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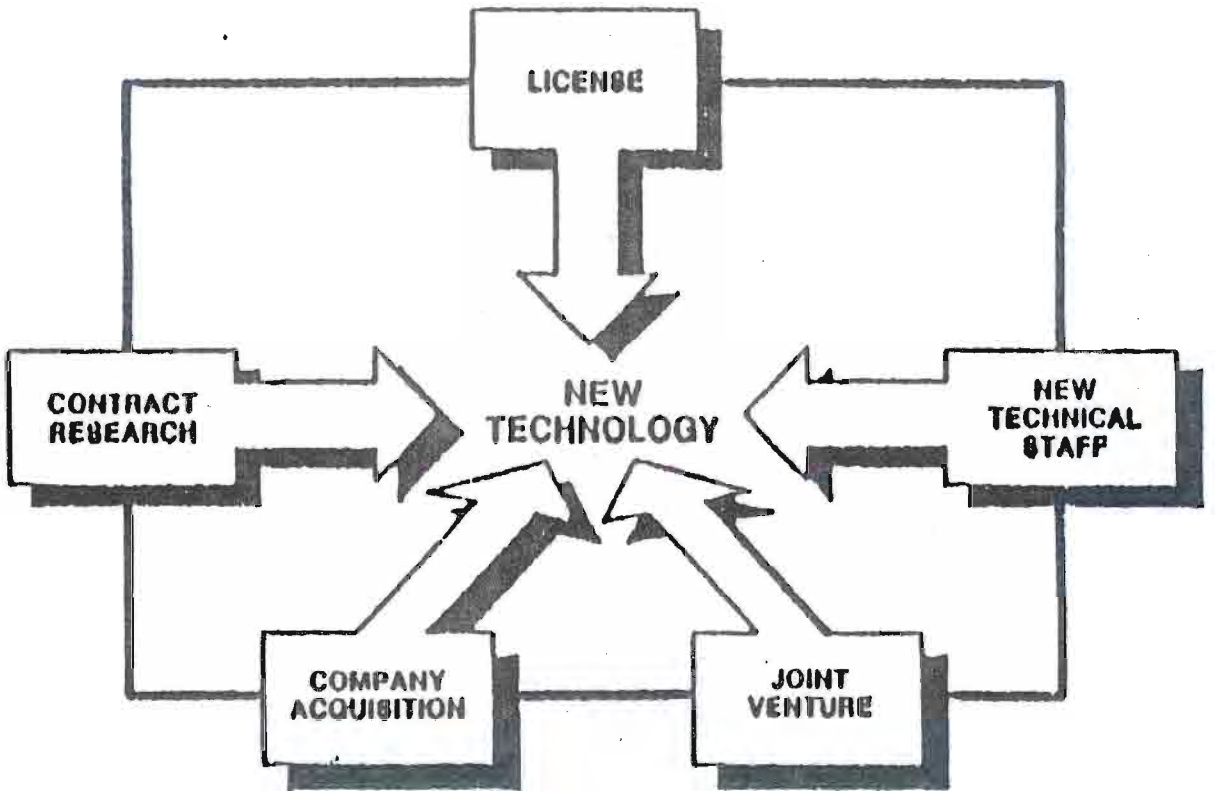
Several ways of acquiring new technology are shown on this viewgraph.

Suppose a company sees that it is necessary, for example, to produce a new jet engine in order to be competitive in the 1990's. It can move forward by:

- obtaining a license to produce the new turbine blades developed by that other company up in Canada,
- attract the two key technical people away from a competitor, and hire a well-known retired university professor to increase the specific capabilities of its technical staff,
- team with another, roughly equal company, with complementary capabilities; they develop the compressor, we develop the combustor and turbine,
- an outright purchase of a small company that has developed a unique fuel-control device needed for the new engine,
- perform contract research -- say a program sponsored by NASA in the area of aeropropulsion to develop internal corporate skills in turbine fluid flows.

In this discussion, we will concentrate on research and technical staff

The Alternative Routes to New Technology



Source: Arthur D. Little, Inc.

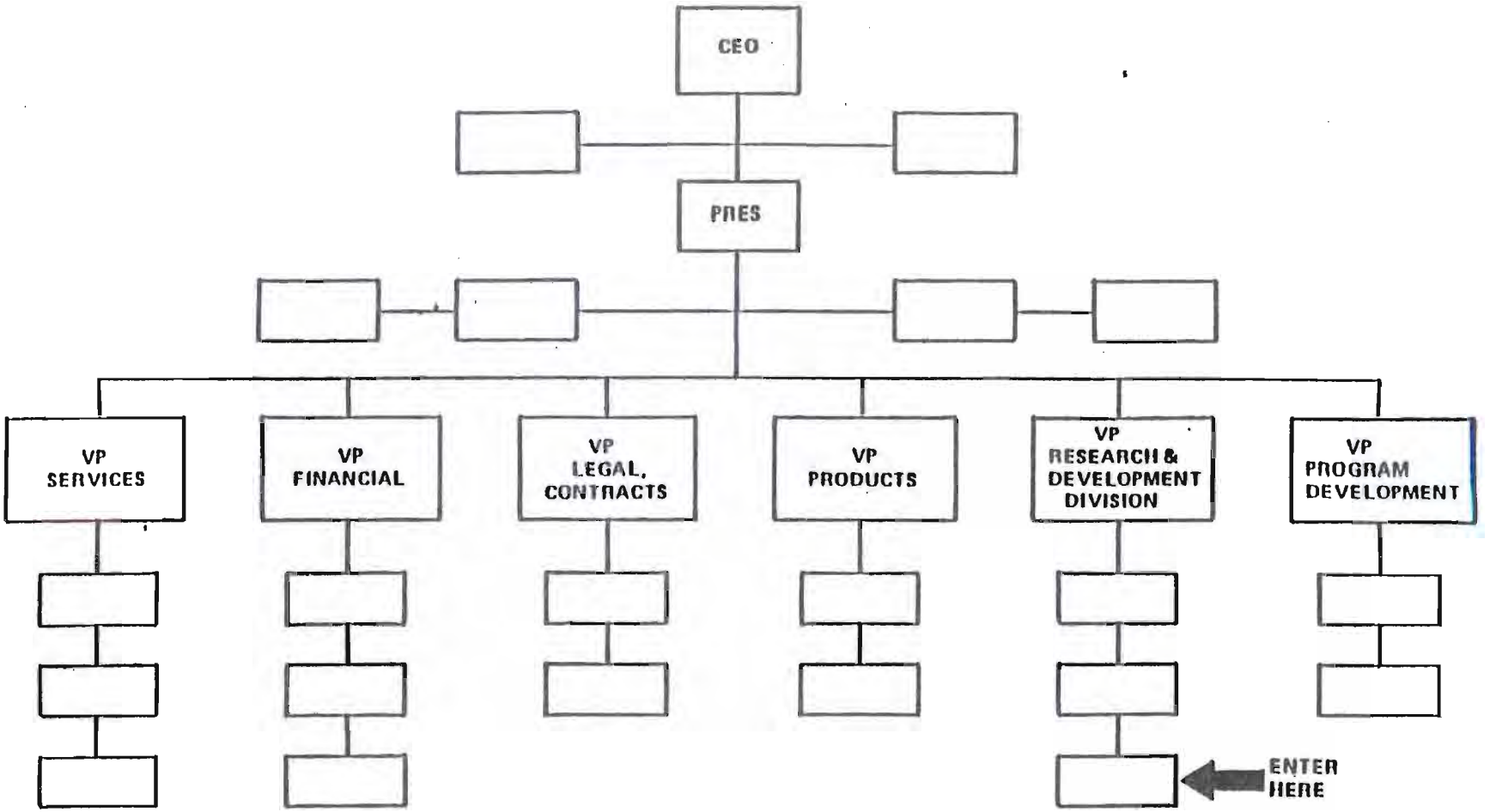
We should look at the organization in which these goals are pursued and the questions are asked.

A generic organization chart is shown, with the "Enter Here" arrow indicating where a young researcher would likely enter the organization.

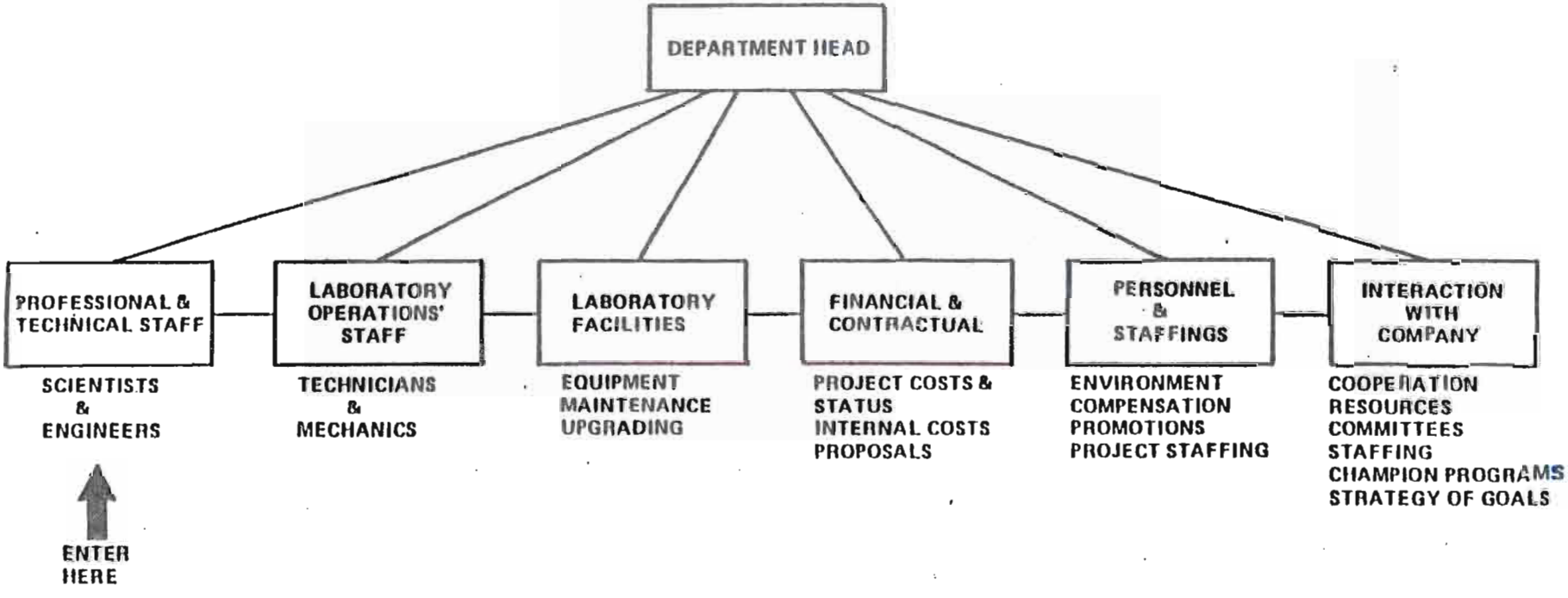
The R&D Division does not act alone, but must interact with all other company divisions .....

- Other departments in R&D have developed new techniques that can be incorporated in your particular department
- program development needs a new product for the market under cultivation
- production says it may have problems producing such a complex device
- legal is looking at the patent position
- financial is studying the costs of the new machinery required, and
- services is wondering where they will construct the new laboratory necessary for this program.

GENERIC ORGANIZATION CHART



A CLOSER LOOK
TECHNICAL RESEARCH DEPARTMENT



Researcher's Goals

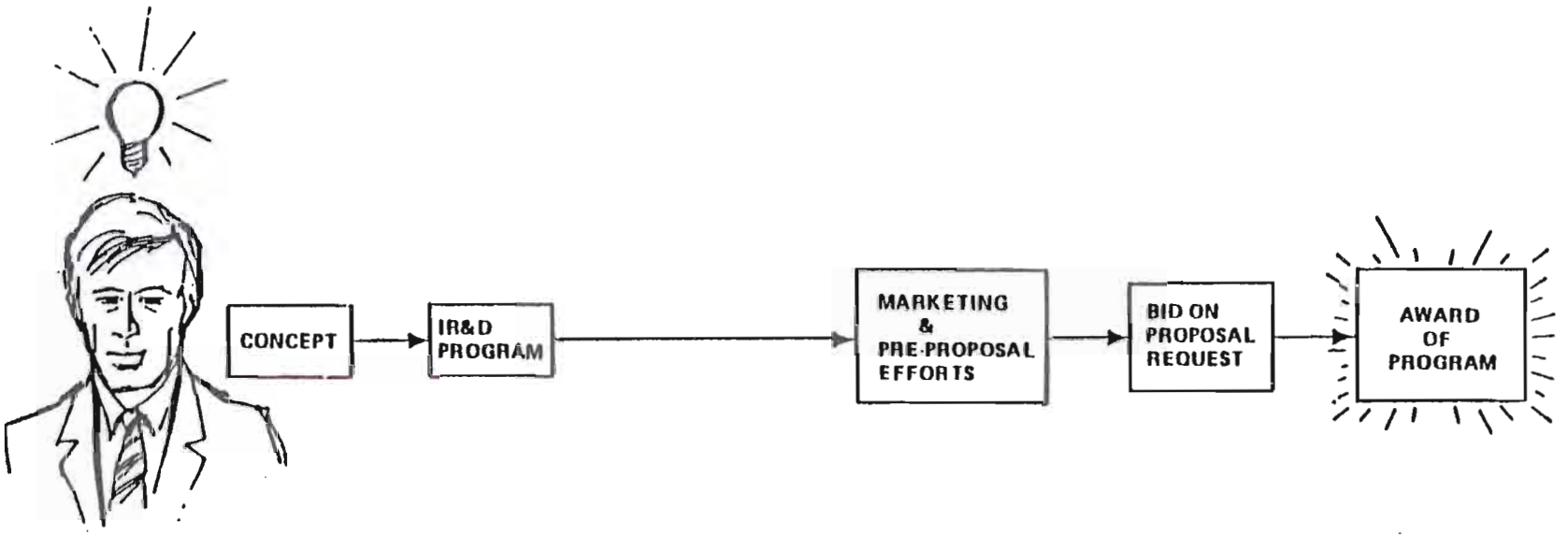
- Do interesting work on a technically challenging problem
- Obtain internal R&D funds to develop concept; obtain patent
- Publish a paper in technical journal and present at meeting
- Find an outside sponsor or customer
- Direct concept into full-blown system

  Become a program leader with subsequent visibility in the company

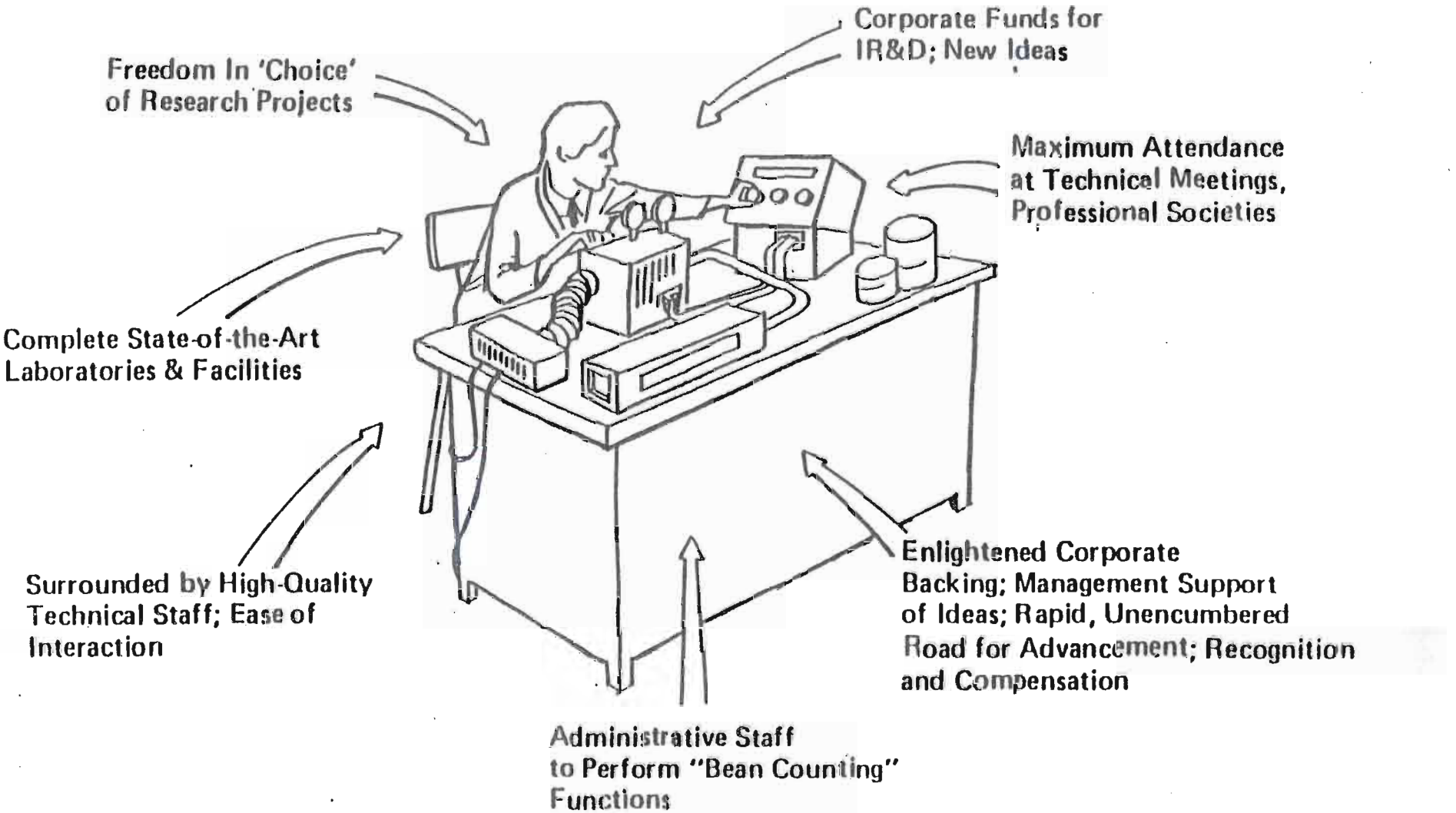
Management Questions

- Is the concept technically feasible?
- Is it part of the company's overall business strategy?
- Is it the correct approach to future business areas?
- How much internal funding is required? These funds would have to be taken from another important program
- How large a research staff required? These people will have to be taken from other (equally or more) important IR&D projects
- What facilities and laboratory requirements?
- How long will this project take? Deadline to first in a new area? Establish a unique position?
- What is the eventual payoff for these investments?

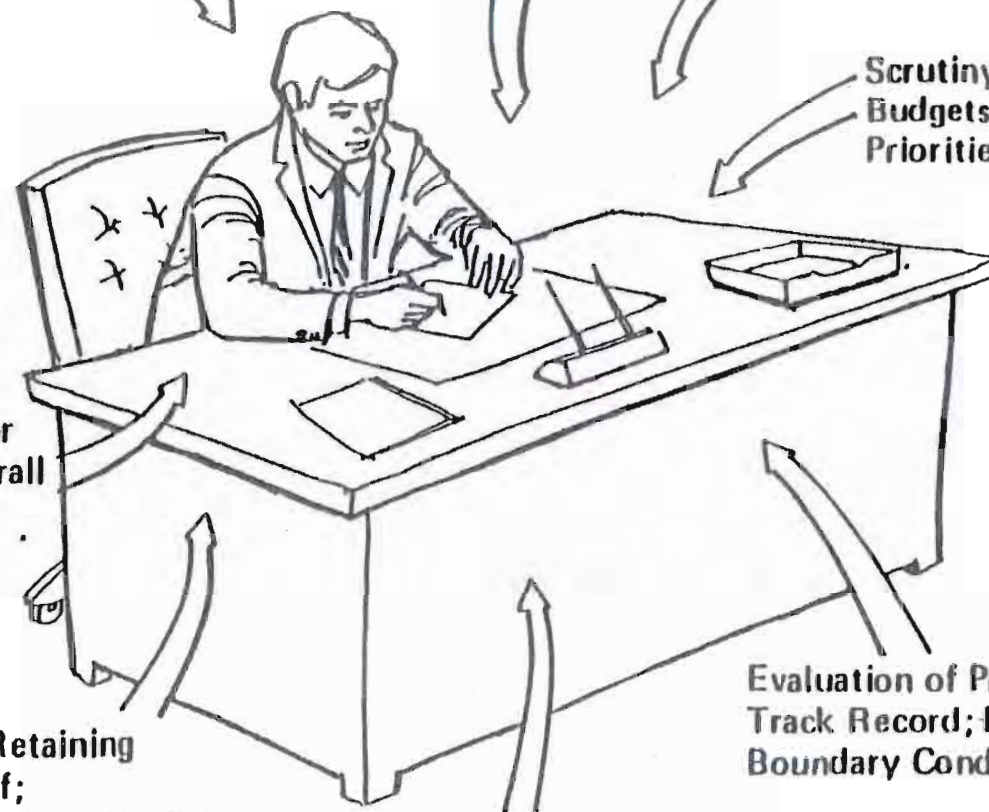
THE ROAD TO A RESEARCH PROGRAM



RESEARCHER'S VIEW OF CORPORATE HORN-OF-PLENTY



MANAGEMENT AND BOUNDARY CONDITIONS; THE "REAL WORLD"



Interaction of Various Projects; Overall Corporate Strategy

Stockholders
Costs
Profits

Multiple Requests for IR&D/Proposal Dollars
Priorities; Finite $;
Overall Strategy

Scrutiny of Overhead & Travel Budgets; Multiple Requests, Priorities, Benefits to Company

Careful Control of Capital Investment Funds; Priorities for New Facilities; Overall Strategy

Attracting & Retaining Technical Staff; Compensation; Investment; Financial Performance; Selection of Research Areas

Careful Control of Overhead Budgets; Limited Administrative Staff

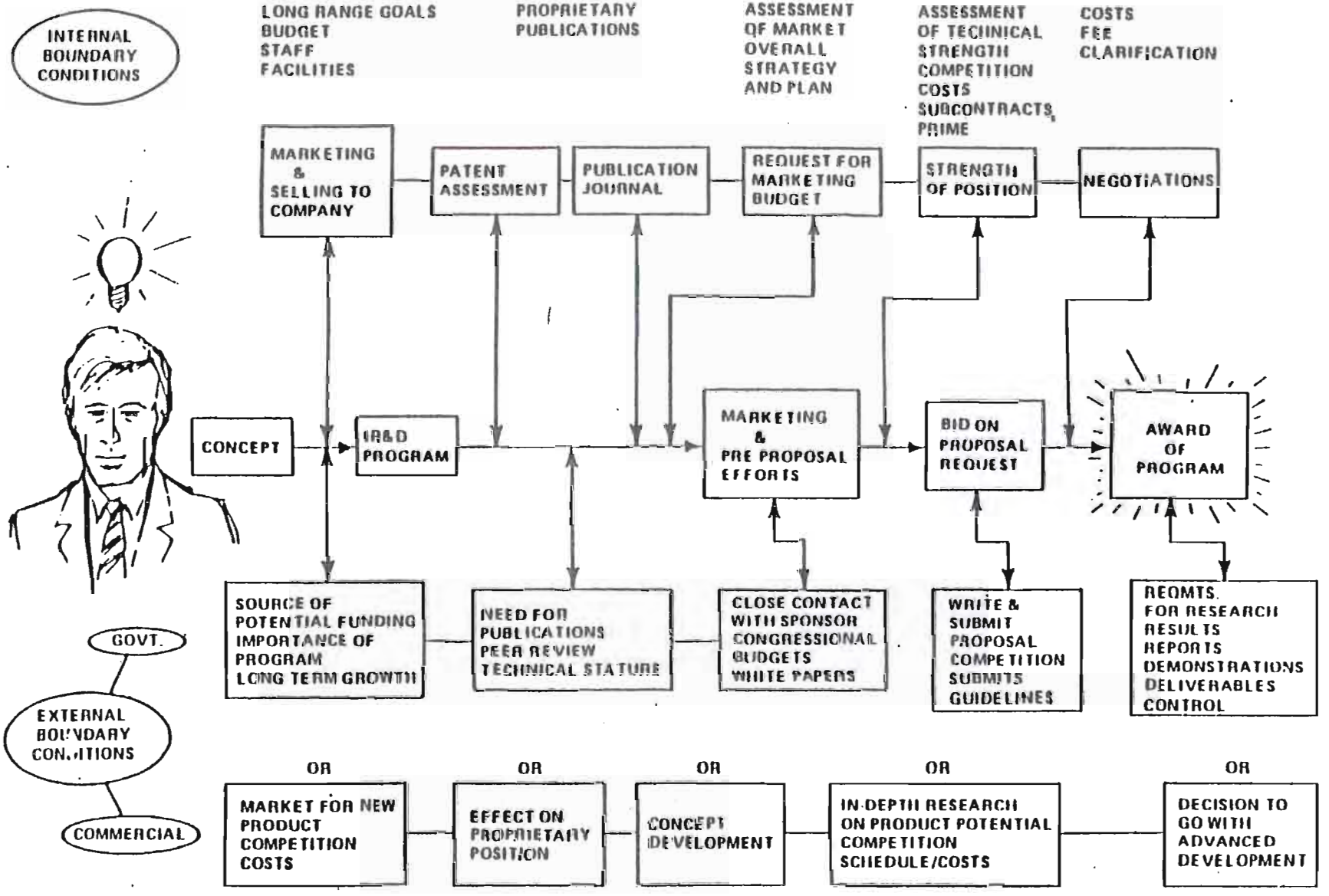
Evaluation of Program Champion, Track Record; Performance Boundary Condition on Compensation

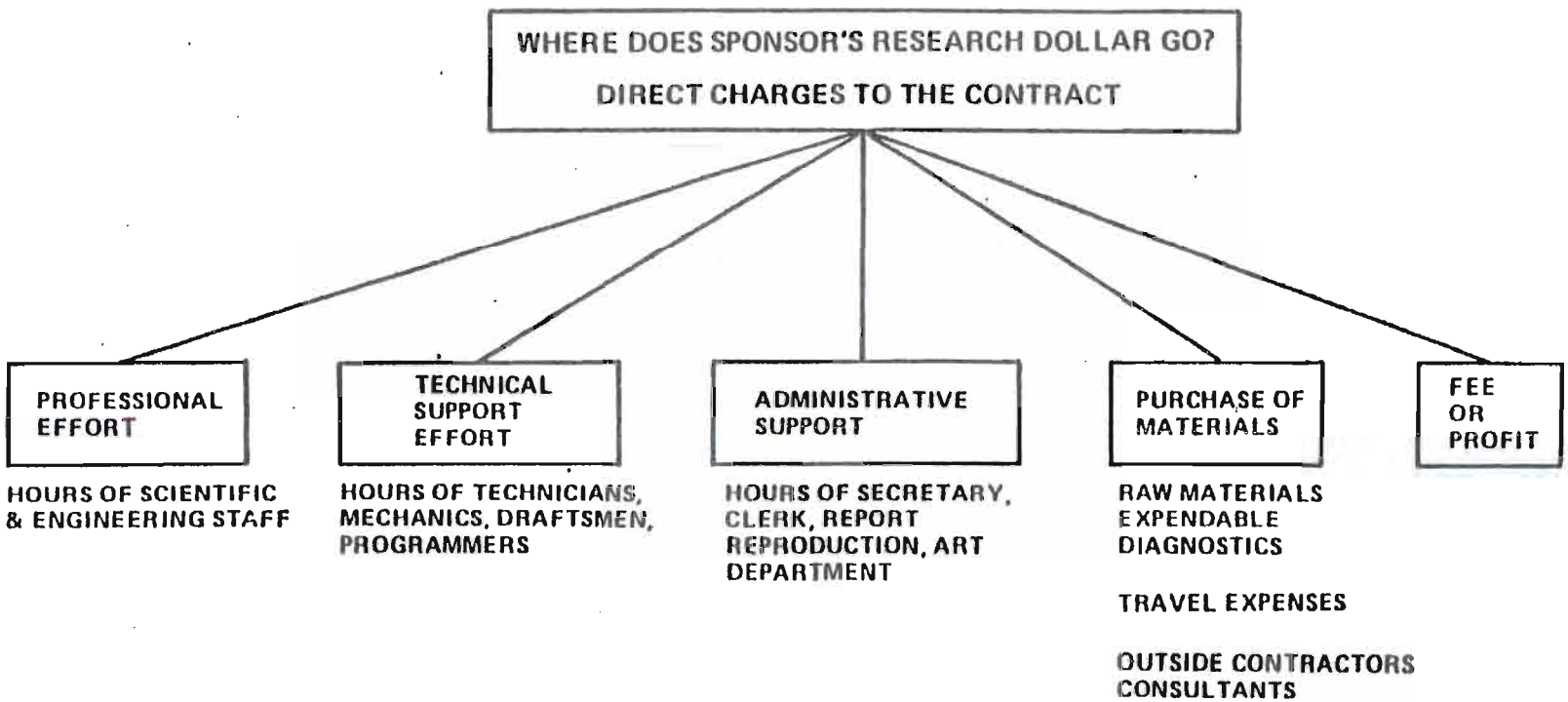
The bright, conscientious researcher, then says....here is what I want to do, pure and simple.

I have an idea; I need some company funds for an IR&D program to prove my concepts; I would then like to talk to several prospective sponsors - write a proposal and WIN A CONTRACT .... this requires hard work, but appears straightforward.

However, remember there are at least 17 other researchers trying to follow the same course on other concepts... so this simple road acquires boundary conditions.

THE ROAD TO A RESEARCH PROGRAM




WHERE DOES SPONSOR'S RESEARCH DOLLAR GO?
DIRECT CHARGES TO THE CONTRACT
PROFESSIONAL EFFORT
TECHNICAL SUPPORT EFFORT
ADMINISTRATIVE SUPPORT
PURCHASE OF MATERIALS
FEE OR PROFIT
HOURS OF SCIENTIFIC & ENGINEERING STAFF
HOURS OF TECHNICIANS, MECHANICS, DRAFTSMEN, PROGRAMMERS
HOURS OF SECRETARY, CLERK, REPORT REPRODUCTION, ART DEPARTMENT
RAW MATERIALS EXPENDABLE DIAGNOSTICS
TRAVEL EXPENSES
OUTSIDE CONTRACTORS CONSULTANTS

The actual costs can still be surprising, even though you have prepared for the shock. Nonetheless, it is often asked -- "how can one person cost so much?"

The various parts of researcher's costs are shown in this viewgraph. Suppose a young researcher proposes to do a study program that will engage him full time. As shown, his $25,000 salary becomes an $84,000 charge to the sponsor.

The company, in order to compete, must control its overhead costs - the one real area where it has a degree of control. Evaluation of such areas as administration, travel, non-contract technical expense, etc., is necessary to keep costs on a competitive basis.

WHAT ARE THE INGREDIENTS OF A CONTRACT CHARGE?

(OR HOW CAN ONE PERSON COST SO MUCH?)

	BASIC SALARY	+	FRINGE (VACATION, SICK DAYS, HOLIDAYS, MEDICAL, ETC.)	+	OVERHEAD ITEMS (TECHNICAL ACTIVITIES INCL. IR&D, PROPOSALS, STUDIES . . . PLUS ADMINISTRATIVE INCL. ACCOUNTING, CONTRACTS, SECURITY, MANAGEMENT PLUS LIGHTS, HEAT . . .)	+	FEE	→	TOTAL
YEARLY	$25,000	+	$8,000	+	$45,000	+	$6,000	→	$84,000
HOURLY	$12.00	+	$4.00	+	$21.00	+	$3.00	→	$40

IN ORDER TO COMPETE EFFECTIVELY, A RESEARCH LABORATORY MUST KEEP COSTS UNDER CONTROL.

Once the researcher is a respected member of the laboratory, where does the future lie? You don't necessarily have to leave the back lab buildings and move up to the 4th floor someday.

In most enlightened research organizations there is a dual ladder road that may be followed.

To the left, where the emphasis is on management of research, the researcher gains more responsibility, and authority, moving from project engineer leading several people, to branch head being involved with ten or so, to the head of a 50-person department -- and finally as director of a division of several hundred people.

To the right, the emphasis is on research. Increased visibility and leadership are associated with the higher rungs on the ladder. The most senior positions are ranked close to that of vice president. And it is the stature and visibility of these staff scientists that draw the young researchers to a laboratory.

THE DUAL LADDER