The envelopes may be compact and include only people on the same branch of the organization tree. The layout and organization are then consistent. Fig. 15.6 illustrates this. Official channels of communication coincide with the layout and those who communicate have workstations in close proximity.

In other instances, the envelopes may appear disjointed, stretched and generally 'messy' as in Fig. 15.7. This indicates a mismatch between layout and organization. People have workstations far removed from their superiors, subordinates and colleagues. Such a situation makes for poor communication along the chains of command.

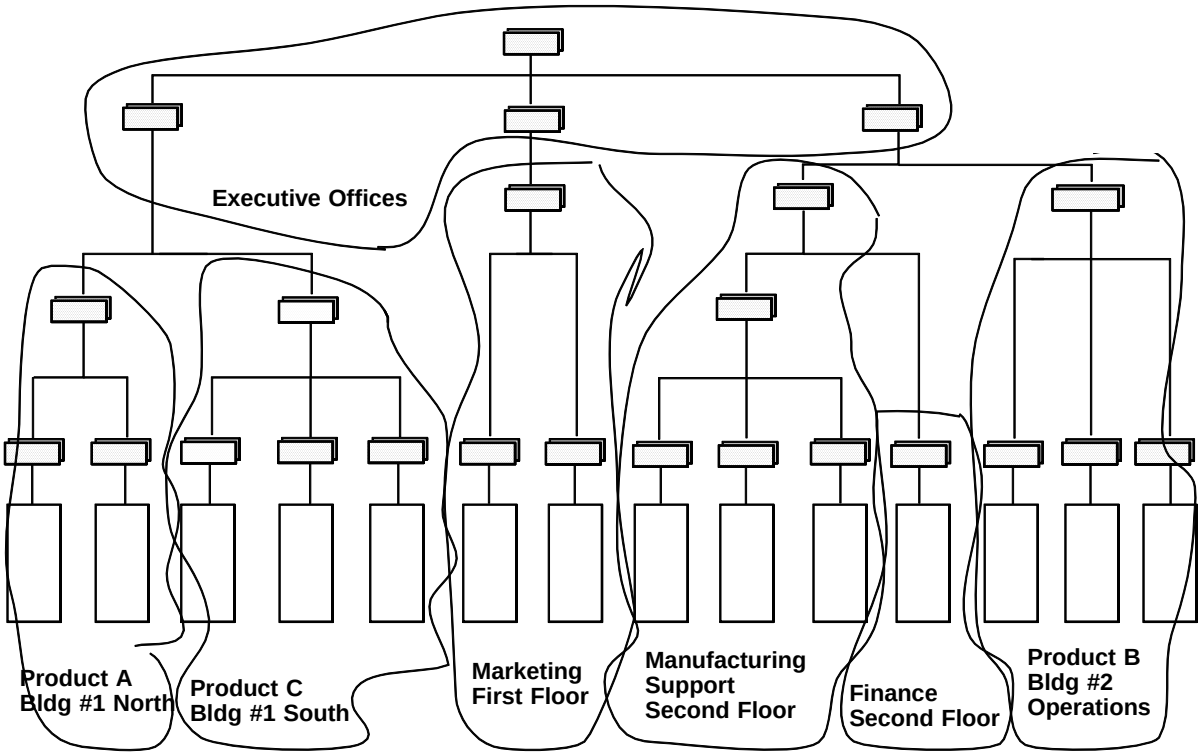

Figure 6 Good Alignment of Organization & Facility

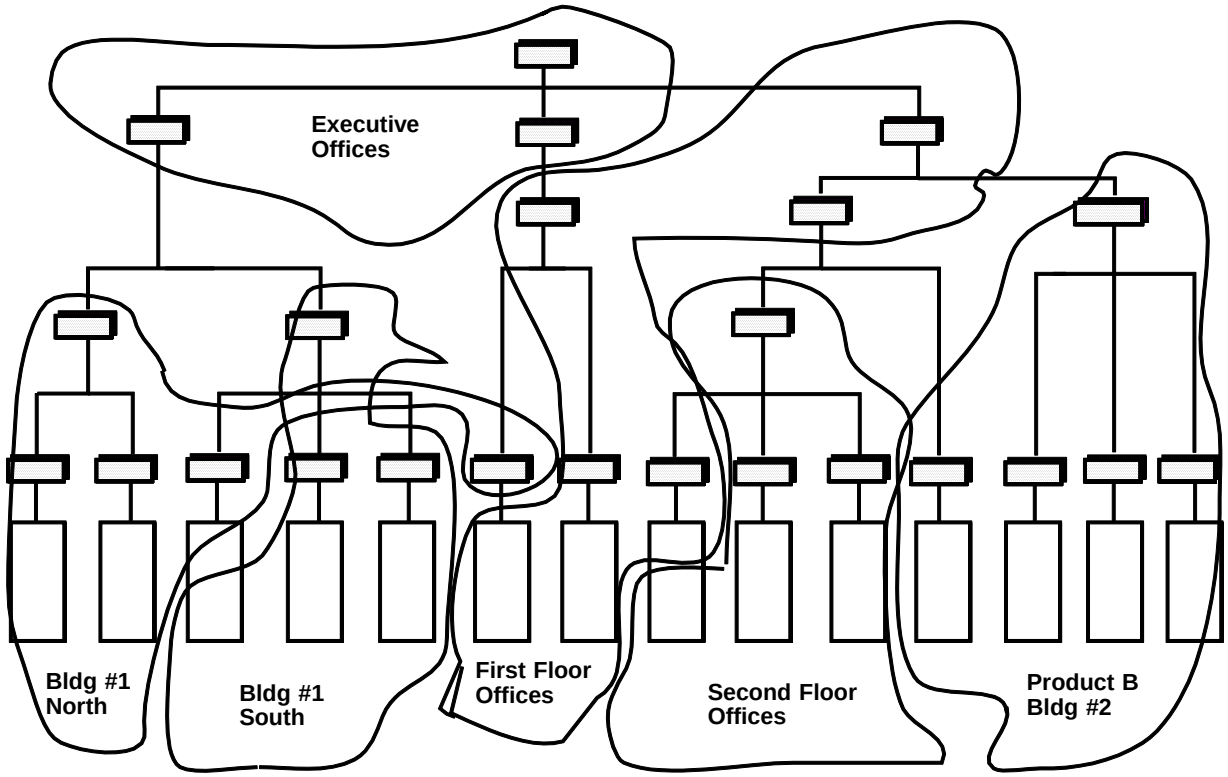

Figure 7 Poor Alignment of Organization & Facility

15.11 Focus for time-Based Competition

Stalk (1990) and Blackburn (1990) suggest that time-based manufacturers, most of whom are Japanese, are moving away from focused factories. Such companies emphasize flexibility in their production facilities and produce a wide range of products at comparatively low volume.

From a traditional perspective, flexibility and low volume lead towards process focused functional layouts. Functional layouts are, after all, a very flexible manufacturing approach. But process focused factories seldom provide fast or even reliable throughput. They do not meet the requirement for fast response that time-based marketing requires. If the concept of focus is no longer valid in a time-based world, it raises again Roger Schmenner's question, 'How should you organize production?' (Hayes and Schmenner, 1978).

In an attempt to re-answer Haye's and Schmenner's question, additional issues came to light:

- What is a product?
- What is flexibility?
- How can we gain flexibility?

What is a product? The answer may seem self-evident. Experience in planning production facilities, however, shows that answers often are controversial, vague and contradictory. A workable answer depends on the purpose of the question and the perspective of the respondent.

Marketing people usually view a product mix by market segment or the product function. A manufacturer of aircraft engine parts views them as GE, Rolls Royce or Pratt and Whitney products. A manufacturer of commercial light fixtures sees its products as either 'specification grade' or 'architectural'. A market-oriented definition may be appropriate for manufacturing strategy and factory planning, but only when each product requires unique processes, unique procedures or has unique performance criteria.

A product engineer would normally define products by part number or drawing number. They would most often group similar products by function or appearance. Product engineers thus think in terms of bearings and bushings or turbine blades and compressor blades.

For manufacturing strategy and factory design, a product definition is suggested based primarily on process similarity. If items can be manufactured in the same sequence on the same equipment, they are in a single product group. If, in addition, these items require no significant changeover, they are for manufacturing purposes, considered as identical products.

Note that the above definition states that products are in the same family or group if they can be manufactured with the same process. This implies process standardization. It also implies that a revision of process technology may or equipment may change the product definition.

Hill (1985) suggests that only market requirements are a proper basis for focus. But situations requiring identical products to be made in different factories or departments

due to different market requirements are unusual. In practice, it has been found that defining products on the basis of their process similarity generally brings one of the following results:

- The process-oriented definition corresponds to market-oriented definitions.
- Different markets make similar demands on manufacturing.
- The differing market demands are not contradictory.

Here are some examples.

Conplastics Corporation extrudes vinyl products, such as vinyl pipe, conduit and guttering, for the building industry. The marketing people classify their markets as 'wholesale' and 'retail'. Wholesale customers operate large chains of home-improvement stores or lumberyards. Retail customers are small lumberyards or home-improvement contractors.

These two markets make quite different demands on the sales department, requiring different personalities, discounts and order procedures. But to manufacturing, these market differences are transparent. The large wholesalers actually order and ship for individual stores, with such orders being similar in size and mix to those for retail stores. Retail contractors usually accumulate several contracts before ordering, and several contractors may combine orders for each shipment. These shipments are similar as well.

For manufacturing, the important product differences are those features which require major changeovers or different sizes of extruder, not who the end customer is.

15.12 Flexibility

By flexibility, most manufacturing people mean the ability of a factory easily to adapt to varying conditions. Both economy and speed are usually implied. While cost and response time go together, they are in fact different issues. The conditions referred to may include changes in:

- Product mix,
- Volume,
- New products.

While these three types of flexibility are sometimes related, they are also separate issues which should be addressed individually in different ways

An extrusion plant can easily vary its output but rapid changes in product mix may require expensive setups.

Flexibility and improved response time will be important future issues for many manufacturers. How to achieve them needs to be examined and trade-offs are also involved.

Process focused factories and departments are the long-accepted means to attain flexibility in product mix, volume and often in the introduction of new products. However, they do not perform well on delivery speed or reliability. Process focus is an inadequate strategy for the time-based competitor.

Group technology cells achieve good flexibility within the range of their product families. In addition, new products often fit well in existing families, which eases their introduction. GT cells also have good response, with low inventory and fast throughput.

Another approach to flexibility is process technology (as distinct from process focus). Certain technologies may lend themselves to faster changeovers. This provides high product mix flexibility. Some technologies have lower tooling costs than others, which increase new product flexibility. Numerical control machine tools, for example, are highly flexible for both product mix and new products.

Flexible processes are not necessarily sophisticated or expensive. Manual methods are often quite flexible and should not be discounted. Small sacrifices to direct labour productivity can bring large benefits in productivity of capital, material flow and support requirements.

Toyota approaches product mix flexibility by dedicating simple, inexpensive machine tools to particular products, which seems an anomaly. They then merely turn the machine off if that product is not required. They thus achieve good mix flexibility with only a small trade-off in floor space.

The use of dedicated but small-scale equipment can also bring new product flexibility. A manufacturer of sheet metal products is an example. This firm specializes in sheet metal parts for defence electronic systems. They have many new contracts with low production for a number of years. When terminated, most products do not return. This firm has achieved flexibility by using simple conventional sheet metal forming equipment arranged in manufacturing cells. Their equipment, however, is not bolted to the floor. Each piece sits on a skid and is connected with flexible rubber cord to a receptacle. It can be moved with a fork truck in only a few minutes. With this concept, one-product workcells are rapidly put together and then disassembled when no longer required.

15.14 Manufacturing Focus and Plant Design

Relationships exist between product definition process selection, and production mode. For success, these must work together in a coherent manufacturing strategy. For success in a time-based market, they must satisfy requirements for quick response and rapid new product introduction.

The time-based competitor will most likely choose a manufacturing strategy which emphasizes workcells. Group technology cells will combine with flexible process technologies. A time-based competitor might also use simple conventional tooling in a dedicated workcell.

Time-based competition does not negate the advantages of product focus. It simply requires it at a lower level and smaller scale. Defining the product mix in terms of process commonalities clarifies the idea of manufacturing focus and permits a more universal application.

15.14 Manufacturing Focus and Manufacturing Strategy

The focus criteria selected should be consistent with corporate goals, market strategy, manufacturing processes and infrastructure. Developing such focus is one of the most important elements of manufacturing strategy.

Focus is our best means to reduce manufacturing complexity and direct technical and knowledge resources at customer demands. By doing this, it makes manufacturing an integral part of the corporate strategy rather than merely being a hapless supplier of commodities.

15.15 References

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