Good Practice in Plant Layout and Facilities Planning

Founded in 1956, Richard Muther & Associates has completed more than 1000 layout and facilities planning projects, involving all kinds of plants and warehouses. Our planning methods -- Systematic Layout Planning (SLP), Systematic Handling Analysis (SHA), and Systematic Planning of Industrial Facilities (SPIF) -- are used throughout the world.

Recently, a manufacturing company refused to pay its architect over inadequacies in a newly-constructed building. These included lack of space in key areas, poor placement of key activities, excessive material handling, and increased operating costs.

We were retained as experts to determine if the architect did a competent job and observed good planning practice. We provided the following list as the most important elements of good layout and facilities planning. In our experience, a well-planned project will observe each of the 20 points below.

1. Written summaries of key input data. This is data about the business and its processes – not the facility or its space requirements. For new plants, the planner should provide charts or tables that clearly contrast historical, current, and projected future data in a way that clearly alerts management and reviewers to the significance of planned changes in:

   Products and materials, especially changes in the numbers of items being processed, and in their physical sizes and types.

   Quantities: throughput (production volumes) by product (P-Q or product mix). And for storage facilities and areas, the inventory levels on hand.

   Routings, processes, types and sizes of equipment, and sequence of operations.

   Supporting services, including tool storage, maintenance, offices, utilities…

   Time-related changes in shifts, working hours, seasonality, etc.

   This key input information should be gathered, presented and confirmed, before layout planning begins, and re-confirmed at subsequent major reviews and decision points. It is not uncommon for such data to change as people have more time to reflect on implications, and as a wider circle of reviewers see the information that has been provided.

   The larger the capital investment, and the greater the "fixity" of proposed plans, the longer should be the horizon on input data and trends.

2. Formal presentation, written analysis and (written) reconciliation of any major differences in the input data. This is done to insure that the best numbers or assumptions are being used, and that everyone involved in planning and approval agrees on the requirements.

3. Written list of key planning assumptions and discussion of their consequences if not obvious. Best practice is to rate the significance or import of the assumption on the plans being prepared. The assumptions list should be started early in the planning process and maintained as a "register." It is typically reviewed periodically in attempts to resolve issues and uncertainties, and as later input to contingency plans. Open issues should be resolved early in the project whenever possible.

4. Involvement of a multi-disciplinary team, formally named by the overall project manager as the source of layout relationships and ultimately for approval of the plans developed. When too much of the work, and too many of the decisions are made by the layout planner, then oversights are sure to result. To guard against this, the planner should lobby senior management to name a team.

5. Formal presentation and systematic evaluation of 2 or 3 significantly different alternative block or overall layouts. Typically, these alternatives are constructed to feature differing:

   a. Flow patterns, such as straight-thru vs. U-shape (with combined Receiving and Shipping)
   b. Storage concepts – central vs. decentralized; with and without mezzanines…
   c. Directions of and reserves for future expansion
   d. Placements of major "monuments" (fixed equipment such as drop hammers, autoclaves, process tanks, compressors, boilers, etc.)

   Evaluation customarily includes cost and benefit comparisons, and participative, formal scoring of the alternatives by a cross-section of appropriate operating and support personnel.

   When the project is to plan a new or expanded site, the evaluation should consider alternative site layouts and flow patterns and well as alternative building layouts.

6. Effective use of color on drawings and presentations in order to highlight and help the viewer understand the amounts, kinds, and overall shapes of the proposed spaces and arrangements. Typically, aisle placement and storage areas are highlighted in this way.

7. Use of colored overlays to show major movements of materials and flow patterns, and to help the viewer confirm that the layout minimizes material handling effort. Overlays should indicate the material handling methods where known.

8. Formal presentation and written reconciliation of all space estimates, in amount, kind, and shape or critical dimensions:

   a. Between space currently used and projected future needs;
   b. Between projected needs and the space actually provided in the various alternative plans.

9. Well-documented support for any major reductions (or increases) in space, from present operations. Such documentation includes:

    a. Written list of space estimating assumptions.
    b. Calculations showing the effect of specific assumptions on space required.
    c. Sketches where new, unfamiliar, specialized, expensive, or highly fixed equipment is the basis for the difference.

10. No summary of space requirements without explicit, written presentation of an allowance for main aisle space. Without this, there can be no closure on the adequacy of the total space provided. (Aisles could simply be an afterthought and receive whatever is left after housing individual areas).

11. No summary of space requirements without explicit, written recognition and discussion of building features, especially ceiling height and overhead clearance, floor loading and strength, column spacing, primary utilities distribution, docks and other major openings.

12. Formal documentation of all activity-area relationships in the proposed layout. Documented resolution of differences in desired activity-area placements as expressed by different client personnel. This is a universal problem in layout work. The people involved will differ in their desires and reasoning. It is the job of the layout planner to achieve and document consensus on desired placement, clearly record the reasons therefore, and to quantify or rate the degree of desired closeness that will be observed during planning. The industry standard document for this purpose is the rated-and-reason-supported Relationship Chart, signed-off by the leader of the project and/or planning team.

13. In the early stages of the planning, more weight should be given to the voice of operators and supervisors on matters of layout, material movement, and space requirements than to top executives. The planner should believe the operators and supervisors until it can be demonstrated that they are wrong.

14. In the early stages of the planning, more weight should be given to the voice of "old timers" than to "new comers." The planner should believe the more senior people until it can be demonstrated that they are wrong.

15. If the top manager or new managers are at odds with old timers and operational management on matters of consequence, then the layout planer must tactfully surface and explain the consequences of such disagreements to all parties involved, and try to get them to agree. If disagreements remain, prepare a contingency plan around them.

16. Formal risk assessment and contingency plan agreed to during approval of plans (so that consequences and redress of incorrect assumptions and inputs are themselves planned events). The contingency plan is thus a part of the total plan being approved.

17. Hold detailed layouts of machinery and equipment, or limit these to critical areas until total space requirements and the block layout are established. When this rule is violated, the reviewers become so overwhelmed by the detail and amount of information presented that they lose sight of the big picture and of what may be missing or not presented.

18. When detailed layouts are presented, storage racks are included as equipment, the same as machinery. Leaving them out leads to oversights in amount, configuration, and accessibility, and to misunderstanding of material handling methods.

19. Detailed layouts should show material handling equipment. Templates loaded with the largest pieces of material and placed in tightest maneuvering areas to provide visual confirmation are helpful. Material handling personnel should review the plans. Typical checking points should include: docks, narrow aisle spaces or intersections, in storage racks, and at access and staging points to ovens, autoclaves, paint booths, etc.

    In cases where clearance and maneuverability cannot be visualized in a two-dimensional plan view, the planner should provide elevation drawings or a 3-dimensional visualization.

20. Finished layouts should be documented with adequate drawings and /or specifications, so that suppliers of purchased equipment understand what they are bidding on, and so that the installation crew(s) can understand what is needed.

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How does your project rate? If you are observing the 20 points above, chances are you will arrive at a good plan with minimal oversights and changes at installation time.

If you want to assure that these points are addressed on every project, then use our systematic planning methods. These include:

- Systematic Layout Planning (SLP)
- Systematic Handling Analysis (SHA)
- Systematic Planning of Industrial Facilities (SPIF)

To learn more about these and our other planning methods, visit our website at: www.hpcinc.com/rma.html, or contact us at:

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