Now we need some help from you. At Puerto Rico, we got a good indication that golf and tennis tournaments would be popular, and also that free golf and tennis time would be desirable. Now we need a more up-dated count; — and we have added a bridge tournament. So, whether or not you have previously filled out a form, please do so today and mail in if there is a reasonable chance you will be at San Antonio (no binding obligation will be created — we're after ballpark figures).

1972 — Golf *1972 — Tennis*
1972 — Mexico

Chemical Engineers & the Construction Industry:

EVALUATING OUTSIDE TECHNOLOGY

One way to avoid an overly-negative reaction to purchased know-how by R & D personnel is to involve these people in the evaluation and negotiation of licenses.

by
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Sooner or later every major technically-oriented organization must decide whether or not to purchase outside technical know-how. An unbiased, unemotional business analysis should govern this decision since even the largest companies can sponsor only a small fraction of the research and development potentially useful to them. Access to outside technology can certainly multiply a firm's chances for competitive, profitable investment. This may all seem rather cut and dried, but "not invented here" problems, as well as the momentum of existing programs, can lead even highly organized R & D departments to overly-negative evaluation of licensed know-how. On the other hand, the concept or purchasing vs. using homegrown ideas can be overdone and misused. Morale at the research and engineering function can be damaged with loss of momentum to concurrent programs, and an uninspired approach to development and utilization of the acquired process.

There is a basic concept behind licensing technology which says "do not reinvent." However, there is a more rewarding and positive position which should be considered. A company's profit potential will be higher if it does invent or contribute something. Licensing is no relief for the company which has no significant strengths. It is used to maximum advantage through application of your existing, sophisticated collection of abilities. Your own technical contribution may be your most obvious strength, but there are less obvious abilities which can be as valuable:

1. Ability to get a plant designed, built, and running in the shortest period of time.
2. Ability to minimize capital in final design and in construction.
3. Special know-how in analysis, instrumentation, purification and separations, and utility operations, or a special discipline for operations scheduling, preventive maintenance, high on-stream capabilities, etc.
4. Strong process development capability.
5. A unique volume capability related to internal use or marketing strength.
6. Raw material, storage, shipping and other logistic strengths.

You may end up bringing to the overall project only the cohesiveness to put a complex set of internal and external requirements together, but this may well be sufficient to keep your competitors a safe distance behind.

These internally supplied "inventions" or capabilities have their most valuable potential if you can put together a viable agreement with a licensor at the precommercial stage of his technology. This bit of generalized advice is limited to licensee companies with strong technical and managerial capabilities of their own, but whose creative sparks have been lighting other fires. Unless you are interested in producing products using the same process, with close to the same costs, and slugging it out with innumerable world-wide competitors, you should be ready and willing to spend some money to build your particular strengths into the purchased process, and to sort out any hidden weaknesses.

The search

To be aware of new processes in development, you need to know the technological territory, particularly of Europe, the U.S., and Japan, as well as the Eastern Bloc nations. You have certain general needs before your specific need arises. You need to know who is doing what in your field, and you will benefit by having an existing relationship to draw upon. Your leads may come from patent and literature scanning, but there is no real substitute for getting out of your office and making your strengths visible — your company's reputation, capabilities, products, and processes. This is the best means of developing the base for beating your competition to the technical opportunity.

There is, nonetheless, a need to know the basics of the technology purchasing business, both to know what is available to your competition, as well as to develop comparisons for new process possibilities. For these purposes you will find it useful to collect technical directories to provide a resource of information on processes for license or sale, and quick references to companies, people, and products. Some useful reference books are noted in Table 1, and Table 2 lists certain magazines and publications which can be useful. Keep in mind that the process you read about in a magazine is being ready by your competitor as well.

A more conservative approach in licensing known processes is to utilize the proferred services of many of the major engineering companies. Still, the biggest

Table 1. Selected reference books which describe technology.

Text	Comment
Faith, W.L., D.B. Keyes, and R.L. Clark, "Industrial Chemicals," John Wiley & Sons, New York (1965).	• Many elements outdated, but still valuable for processes economics
Sittig, Marshall, "Organic Chemical Process Encyclopedia," Noyes Development Corp., Park Ridge, N.J. (1967).	• Many processes well described
Standed, Anthony, "Encyclopedia of Chemical Technology," Interscience Encyclopedia, Inc., New York (1967).	• 25 volume basic reference • Many processes generally described
Shreve, Randolph N., "Chemical Process Industries," McGraw-Hill, New York (1967).	• General descriptions
Stephenson, Richard M., "Introduction to the Chemical Process Industries," McGraw-Hill, New York (1066).	• Many processes briefly described
Miller, S.A., "Ethylene and Its Industrial Derivatives," Ernest Benn, London (1969).	• Massive, detailed compilation
Hahn, A. V., "Petrochemical Industry-Markets & Economics," McGraw-Hill, New York (1970).	• Processes/economics for 50 major petrochemicals

rewards, offering the most flexibility, lie in searching out the processes yourself. Automated date services are helpful, such as that offered by Predicasts, Hydrocarbon Processing, Derwent Chem Doc program, Chemical Abstracts and the Uniterm Index to Chemical Patents. At Celanese Chemical Co., we find that personal contacts, our own commercial intelligence, technical information centers, and patent departments are our best resources for information collection.

Table 2. Selected periodicals describing chemical technology.

Periodical	Comment
Chemical Engineering Progress, published monthly by the American Institute of Chemical Engineers, New York	• Official AIChE periodical
Chemical Economy & Engineering Review, published monthly by the Chemical Economy Research Institute, Tokyo	• Formerly Japan Chemical Quarterly • Describes processes for license • "Japanese Chemical Manufacturing Technology for Licensing & Sales appears periodically
Stanford Research Institute Process Economics Program, published by the Stanford Research Institute, Menlo Park, Calif.	• Plant designs/economics for major routes to selected products • Patents and literature described
European Chemical News, published weekly by the Engineering Chemical & Marine Press, London	• Processes/economics described • Quarterly and annual indices
Chemical Engineering, published biweekly by McGraw-Hill, New York	• Annual "Chemical Processes for Sale of License" • Annual index
British Chemical Engineering, published monthly by the Engineering, Chemical & Marine Press, London	• Condensed process and patent descriptions • See "Chemical Processes in Europe - 1967"
Chemical and Process Engineering, published monthly by Morgan-Grampian, London	• Comprehensive technology economics reviews • Summary of "French Chemical Processes" (January, 1969)
Hydrocarbon Processing, published monthly by Gulf Publishing Co. Houston	• Articles describing processes economics • Annual "Petrochemical Handbook" discontinued
Petro/Chem Engineer, published monthly by Petroleum Engineer Publishing Co., Dallas	• List of licensed processes • Annual Engineering Construction Directory

Information development

Having determined prime possibilities for supplementation of your own strengths, how do you obtain the information required for internal evaluation, and how do you proceed in evaluation before decision making? Let's take the second question first since it relates to both. In business decisions, you should never structure a delay into decision-making in order to have all the information potentially available. Even in these times of automated information, one answer can trigger an infinite chain reaction of new questions, all of which can be answered in part. The resulting situation, unless time-limited, can diffuse the thrust of your project or give the competition time to catch on to your original private insights of the profit opportunity. For example, in 1962 we were involved with a major German company which was interested in a joint venture with Celanese. The German project leader was asked by the president of his division for a statement of capital cost of the proposed project. He replied that the accuracy of the estimate was a function of time available. When asked why, he replied that within one week he could give an estimate within ±10%, if given three weeks, he could give an estimate within ±30%, and if given six weeks, he could probably get the estimating accuracy down to ±15%!

Since most projects which could benefit from input of outside technology usually have a basis relating to existing operations and research know-how, *the information you need the most is potentially the most compromising.* It is usually accompanied by requirements of confidentiality and non-use provisions which can severely limit your future actions. Should you eventually license the package in question, these problems fade. But since you are only evaluating, you just don't know. How do you cope with this situation and still maintain an unhampered decision capability? You can usually work with the potential licensor to minimize the restrictions he feels he needs for his own protection, namely:

1. Obtain information in stages, limiting initial economic assessment data with the understanding that no secret technology is being transmitted.
2. Limit the receiving audience and formally monitor and return the information documents.
3. Sign personal secrecy documents.

4. Isolate yourself by engaging third parties such as legal firms, consultants, engineering firms, and investment bankers.

All of these approaches have drawbacks and must be carefully considered in terms of short term effectiveness vs. obligations restricting your freedom of action and future effectiveness.

Factors which cause the most problems in evaluating outside assessment data are:

1. Contingencies, direct, hidden, and compounded. Each company has their own brand of estimating and planning contingencies, and they are often not too easy to translate, even in the same language.

2. Utilities — Be aware that European as well as Japanese processes are usually designed for the lowest utilities usage and will sacrifice capital to minimize energy costs. In this sense, U.S. plants removed from the Gulf Coast are similar to European plants.

3. Scaling factors — The smaller the base the poorer the scaling capability. Furthermore, obscure factors often confuse capital scaling, e.g., in Japan, plants are limited by the smaller road dimensions, restricing deliveries of large reactors.

An assessment data format for new processes is presented in Table 3, and a typical assessment data checklist in Table 4.

Table 3. Assessment data format for new processes.

I. Capacity	______
II. Capital Requirements	
A. Battery Limits Capital*	
1. Year of Capital Expenditure	______
2. Recommended Contingency as % of Battery Limits	______
3. On-stream Time	______ days/yr
*Battery Limits Definition: ______	
III. Raw Materials & Chemicals per Unit of Production	
A. Raw Materials Usage	
B. Catalyst Costs Based on	
1. Expense (Regeneration and Replacement)	______ yrs. life
2. Other Chemicals	______
IV. Reaction System	
A. Yield of Products	______
B. Reactor Residence Time by Stage	______ seconds
V. Labor Requirements	
A. Men/Shift (Operators)	______
B. Supervisors Shift	______
VI. Utility Requirements per Unit of Production	
A. Steam (net)	______
1. Utility Steam Pressure Level	______
B. Electricity	______
C. Process Water	______
D. Cooling Water	______
1. Circulation Rate Only	
a. Temperature In	______
b. Temperature Out	______
E. Fuel	______
VII. Raw Materials & Product Specifications	

Table 4. An assessment data checklist for new processes.

Sites—Battery Limits - Are the Following Included?
1. Drainage, Sanitary Sewers, Septic Tanks
2. Roads, Walks, Slabs, Parking
3. Railroad Sidings
4. Yard Lighting
5. Fire Protection (Piping Monitoring Nozzles, Sprinkler Systems, Firewalls, etc.)

Buildings—Are the Following Included?
1. Office and/or Control Room
2. Laboratory
3. Utility Room
4. Warehouse (Product or Chemical)
5. Control Pump House (Concrete or Steel)
6. Maintenance Building

Equipment—Description and Questions
1. Piping Type (Flanged or Screwed)
2. Instruments
   A. Type - Pneumatic or Electronic -
   B. Do Control Valves Have Blocks and By-passes?
3. Electrical
   A. What Service Factor is Used?
   B. Power Supply Located in Unit?
4. Are Steam and Dowtherm Facilities Included in Battery Limits?
5. Are Waste Disposal Facilities Included?
6. Design Criteria for Equipment and Piping (ASME, TEMA, SAS, etc.)
7. What Equipment is Standby?
8. Cooling Water Facilities Included?
9. Are Instrument and Service Air Facilities Included?
10. Are Storage and Rundown Included? (If so, how Sized?)
11. Is Condensate Gathering System Required?
12. Are Facilities Required for Handling Raw Materials?
13. Is Emergency Generator Included?
14. Are Spare Parts Included?
15. Pumps and Compressors—Electric or Turbine Devices?
16. How Much Contingency Included in Battery Limits Capital?
17. Is Catalyst Cost Included, if Required?
18. Are Flare or Vent Stacks Required?
19. Soil Conditions
20. Is Refrigeration Required? Load per Unit of Product
21. Type and Quantity of Specialized Construction Materials

Process
1. Are There any Unusual Requirements for Utilities (Steam, Electricity, Refrigeration) Required for Startup Conditions?
2. Effluent Produced—Quantity and Analysis? COD, BOD by Major Stream.
3. Product Specifications
4. Information or Down Stream Requirements Which Would Clarify the Potentials of Your Process

General
1. Breakdown of Capital Cost (Direct Costs, Overheads, Contingency)
2. Is Construction Labor for Gulf Coast? What is Manhour Labor Cost?
3. Area Required for Unit
4. Maximum Practical Capacities, Scaling Factors At Capacity Ranges.
5. Area of Land Required for Battery Limits Unit

Value of the technology

Let us assume that you have determined the process or processes most likely to fill your needs. What is it worth? I can give you some thoughts on this question, I can refer you to Worth Wade's book[1], and I can further advise you to join Licensing Executives Society, to participate in its meetings and to read its excellent newsletter, *Les Nouvelle,* but neither I, nor anyone else can provide a Universal formula for determining the value of a license. Furthermore, it is of critical importance to understand that the non-dollar costs of a license can be more burdensome than the dollar involvement. You risk restriction in licensing out of related developments, as well as the danger of uncontolled utilization of your own information by potential competitors. Your own incentives for research and developments in the field can be severely inhibited. You must carefully utilize the licensing function as a growth stimulant for your own research capabilities. Direct involvement of your technical people in evaluation and negotiation of licenses initiates new enthusiasm rather than unrealistic demoralization. Other points worth noting are:

1. As technology becomes older, it deteriorates in value. There should be a fully paid-up possibility and a rate reduction for expansions.
2. The licensee's largest risk is in his investment in plant capital. Optimum use of this investment often provides sufficient pressures to limit insistence on minimum annual payments.
3. Flowback of information to the licensor for use by your competitors severely limits the value of the license.
4. The value of a license increases in the licensor's eyes with advance in status of technology. Thus, a process in pilot plant offers higher risk (and lower value) to a licensee compared with an operating plant. As noted above, however, there can be compensatory advantages.
5. The elements of uniqueness offered through patents, know-how, lead times, and complementation of strengths, add value.
6. The portion of the total process involved relates to the value of the license.
7. The size of the project is pertinent. Large potential total dollar licensing income should reduce the per unit licensing fee.
8. The licensing cost should not significantly reduce profit expectations in highly competitive fields.
9. Maintain your alternatives and options to the last, and keep them visible to the seller.

The value of technology is usually negotiable, often with broader ranges of acceptability than are apparent in the first exchanges. In addition to the prime requisite of "doing your homework" beforehand, negotiators should avoid the five common pitfalls noted below[2]:

1. In approaching a negotiation, the inexperienced man will discard in advance any proposal he thinks the other side will object to.
2. The timid negotiator will not want to pose difficult questions.
3. A classic error is to signal the opponent that you are desperate to get some kind of agreement, especially for internal political reasons.
4. The over-gregarious negotiator will put a premium on being popular with the other side.
5. The over-eager businessman will try for accord by continually receding from an equitable position in return for nothing but short term harmony.

In conclusion

Remember, you may end up as the licensor. Of utmost importance is the requirement to act and react so that at any future time you can defend with pride any and all positions and tactics you have taken, not just at the negotiating table, but in every direct and indirect exposure of your company and personnel.

**About the Speaker: H. L. Pilat received his B.S. from the University of Oklahoma and his Ph.D. degree in organic chemistry from the University of Pittsburgh. He served as a Naval Officer in the Pacific Theater in the Second World War. He is currently director, External Technology, Chemical Group, Celanese Corp. He is a long time member of LES.*

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[1]Wade, Worth. "Licensing Handbook and Checklist for Negotiating Agreements," Advance House, Ardmore, Pa. (1966).
[2]*Nation's Bus.*, 7, 52 (April 1971).

Chemical Engineers & the Construction Industry:

TRANSFER OF LICENSED INFORMATION

In the chemical industry, the transfer of licensed information is a relatively complex procedure so it is essential that both parties know what to give and what to expect.

by
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The first step in the complicated procedure of transferring licensed information in the chemical industry is the execution of a license agreement. Any license is a form of contract, and each contract has give-and-take portions to it with respect to the contracting parties. For example, the licensor will agree to "give" licensed information and the rights to use it. This right of use is generally set forth with respect to a plant, several plants, or a geographic area. For this "give," the licensor "takes" something. That is, the licensee agrees to pay royalties and, in certain instances, to feed back improvements that he may make with respect to the process.

The payment of royalty can be in the form of a lump sum payment for a specified paid-up capacity with an obligation to pay either running royalties in excess of that, or an obligation to buy increased amounts of paid-up royalties if the plant produces above the capacity for which a paid-up license has been purchased. Alternatively, there can be the obligation to pay running royalties at a specified percentage of the sales price for a given period of time. This has been found to be the most common form of royalty payment in the chemical industry. On the other hand, the petroleum industry leans toward paid-up licenses.