PLANT SURVEYS

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by

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In such a discussion there are two principal groups of considerations

I. Tangibles)
) The motiviating force of both is management
II. Intangibles)

DEFINITION OF MANAGEMENT

> Management is the correlation of details of operation of an enterprise so that it will work as a harmonious whole toward the desired goal.

It is a broad term and covers all the factors in the operation of an enterprise.

It involves all the elements in the control of business activities.

METHOD OF PRESENTATION

Your object is to get production - selection of places and methods.

My object will be to present those things an industrial engineer works with to get production. This presentation, however, is not intended to indicate technique or application. It is intended to present management principles by which you, in your searches for manufacturing capacity, can properly evaluate the productive efficiency of the plants you inspect prior to allocation or with which you work in prepation a Factory Plan after allocation of the facility has been made.

I. TANGIBLES

1. Buildings and site

a. Geographical location

A. Strategic factors of industrial location

Civilian (former)	Civilian (present)	Military
Raw Material	Market (Critical)	Raw Material
Labor	Raw Material	Labor
Power	Transportation	Power
Transportation	Labor	Transportation
Market	Power	Market (Theatre of Operations)

(1) Through the working out of new economic forces in the United States, manufacturing capacity is becoming more widely diffused each year throughout the country. With the passage of time this will greatly enhance the degree of variation in the above factors from the commonly accepted order of military importance.

(2) From the standpoint of military procurement, certain effects resulting from this tendency are of outstanding importance:

(a) The day of the big, inflexible plant, facing intense competition in distribution as well as in production, seems to be on the wane. Already, many of the newer and better managed industries are getting away from building very large units and are leaning more strongly toward those commensurate with the immediate market to be served and building them near that market.

(b) Military procurement in any future emergency will have to be accomplished over a much wider area because existing manufacturing capacity is being spread over a wider area.

(c) Therefore, from the standpoint of geographical location of capacity, the military procurement function will have to pay increasing attention to the potential importance of wide regions that heretofore have not been considered. The selection of ultimate specific capacity will have to be based on the findings with regard to these new areas.

(d) Procurement operations over a wider area will develop interesting variations in economic phenomena that were encountered during the past war. In many instances there will be involved the necessity of utilizing capacity in certain areas the location of which is wholly out of line with locational factors as viewed from the military standpoint. This means on your part much careful study to adapt to best advantage. It also means that the procurement function will have to keep abreast of the bewildering staccato changes that have constantly been taking place in industry since 1919 and which have every indication of continuing in increasing degree.

(e) The diffusion of procurement effort over wider areas has two beneficial results:

(A) It reduces congestion of effort at vital centers and thereby tends to reduce the distortion of normal economic phenomena.

(B) It reduces the effect of the capture or destruction of a portion of the nation's productive capacity.

(3) These changes in civilian industry are being very carefully studied by three important groups from each of which the procurement function of the army should be in position to receive valuable assistance. They are.

(a) Industrial development departments of the public utility companies.

(b) Industrial development departments of the railroads.

(c) Local and state chambers of commerce that maintain an industrial bureau.

B. Secondary factors of industrial location (military standpoint)

(1) Proximity to tide water
(2) Quantity and quality of water supply
(3) Necessity for isolation (dangerous)
(4) Living conditions, etc., to name but a few.

Add any others you can think of.

b. Construction and layout of buildings

A. This will be considered under the subject of "Layout" when we come to the discussion of "Machinery and Equipment."

c. Plant lighting

A. As contrasted with the period before the war, industrial lighting has been revolutionized. Research in this field by the National Electric Light Association has been one of the outstanding contributions to industry in recent years.

B. Plant lighting is important from two stand-points both of which are important from a military procurement point of view. They are.
   (1) Social effects
   (2) Production effects

C. Results of defective illumination
   (1) Loss of production
      (a) Recently the Detroit Piston Ring Company made an extensive test, the results of which are quite interesting. Starting with a production of 12,000 piston rings per day under an illumination of 1.2 foot-candles, the following gains in production were recorded.

Foot-candles	% increase in production
1.2	
6.5	13.0
9.0	17.0
14.0	25.8

      (b) The total cost of operating a good lighting system is seldom over 2% of the productive wages, and if a workman is hindered for even as low as 1 minute in an hour by defective lighting, the resulting loss in production is sufficient to pay for properly lighting his place for that hour.
      (c) On a semi-automatic buffing operation at the Schenectady Shops of the General Electric Co/ improved lighting alone caused an 8.5% increase in production. The increased cost of this lighting was but 0.4% of the increased value of production.
   (2) Spoilage
      (a) Estimates from various sources seem to agree that approximately 75% of spoilage in American industry results during the time that artificial lighting is used, or roughly during 15% of the working year.
      (b) Sight should not be lost of the fact that frequently the natural lighting of a plant is worse than its artificial lighting.
   (3) Present and future capacity of the worker
      (a) Increasing eye strain and fatigue
      (b) Decreased productive push (reduced output)
      (c) Lowering of quality of production
      (d) Greater time required to insure accuracy
      (e) Development of chronic ailments that shorten the productive life of the worker.

(4) Accidents

(a) In 1920 the Travelers Insurance Company surveyed 91,000 industrial accidents and found that 23.8% of them were attributable to poor lighting. Since that time there has been no exact survey, although this company now estimates that 10% can be charged to poor lighting and of this 10% a large proportion are accidents occurring outside of buildings in places not yet generally stressed in good lighting campaigns.

(b) Accidents cause

(A) Loss of productive time of the
Injured one
Those about him (morale)

(B) Caution induces slowing up

(5) Effect on the general character of the workplace

(a) Relation of good lighting to cleanliness.

(b) Relation of shop cleanliness to health of worker.

(c) Psychological effect of good lighting on cheerfulness, health and activity of workers.

D. Good lighting is obtained by

(1) Effective use of natural lighting, supplemented by effective artificial lighting whenever necessary.

(2) Correct intensity for different operations (tables).

(3) Elimination of glare and use of proper reflectors.

(4) Proper diffusion (no lights and shadows)

(5) Proper color

(6) Proper arrangement of lighting sources

(a) General)
(b) Group) Spacing of outlets important. Tables of lumens
(c) Local)

(7) Proper maintenance of lighting equipment.

d. Plant ventilation

A. Atmosphere directly influences production (worker and process)

(1) Dr. Ellsworth Huntingdon "Civilization & Climate."

(2) Society of Heating & Ventilating Engineers.

(3) Parks-Cramer Co., Fitchburg, Mass.

B. Quantity of ventilation

(1) 3000 cubic feet of air per hour per person.

(2) The air of a room can be changed from 3 to 5 times per hour without causing a draft.

C. Relation of temperature and humidity to production

(1) Heat with insufficient humidity dries the tissues and increases the possibilities of colds in winter.

(2) Increased humidity reduces the necessity for higher temperatures. Heating cost reduced.

(3) For different types of operations there have been developed tables of optimums of temperature and humidity that are readily available.

D.

D. Industrial air conditioning today is accomplished in the best managed plants by automatic mechanical means. It is used to overcome the irregularities and deficiencies of the atmosphere caused by

(1) Outside weather conditions
(2) Inside process conditions
(a) Remove the humidity of a dye house
(b) Increase the humidity in a forge shop, etc.

Standard conditions are constantly maintained by thermostatic control operated by both wet and dry bulb thermometers.

2. Machinery, tools and equipment.

a. Plant layout

A. The modern factory building is developed so that all processes are thoroughly considered and related to one another and to the site which is available. Room for expansion is always considered.

B. Proper layout of buildings is assured by designing them to house properly the processes for which they are built. This is in strong contrast with the older idea of fitting processes to buildings already constructed. Fewer and fewer buildings wear out these days because the rapidity with which processes are changing make them obsolescent long before their period of physical usefulness is over.

C. However, modern industrial architecture does not incline so strongly to specialized construction that future adaptation is not possible. In fact, adaptibility to variation in layout is an important factor in any industrial construction program. For this reason in the future the assigning of capacity for military production will not be so difficult as it might seem.

D. Classification of industries according to the layout they require:

(1) Continuous: All material received at one point from which successive operations turn it into the finished product.
(a) Analytical. One material broken up into different products, such as, Oil refining - by-product coke.
(b) Synthetic: Various ingredients brought together to produce one product, such as yarn spinning, paper manufacture, explosives, etc.

(2) Assembly: Make various components by different operations and bring them together.
(a) Similar. Components are similar and go thru similar operations, as the clothing industry, where all pieces are cut and sewed.
(b) Dissimilar: Components are dissimilar and go thru different processes, such as shoes, automobiles, cannon, small arms, ammunition.

E. How to check up a layout

(1) A poor layout is an inadequate layout. It cannot carry the load required of it. Its inadequacies become evident in several ways:

(a) Congestion points (look for them)

(A) Too many operations at one point

(B) Inadequate equipment for one or more operations (unbalanced shop).

(C) Inadequate provision of space for materials in process.

(D) Inadequate material handling facilities, e/g/ internal transportation.

(b) Product recrossing its path or backtracking

(A) In assembly industries of a dissimilar character a certain amount of this is unavoidable, and it becomes increasingly so as the equipment is called on to bear a wider range of products.

(B) Two schools of thought:

<u>One.</u> Avoid it at all times even to the extent of placing single machines at points in the production line where a certain operation is needed. Needless to say, this complicates supervision and inspection of that operation.

<u>Two:</u> Facilitate supervision and inspection by grouping all similar machines together regardless of the path of the product

(C) That plan must be selected which will under careful observation produce the best results at commensurate costs.

(2) The ideals toward which layout should strive are.

(a) Proper balance of departments & operations.

(b) Development of production centers for groups rather than workplaces for individuals.

(c) Direct line layout wherever possible.

(d) Short moves.

(e) Adequate internal transportation.

(f) Convenient service centers. (loss of time)

(g) Provision for future expansion.

b. Age of machinery and equipment

A. Is an important factor because of its bearing on:

(1) Maximum capacity of equipment.

(2) Degree of precision that can be attained.

(3) Amount of time lost for repairs.

(4) Commercial availability of spare parts.

(5) Adaptibility to several types of operations, e.g., chucking machines on turret lathe work that can be switched over to wire-feed or bar-feed equipment, or again, gear cutters that will cut spiral, straight, spur, and shoulder gears, or do gang arbor work.

B. Sturdiness to withstand modern tooling.

(1) Effect of introducing high speed steel.

(2) There has now been reported a new steel which cuts brass eight times more efficiently than the best we now use, and forged steel four and one-half times.

(3) Some machines five years old will not hold up under the tooling that intensive research has found to be best suited to machines of that general type.

C. Reduced production also results from the psychological effect that an obsolete machine produces in a highly skilled worker.

c. Tools and fixtures

A. Is there a sufficient quantity of tools

(1) To keep each machine fully supplied at all times

(2) To permit of inspection, maintenance and repair after return from a production job

B. Is quality such that the tools will do their tasks without unduly rapid deterioration. Is this quality and efficiency maintained by :

(1) Prompt sharpening & repairs by skilled tool men

(2) Adequate tool control at various machines

d. A ready means of checking up the weak points in the equipment or management of any factory is to make a thorough analysis of the reasons why each piece of equipment that is not running is idle. If you add to this the reasons for the existence of congestion spots, you have an almost infallible measure of the relative efficiency of that factory, as well as the management that operates it.

3. Power supply - bare outline of checking points

a. Make or buy - existence of stand-by facilities in either case

b. Maximum present capacity in either case.

c. Future increases in capacity - are they readily possible.

d. What is the likelihood of other war time demands for power in that area and will the maximum potential capacity take care of it

e. Adequacy and protection of the fuel supply that generates that power.

f. Hydroelectric possibilities.

4. Labor supply - bare outline of checking points

a. Present quantities according to sex, age, and degree of skill

b. Extent of potential sources of labor that can be trained to the operations

c. Adequacy of local transportation to bring labor to the factory

d. Adequacy of housing in the community if there was a large influx of labor

e. Social and cultural advantages (efficiency of labor) - livability.

II. INTANGIBLES

1. Attitude of the management toward standardization (a primary management step)

   a. Standardization is the development of the one best way and sticking to it.

   b. Attitude can be gauged by several things.

      A. Extent to which civilian production has been simplified
         (1) Has research been applied to the product for this purpose?
         (2) Is it felt that no improvements can be made?

      B. Extent to which standards have been set up for the
         (1) Purchase of raw materials and supplies.
         (2) Purchase of machinery and equipment.

      C. Extent to which standards are maintained
         (1) Purchased materials - inspection and testing
         (2) Product - inspection department
            (a) Accuracy limits within which the inspection department is accustomed to operate.
         (3) Equipment - maintenance department
            (a) Belt schedules
            (b) Motor schedules
            (c) Idle time reports
            (d) Individual machine repair cost records
         (4) Labor performance records
            (a) Output per man hour (or other unit)
               J & L - tons per machinist hour
            (b) Steps taken to secure standards of labor performance, such as
               (A) Job study - time, motion and production studies.
               (B) Setting standard performances

2. Personnel relations

   a. Personnel policies

      A. Morale-building versus morale-destroying organization.
      B. The scope of the personnel director's authority.

   b. Employee training methods

      A. For the next job.
      B. For supervisory capacities.

3. Control of operations
   a. Budgeting for administrative control
   b. Control of inventories
      A. Finished product - sales planning & production correlation thereto.
      B. Raw materials - stores control methods.
         (1) Storeroom procedures.
      C. Purchasing department procedures.
   c. Control of production
      A. Routing and scheduling
      B. Order of work and despatching - elimination of rush & special rush
      C. Planning economic manufacturing lots