"SIMPLE MINDED" ENGINEERING - 1958

In January 1957, a write-up titled "Simple Minded Engineering" was issued with limited distribution. What has been accomplished in this field over the past year? This write-up is being presented as a general appraisal of one unit's (Drive Mechanism) effort in 1957. For brevity, all the jobs in this unit will not be covered. The original write-up will be repeated with appraisal comments following each portion of Item II. The original write-up will be indicated by a vertical line in the margin.

How can G.E. be competitive in the atomic power equipment field in general and the control drive mechanism engineering field in particular?

To be competitive we must surpass competition in value given to the customer. Value consists of the proper equipment to perform the function the customer requires - at the time, the cost, and at the quality level he requires.

Are we offering the customer good value? No! This is the heart of our problem. Most of our design engineers and at least some of our supervisors will say "yes" because we are giving the customer more than he needs to perform the required "function" - our fits are superb, our finishes are really smooth, our parts will last forever, we design "G.E. quality" into it. Actually we are giving him poor value - we are making him pay for things that have no value. He is not only paying for them, but he has to wait to get them. He will do business with us only as long as no one else offers him higher value.

I. Why are we designing things this way?

A. We definitely lack experience and training along "simple-minded" engineering lines. This results in:

1. Lack of understanding the "value-function" concept.

2. Failure to realize that often a dollar spent in engineering saves ten dollars in manufacturing.

3. Failure to utilize G.E. Specialists.

4. Failure to utilize speciality vendors.

2/7/58 (notes on back)

-GE

- Results

5. Failure to utilize draftsmen at maximum efficiency.

6. Failure of individuals to properly organize their efforts.

7. Engineering tendency to develop forever but never produce.

8. Lack of training in creative engineering.

9. Misunderstanding of emphasis on cost and schedules.

10. Overconcern about and trying to do OTHERS JOB manufacturing's, purchasing's, etc. job.

11. "Too much red tape" attitude.

12. Use of negative approach, road blocks.

13. Failure to realize that even the low quantities quantity or prototype items are costing up to double what they are worth.

B. Cost figures (estimates and actual) are not being given to individuals.

C. No general investigation program.

D. Insufficient engineering assistant, technical specialist, and drafting personnel.

E. No standard drafting practices.

F. No model shop.

II. What does all of this mean and what can be done about it?

A. Engineering personnel has been accumulated from a large number of locations. The majority have come from G.E.L., A&O or similar locations that have not developed many "simple-minded" engineers. What is a "simple-minded" engineer? He's a person who will make one simple part replace two parts, or if the occasion warrants, will make two simple parts replace one complicated part. He will open up tolerances as much as possible. He will eliminate

parts that have no required function. The life of his design will be only sufficient not excessive. He will use stampings, castings, forgings, and machined parts where each is most economical. He will replace polished surfaces with rough surfaces. He will use standard parts rather than special parts. He will consider appearance of the finished product. He will cut the cost of any present APED designed product by 30 to 50% whether the quantity is one or one hundred.

A year ago it was very difficult to find a casting in any design while welding was used "everywhere". At the present time, the percentage of "hog-outs" and weldments have been reduced appreciably while the percentage of castings have been increased. The number of parts have been reduced appreciably. For example, quantity of parts on GETR drives compared to parts on the ETR drives have been reduced by approximately 30%. Finishes have been "roughened" by one to two steps. Drives have been "cleaned-up" and uniformly painted for improved appearance. Tolerances have been opened up by 50 to 100%. Approximately 100% standard hardware is now being used. The number of tapped holes has been cut by 75%.

How about this 30 to 50% reduction in costs? Let's take four examples:

1. Open pool reactor -

"Spanish Design"	$2,700	Shop cost/drive
"Venezuela Design"	$1,700	
Reduction	$1,000	per drive
	37	%

To accomplish this savings, it was necessary to spend $9,000 in engineering. Therefore, to show a net savings it is necessary to write off the engineering over the first two lots of drives (12) which are now being made. This write off is faster when all the "adders" are considered. Additional drives are contemplated.

2. Ebasco - (12.5 MW Power Plant - Standard)

   A recent cost estimate shows a shop cost of $8,500 each. As a result of "simple minded" engineering, present estimates indicate this cost should be $3,800 each. A reduction of 55%. This was accomplished without added engineering expense.

3. G.E.T.R. -

   At the beginning of this program, Drive Mechanisms was told no engineering money was available - use ETR design as is. The ETR design looked costly so Drive Mechanisms got together with manufacturing and worked out a program which indicated that by spending an extra $5,036 in engineering the shop cost for the drives could be reduced from $66,171 to $52,661 for a reduction of $13,510 (for 7 drives). This story was presented to Project Management who in turn authorized Engineering to proceed with the redesign. When all adders are considered and the engineering cost subtracted, a net savings of $11,350 or 10% results. It now appears that this estimated savings is very conservative. Engineering actually spent approximately $4,200 rather than $5,000 in redesign.

4. Dresden -

   There have been many estimates made for these drives. The highest estimate Drive Mechanisms has heard is $25,000 each shop cost. Estimates now being made from the planning indicate a cost of $3,400 each - a reduction of $21,600 each or 86%. For the 80 drives to be used on the reactor, this gives a savings of $1,728,000. The previous "low" estimate would have given a savings of 50%. This savings has been accomplished without increases in engineering allocations.

All of these savings have been accomplished without "cheapening" the product. As a matter of fact, in all cases the products have been improved in such things as simplicity, reliability, ease of maintenance, ease of manufacture, and appearance. The simplifications have also helped to "meet schedule".

A-1. What a dreamer! How is he going to accomplish this?

He will use the "value-function" concept automatically due to training and experience. He constantly asks himself - is the function of this gadget worth its cost, does the customer require the function it performs, can it be made in the time required, what else will do the job for less, am I trying to put too much "quality" into it, and can it be eliminated completely? If these or similar questions are not constantly asked and re-asked, any engineer will make a design that is excessively high in cost and time to manufacture.

The results given above cover this item.

A-2. He will constantly measure time and money expended in engineering to make sure that it is more than offset by time and money saved in manufacture when he is considering redesigning for "simplicity". Quantity to be produced is carefully considered here.

This has been done in each case.

A-3. He will utilize G.E. specialists whenever possible rather than trying to be an expert in all fields. He relies heavily on manufacturing, engineering, purchasing, materials specialists, casting specialists and many others. This does not mean becoming a "yes man".

All programs now being done in Drive Mechanisms are reviewed with manufacturing people and other engineers during layout and prior to release of details.

A-4. He will use speciality vendors to design and supply springs, solenoids, switches, bearings, castings, stampings, and other speciality items.

This is being done - particularly in the fields of gearing and casting. It can stand more emphasis in other fields.

A-5. He will have draftsmen do as much of the design job as possible. He will not have a designer doing detail work while design work is not being done. He will help train draftsmen in the "art of simplicity".

This has been done some but much more remains to be done.

A-6. He will organize his own time to make sure that all details are accomplished. He will allocate his time between:

a. Design, test, and "debug".

b. Production engineering

(1) cost reduction
(2) quality improvement
(3) factory aid (He will realize that this cannot be done while sitting at a desk. He will "get his hands dirty").

c. Customer relations.

d. Requisition work

(1) scheduling
(2) costing
(3) engineering instruction, etc.

e. Coordination and communication with management.

f. Training

g. Cost control

h. Clerical

i. Supervising

(In the case of supervisors or managers they will allocate the effort for the whole group as well as having each individual allocate his own time).

The biggest improvement noted in this area has been in production engineering. The next biggest has been in scheduling and costing. Time spent in training in Value Analysis has been very profitable.

A-7. He will realize that although he would like to "develop" something forever, it is not economically feasible. The money for development comes from selling the results of development.

> This has been no problem - no one has had time to develop things at all much less "forever". At the present time, it would be very desirable (if not absolutely necessary) to inaugurate some Advance Engineering Programs to develop some "feasibility proven" designs for incorporation in future product designs. Would it be appropriate to obtain a percentage of the above savings to "plow back" into advance engineering?

A-8. He will use the "Creative Engineering Approach" to design problems. He will take time in the beginning to really understand the problem before trying to solve it. He will think of eight or more possible solutions before he starts work on any. He will get ideas from others. He will constantly "back-off" and look at the overall problem rather than constantly concentrating on details. He will design by comparison, e.g., if he needs a snap action, he will consider using a mouse trap principle rather than coming up with a complicated self-designed principle that requires much "debugging".

> Individuals have been getting ideas from others by layout reviews, etc., as mentioned elsewhere. Although there has been considerable "design by comparison", more is warranted.

A-9. He will use costs and schedules as a tool to help him accomplish his job rather than considering it a curse to be ignored while he enjoys himself until the last minute at which time he rushes through a lot of drawings without proper layouts, thought, calculations, and checking in an effort to get a "gold star" for meeting a schedule - the purpose of which he has never understood or appreciated. He will use schedules to aid in organizing his work as discussed in II A-6 above.

The making and adherance to schedules has improved. Schedules could be made in more details to give a better allocation of time to various portions of an individual's job, and to aid in the preparation of estimates.

A-10 He will not waste time worrying about purchasing, manufacturing, and other function jobs. He definitely will not do their job for them. (He will undoubtedly "louse it up" worse than they do regardless of what he thinks about their ability. He also would not accomplish his own job). He will, however, be ready to lend aid or "do battle" when the occasion arises.

This area shows improvement. This has been brought about by working more closely with personnel from the other functions.

A-11 He will consider "red tape" details in the same way he considers schedules. If he is truly convinced it is just red tape, he will suggest changes.

In general, the criticism of "red tape" has been constructive. An effort has been made to use procedures as they exist, but to criticize them when it appears appropriate.

A-12 He will take a positive approach to his problems rather than arbitrarily using "roadblocks", such as: the quantity isn't large enough, it won't work, we can't pay for the tools, we tried that before, we haven't had a failure so don't change it, it's not G.E. quality, there's no other source of supply, cost is not important - just get if out the back door, we can't help it - it's policy, we don't have enough time or money. Another roadblock that warrants special attention is - "it will never get by safeguards". This is probably the most used roadblock in APED. It must not be used in fear or as a cover-up for laziness or ignorance. Just as other departments have as their favorites - Underwriters or Army Ordnance, APED has Safeguards.

Roadblocks have been minimized. "Safeguards" has been used as an excuse very seldom.

A-13. He will realize that if he can save 30 to 50% of cost (with due regard for all costs including his own) that it is worthwhile. A quarter million dollars saved on several low quantity items is worth as much as a quarter million dollars saved on a high quantity item.

Comments regarding this were made above.

B. In order to make an engineer value and cost conscious, costs must be "brought home" to him. If a part or assembly fails in test, he is very aware of the situation. If a part or assembly costs too much, he may or may not even hear about it until too late. He should receive breakdowns of estimated costs and actual costs.

This has been difficult to accomplish. New procedures Finance is now planning will aid in this area.

C. A general investigation program as now being planned should be initiated. Many of the problems (and roadblocks) on such things as materials, tolerances, and finishes are by-passed because no tests have been run to convince the "doubting Thomas's" that a design which is probably "good for a million strokes" is not required for "5,000 strokes".

This program has not reached an optimum magnitude, but the results obtained to date are very beneficial.

D. By using more engineering assistants, technical specialists, and draftsmen, the engineers could be relieved of approximately 20% of their load. This would also require training the engineers for this type of operation. It also improves efficiency and morale by relieving engineers of work they begrudgingly do, if they do it at all.

Assistance of this type is being utilized to a large extent. If more was available, it could be used advantageously.

E. A carefully considered drafting practice can go a long way to improve the quality (number of errors) in our drawings. It would also reduce manufacturing cost and delays by permitting more rapid and accurate interpretation of drawings.

Drafting practice has made definite improvements in the past year and is continuing to improve regularly.

F. A model shop organized to give engineers an opportunity to have samples made with a minimum of "red tape" and lost time would result in engineers having more sample components made prior to release of drawings for either prototype or production machining. This, of course, would also require adequate test facilities.

Although a model shop as such has not been organized, it is easier now than it was a year ago to get samples fabricated. There is more component testing done now, but still more should be done.

III. How can we get the show on the road?

It is obvious that training is the main requirement at this time. The type of job to be done is shifting from research and development to plain business competition. In general, the work to be done by the same personnel (managerial, supervisory, and individual) that did the research and development. To successfully do this, these people must be trained to do a different type of work. The atomic and nuclear glamour must be removed and replaced with hard and cold hardware. The emphasis on intriguing physics must be separated from the nut and bolt problems. This training should be done both formally and informally. The formal should include discussions on value, function, cost and other subjects covered above as well as discussions on business economics and overall APED organization. The informal would be by daily individual contacts and design review meetings. The first objective of this training program should be to build up a desire in the individuals to have APED become competitive in a business sense. The overall training program should include supervisory and some managerial personnel as well as individuals. It has been proven disastrous to have individuals very enthusiastic about doing something when their supervisors and managers are not familiar with what is going on.

Organization charts and description should clearly show the relative authority and responsibility between physics, advance engineering, product engineering, and other such groups. In the selection of new personnel and appointments, the type of job to be done in the future should be considered.

Beware of the attitude that all of these problems will be automatically solved by the "passing of time". "Time will tell" how successful we have been in our efforts to solve our problems, but there is no magical property of time that will solve our problems for us.

This discussion should not be construed as a blessing on all functions except engineering. However, before we start excessive complaints about not being able to get manufacturing cost estimates accurate within ± 100%, insufficient information about vendors, etc., let's try to get our own house in order.

This all sounds like Drive Mechanisms has done a very good job in the past year, but when you consider the remaining potential - it is only the beginning.

How have other units progressed in the past year? That's up to each unit to determine.

R. R. Hobson
Value Analysis Counselor
Control & Instrumentation Eng'g.

February 6, 1958

P.S. It should be noted that the progress made by Drive Mechanisms in the past year is largely due to the assistance from other functions, such as: Equipment Manufacturing and from other engineering groups. This, in turn, is to the credit, <u>not</u> <u>discredit</u>, to those in Drive Mechanisms.

Cost is important — Notes APED 2/7/58 By LDM

Performance Energy -
Value - Energy - — Quality - automobile
Very Early Stages
" low Quantities

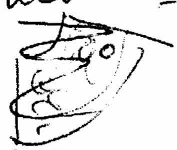
concrete

45 — 6.50 — . Cost mortem "one of a kind"

Laboratory designs + VA — "Maybe Lab. is the place"
Evaluate functions - several workshop examples

Hawk Launcher -

Team work - — Refuing part
motor shield



show instrument.

VA procedure work -
~~Omaha GE club~~
~~Sears Roebuck~~ montgomery ward
1 ¢
Request for mat'l - free

Evaluate functions 2 ways

Value control -

Followed by questions -

A significant question by a member of the group
"where are our sub section and other managers?"
(~~mktg~~ mgr Hobbs - was out of town - is strong for program
mktg mgr McDonald was there helping sponsor the program
but most others were absent. See what Jim was in town.
~~but~~ I saw him 5 minutes. ~~[illegible]~~ LDM)