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MANAGEMENT OF RESEARCH AND DEVELOPMENT IN INDUSTRY

Mr. Lloyd A. Hatch

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Reviewed by Col E. J. Ingmire, USA on 28 January 1964.

INDUSTRIAL COLLEGE OF THE ARMED FORCES

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16 January 1964

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Reporter--Grace R. O'Toole
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GENERAL STOUGHTON: Gentlemen: Continuing our program of hearing from representatives of the 10 best managed companies in the country, we are fortunate today in having Mr. Lloyd A. Hatch, a Vice President of the Minnesota Mining and Manufacturing Company.

The 3 M Company received its distinction in the field of new products. As you have read in Mr. Hatch's biography, he has spent many years in the research and development field in his company and principally in the development of new products. So we are certainly going to hear from the voice of experience this morning.

It is a great pleasure to welcome Mr. Hatch and to present him to this audience.

Mr. Hatch.

MR. HATCH: Admiral Rose, General Stoughton, Colonel Knight, Colonel Ingmire, and Fellow Students of Industrial Research and Development, at least for today: Maybe we both have something to learn, and so we'll get at it.

This portion of your program is designed to acquaint you with the management of industrial research and development. It is my job to convey to you some understanding of this important function in American business.

Let me explain why I stress the words "important" and "American." Have you ever wondered why the United States has the highest standard of living for its citizens ever developed in the history of man? If you have you may have decided it was due to our natural resources. Well,

Europe has as many natural resources. They are fragmented, but they have them. They have as much land, they have as much fertile land. They have as many people. They've had as much intellectual capacity, and for centuries they have had more money and more education. So we must look further for the explanation.

Who were the first people to settle in this country? It wasn't the rich. They were doing all right. It wasn't the uneducated peasants who didn't have the money to get to a seaport. It was the restless people, the emerging middle class of Europe. I have often wondered what would have happened if they had stayed there. I think Europe's history would have been very different. But, thank God, they came to this country. They came because they wanted to better themselves and they couldn't do it in Europe. Europe was already old and had developed rigid processes and systems.

The first settlers had a dream of a new world. They wanted liberty and freedom and they chose to build a Republic to attain these rights. But they went further. They wanted not only political and religious freedom but they wanted something even more radical. Until you have been to Europe you don't know how radical this is. They wanted economic freedom. You don't hear professors talk about this, because I suspect they don't know as much as they really ought to, but economic freedom is a tremendously important thing, and it isn't in Europe today to a very great degree--more than it used to be, yes, but not what we have in this country.

So we stood on the shoulders of Europe at the beginning of the

industrial revolution. The timing was tremendously important. Our restless people began to build and trade as free individuals. They wanted education for everyone, not just for the chosen few. This was also an explosive factor. The first colleges and universities were built on the European model, but they were not rigidly frozen, because their people were not rigidly frozen, in their ideas.

To defend our colonies, military technology rapidly became civil engineering, and the universities responded, and men were educated beyond surveying and elementary construction. Then the universities responded and upgraded the mechanical skills into mechanical engineering, with its emphasis on the why and the how, using advanced mathematics. Electricity was discovered, and again the American universities were able, and perceptive, and responded with electrical engineering.

This didn't occur in Europe. So, where did electrical equipment first begin to be made that was usable? They worked with and trained men at college level, so that by the turn of the century American electrical equipment was on its way to free the world of some of its drudgery. Edison and Westinghouse were free to work on DC and AC. Nobody stopped them. No banker could say they couldn't have money.

Then the chemical industry was born, and the universities again responded. This was the work of restless people who wanted to better themselves, and no one could say, "No." They were free of the hardening of the social and intellectual arteries characteristic of the old world and its resistance to change.

The American industry was born in this climate of change and economic freedom. Originally it was based on supplying needs in competition with imported products. Ingenuity and productivity soon put us in an export situation, first in raw materials for Europe, then in finished goods for ourselves.

The next step was another radical discovery. Historically there were two markets. The peasant needed food and fabrics. The wealthy provided a small market for luxuries. But only in the United States was there developed the mass market for wants, not needs, of people who could pay for them from their own productivity.

Economic freedom permitted the development of a new phenomenon, a large middle class, people who were not laborers and were not wealthy but were entrepreneurs and small business men and bigger business men and productive people. This meant that American industry was born of and into change. It follows logically, as night follows the day, that, when industry found it profitable to promote change and improvesments to meet people's wants instead of only needs, a new era was born.

American industry passed through three phases in answer to a response to public demand. First, production was emphasized until needs were met and wants provided a new market. Second, sales were then emphasized to keep production high, with its lower cost than our competitive markets. The third phase, covering the last 50 years, has emphasized technology to meet new demands, to encourage change, and to control change constructively.

Since 90 percent of all scientists and engineers that ever lived are now alive, and since from 1900 to 1950 European scientists were

produced at about the constant rate. The explosive factor was a production of scientests and engineers in the United States. This happened again in response to the demand of our free economy. European scientists continued to discover and to create, but the development of their ideas for the common good many times occurred in the United States. Their output, together with the new knowledge gained by our scientists, was converted into actuality and mass produced by American engineers. Examples are the automobile, the airplane, penicillin, and antibiotics--the list is endless.

Science is international, but development is national. This is a very important point. I understand some of you are going to be in Europe this year, and you might look at just this key point. It occurred in the United States, and only here, because the economic system, the educational system, the patent system, and the motivation of our people were integrated and oriented toward profitable mass markets provided by our middle class.

It is therefore clear that American industry is different from industries in other nations. In recent years our efforts to help our allies have resulted in their copying many of our techniques. This is proving troublesome when they combine their low wage rates and modern technology to produce products for our mass market. You know, we intended that they make it for themselves, but the first thing they do is send it back here.

However, we have 21 plants in 15 countries outside the United States which produce nearly $200 million of our $750 million in sales. In none

of these countries, in none of these plants, including Japan, can we produce products as cheaply per unit as we can in the United States. This may not always be true, but we are going to try to keep it true. I'm sure that many of you knew this and all that I have told you, but I am equally sure that many of you did not clearly understand why and what was unique about American industry.

Professor Spillhouse, Dean of the Institute of Technology, University of Minnesota, recently said that engineers are a peculiar people. They are unhappy until they classify their subject matter and their data so that they can deal with it. They can't deal with an amorphouse situation, they want it crystalline. They even classify people, and the latest classification puts people in three categories. There are those who make things happen; there are those who watch things happen; and there are those who wonder what happened. I'm sure your presence here this morning will permit me to say that I think we are all in this first class.

Now let us focus our attention on that part of industry which is most unique and different from the foreign industrial operations, namely research and development, or what I prefer to call technical operations. We speak of sales operations, manufacturing operations, financial operations, and technical operations. This is a very important thing, to put it on this same level. It isn't a sub, sub, subactivity. Only in progressive and profitable American industries do you find this function placed on the same level of importance. Why is this? Simply stated, it is because it has paid off in our free economy.

In order to analyze technical operations, we should have some definitions of tools of which to think.

(Chart) We must first understand the difference between research and development in order to even make an intelligent beginning. Some basic definitions of concepts follow which I hope will prove useful. What is the difference between research and development, science and engineering? Simply stated, scientific research makes it known; engineering makes it work. Modern industry requires not one or the other, but both. Research is the search for new knowledge and understanding. It depends primarily upon creative people working in a constructive climate.

Management must not only choose the right kind of people but must also provide perceptive and experienced supervision. It is very important to provide just the right amount of encouragement and sense of urgency. Too much pressure to create is self-defeating; too little results in an absence of challenge and low productivity. A wise research director knows when and how much motivation is needed to meet a corporation's objectives.

I'm trying to give you some criteria on the way you can ask questions, to establish in your own minds the kind of organization you are dealing with.

Development is the job of accomplishing the conversion of an idea or new knowledge into a commercially valuable product or improvement. The best results have been obtained by a group possessing the needed skills. Their effectiveness depends upon their training and their motivation.

Management's utilization of the effective methods for product development has shortened the time required to produce new or improved products and has reduced the risks involved.

It is of primary importance to understand that profitable technical operations consist of organizing and relating these two important jobs and keeping them in balance in order to accomplish the corporation's objectives.

Why should research and development be considered important? The best answer seems to me to be to try to control change. Sure, we don't do it, but I think we do a better job trying than if we didn't try. The business world is in a constant state of change. The rate of change is accelerating. Profitable products and manufacturing plants are becoming obsolete in shorter periods of time. Frankly, I am biased, but I believe that the best way to meet change is to build a strong, technical organization. What is the old expression? La talk, toujours la talk?"

By this action, management can strive to achieve product dominance which is essential to protect an improved product. While change is inevitable and seems rapid, it does not happen overnight, and a good technical team can foresee the strength and direction of the forces of change and work with management to prepare an effective counterattack.

Therefore, in industry the management of change is principally accomplished through the medium of an effective technical operation. Management's first decision is whether the corporation wants to be a leader or a follower. Leadership costs money but, if it is achieved, it

is more profitable. However, it requires good judgment and considerable experience. A capable technical organization can provide the effective instrument which management needs to obtain the break-throughs which are necessary to surpass and stay ahead of competition.

(Chart) Let's look at how these definitions help us to understand technical operations. If a corporation's primary objective is to obtain more security for its invested capital or to obtain more sales or to obtain more profit or to obtain more growth, or some combination of these, then it is possible for an experienced technical executive to design a research and development organization to accomplish the objective efficiently and at reasonable cost.

However, each of these requires a different kind of technical organization. Too many companies have technical staffs whose ability and personnel are not consistent with the accomplishment of their corporate objectives. This is a pitiful thing to see. This condition results in disappointment for management and frustration for the technical organization. When you see frustrated people you can look for this kind of a situation of mal adjustment, not of the people only, too.

Evidence of this condition is a sign of lack of understanding or competence on the part of general or technical management, or both. Technical operations are among the most volatile and dynamic forces with which modern industry must deal. Technical operations are a two-edged sword. If improperly managed, they can cut your profits and threaten your financial security. If properly managed, they can insure greater security for invested capital and new opportunities for growth within established markets.

When most effectically managed and directed they can provide new growth which is financially sound and potentially more profitable than a high percentage of ordinary business activities.

Security of capital investment usually requires an effective process development, but not much growth can be expected from such a group. More sales dollars can be best achieved by placing emphasis on technical market specialists. More short-range profit can be developed by eliminating research and development expense entirely. However, long-range profit objectives can be achieved only by first defining the desired profit range and providing the staff and financial support to achieve it. It requires a very different technical organization to work for a 3 percent after-tax profit than one that aims at 10 percent.

A combination of all the primary objectives above is obviously a more complex matter. It is essential for management to define the relative importance of each objective and accept some risk or limitation in those of lesser importance.

The only kind of technical organization that can assure the accomplishment of all objectives would be quite certain to reduce the profits even of a major corporation. However, since management is accustomed to taking risks, they must establish the working policies and cooperate with those to whom they have assigned the responsibility. To gain the maximum advantages and reduce risk, management must have an understanding of the five primary departments of a modern industrial-technical operation which make up the assembly line to convert ideas into profits--research, product

development, experimental production, quality control, and technical marketing.

Now I am going to take these up one after the other. Should a corporation have a research laboratory? This, of course, depends on what is meant by research. Research is a glamorous word. Scientists and engineers use it to describe the tremendously important search for new knowledge and understanding. Advertising and public-relations specialists overwork the word by applying it broadly to all industrial activity that isn't strictly financed marketing and manufacturing. This is ridiculous.

One of my friends in the humanities was talking about some research he was going to do. I found out what it was and it really boiled down to the fact that it was anything he didn't know, not what wasn't known but what he didn't know. So I said, "You know, looking up a number in the telephone book is research according to your definition. Just because I don't know the number, going to the telephone book constitutes research." This is sort of ridiculous, but, believe me, it is not uncommon.

An attorney friend of mine was doing some research. When I found out what kind of research he was doing, he was looking up a case that would support his client's unfortunate situation. This was known knowledge, only he was doing research because he didn't know it.

Now, research is the search for new knowledge. One of the things that greatly disburb industry is reinventing the wheel, and this is going on. It can't all be helped, but let's keep it down to the minimum. So let's make research the important thing that it is, the search for the

new knowledge which we need so badly. Let's not confuse it with totally different activities.

If a corporation needs and can afford to do research, it should by all means provide from 10 to 30 percent of its technical operations dollar for this purpose. I am sure that many companies do not need research and cannot afford it. Some of them would not know what to do with it if they did have it and something came out of it. Some corporations would spend their money more wisely if they contracted for some research and then they wouldn't have the continuing liability for these fine scientists. However, if a corporation wants the continuing input of new knowledge, there are many advantages to building a good research organization and providing a long-range plan for its support.

I think it should be thoroughly understood that the expenditure required for research prior to building a new product is usually the smallest part of the technical budget. It has been said that for every dollar spent in research a thousand dollars is required for development and ten thousand dollars for commercialization. This generalization is nearer right than wrong.

The important factor in deciding the kind of researcg is the subject of patents. New discoveries and new products resulting from technical effort are frequently patentable. Patents can contribute very significantly to profits and to the security of capital investment required to commercialize the new knowledge. Patents provide a stabilizing influence during the early critical phase of the new product and permit

product development to achieve its maximum value to the customer.

In my personal experience I have seen a change in the attitude of industry toward research. Twenty-five years ago there were many responsible business executives who felt that industry should not do research, that it should be left solely to the universities. This is your European idea, of course. In the intervening years, industry observed the impact of knew knowledge on their financial security and profits. Today both farsighted and practical managements accept the fact that they must know more about research because it is a new economic fact of life. This requires an objective analysis of their needs and a decision of how best to meet their needs within their ability to pay for them.

Some companies find that good research is essential and cut other expenses in order to pay for it. Some must take a considered risk because they cannot possibly afford to do it. Some have elected to follow a middle course by providing a small group of specialists who are capable of doing advanced work in a narrow area.

Building a technological foundation is essential to growth and provides the basis for additional new technology. This is the plus from having your own organization. Corporations who are financially able to do so should provide more freedom for their scientists and assume greater risks on their investments and hope for greater growth situations. When these do occur, the corporation needs trained manpower to convert

the new discoveries into profitable products. This work is called product development.

I believe there is a strong consensus that an industrial corporation cannot afford to be without a product-development laboratory. It has been proven many times that it is absolutely essential to maintain the quality of established products and to improve them constantly to insure profit. It is cheaper to sell a good product than a poor one. Continuous product-development work is the best insurance for retention of a reasonable portion of the market.

Many times the product-development work provides a way of expanding the market by modification into new areas. It has therefore both defensive and promotional aspects. In truth, a great deal of the so-called research money is actually spent for product and process development. The search for less expensive or better raw materials for manufacturing processes is essential for maintaining a corporation's competitive position. Even the smallest corporation should not be without a hard-hitting product-development department.

Product development is usually accomplished by professional engineers who, in addition to their competence in the fields of known knowledge, have received training in the corporation's specific technology and commercial practices. They constantly seek to put newly emerged knowledge to work, whether obtained from inside or outside of the company. New concepts and information must be combined with what is known and proven to achieve new or improved products.

New knowledge from research discoveries is almost like the skin of an apple, compared with the apple. Believe me, gentlemen, there is an awful lot of known knowledge that is not being put to work for the common good today. We will be a good many years putting to work what we do know now. We are like the farmer. A young fellow came down and made a study of his plantation and decided to make his report. After he got about half-way through the plantation-owner said, "You know, young fellow, I ain't farming half as well as I know how." So this is true in industry. It's true in technology. We are deeply concerned, and the Department of Defense has got to be deeply concerned, about new knowledge. But there is a lot of known knowledge that isn't working very hard for us or for the Department of Defense.

Following the research phase and the product-development phase, it becomes necessary to produce a new product in pounds or kilos or square yards or meters. So we come to experimental production. Experimental production, under technical jurisdiction--and I am emphasizing that--begins in order to provide process improvement along with the forecast of the cost of manufacture. When we originally started out we always had to go down to our sandpaper plant to run our first and crudest reflective material for highways, and it cost us $55 an hour to experiment. We had to clean up before and after on our own time. This was a great inhibiting factor in getting something going. Well, we began to set up pilot operations, so we could make our mistakes in a small way. This is what experimental production is. You've got to

get it out of the hands of the factory, who have got to cut their costs. They do not run experiments for you. This increases their costs. They aren't very sympathetic. They're helpful, if you are going to pay for it, and they'll see to it that you pay for it. But it's not the way to get the job done. You've got to do experimental production at bench level, pilot level, and so forth, where you can make mistakes, and have your team working where they can live with it and see it.

The result of experimental production is called the prototype. These are always interesting and usually very expensive. Management is now faced with a decision: Should and how best can this new idea or product be reduced to practice and commercialized?

Here let me strongly advise against taking the project out of the laboratory and assigning it to corporate departments who are already busy with their daily assignments. Don't pass this new idea on to somebody. Somebody in the sales department couldn't be less interested in something on which sales orders won't be coming for three years. He's got to get orders today so we can eat. I love him for it. I don't want to ask him to do a job for me when he is so busy--same with the factory. Keep it under technical jurisdiction until it's at least through a grade school and hopefully through high school, and if they can ever do it, get it through college so it can earn its own living. You've got to fight for this, too. They always want to take your new baby out. They think it's already to sell. Then the collapse comes, and you start over again. Reselling is awfully hard.

Wise managements, like wise parents, avoid judging the brain child of research and development too soon. No one can tell whether a newborn baby will grow up to be President or become an absconder of corporate funds. The adolescent stage in development of a new product calls for patient money, planning, and wise guidance. Management must now assume a responsible role in promoting or discouraging the project.

This next step is a careful study of the market for the improved product. I am going to introduce at least one other thought here. We have the words "quality control" here, which I do want to say something about. It's the bad, forgotten child in industry. All, and I mean all, manufacturing enterprises should have a quality control department. I don't mean just an inspection department, which is properly a production function. I mean a section or department of the laboratory, where research on test methods can be conducted, and where both important and subtle qualities of the product can be measured and expressed in figures so that specifications can be accurately drawn, and which ordinary inspectors then can use in place of personal judgment.

Specifications for raw materials in process, and specifications for final products must be constantly supervised and brought up to date.

A competent manager of quality control is the on-the-job representative of the customer. He's where the point of decision is that is so terribly important. He enforces management's decision to keep mistakes at home. It's too expensive to resell an important customer.

The quality control manager is the key to reliability, which is

of prime importance to the Department of Defense. He can objectively criticize production. He can reject it or he can pass it. But his information is invaluable to the product-development department who are striving for perfection and need his hardboiled help.

It's interesting. I saw a rather unusual kind in Mayo Clinic. If you went to the Mayo Clinic and had a serious operation or a long-term treatment or something, you couldn't get out of that organization without going through the medical equivalent of a quality control laboratory. They check up on their laboratory, and they work only through the Board. If some surgeon isn't doing his job, the Board knows it. Maybe you won't, but the Board will know it. In this way they protect themselves against their problems in the field, which are suits, of course. But isn't that an unusual use of quality control? It's the point that I am making. This is the concept. It's not inspection.

Technical marketing--the work of this department is not research or product development, nor is it merchandizing, nor is it assisting the salesmen in the field. Technical marketing men are professionally trained to provide the bridge between the customer and the rest of the technical organization. They are the eyes and ears of the laboratory. They explore the markets for the new and improved-product ideas that come out of research and product development. One terribly important thing--they have a opportunity to identify new markets.

Now, sales people are wonderful people. We love them, but they seldom identify new markets. You take a product out and you find that

it just won't go for what you thought. But if you are out there you may find that it's just what somebody else needs, and this becomes the identification. It may be 10 percent of the market, but it's there and it's real.

They can educate the established sales organization in the possibilities of their new product. This is very important. The hardest people to sell are your own people, you know. They obtain from the customer an accurate evaluation of the proposed improvement in new products. The information is fed back to the research and development teams and constitutes the kind of intelligence that an army must have in order to win a campaign. This is why it shouldn't be under the sales department. It has to be part of the technical operation and under technical jurisdiction.

Effective technical marketing men do market research but are much more interested in doing market development work, since this is the part of the job that pays off. An established sales organization in a corporation that has a technical marketing group is able to spend more time getting orders and can move more rapidly into new markets because the product has been customer-tested, which saves their time and their money.

Market research and development, whether under technical or general management jurisdiction, should be begun as soon as the prototype can be produced for study. The men who are trained to do this must be both imaginative and experienced. The nature of the prototype dictates the

kind of market assistance required, but technical products require technical men who have been trained in marketing. I mean on-the-job training. They must have a broad knowledge of the field to effectively explore the commercial climate in which the new product is expected to assume a place. In many cases the market must be created. This is very important. It has to be created. Nothing like it ever existed before. This is not easy.

As soon as possible, however, customer reaction must be obtained. Criticism, evaluation, and advice must be brought back to the product-development department for their guidance, refinement, and resubmission. This is like forging and tempering until finally your product stays out. Management then gets a conviction concerning the value and size of the market for the new and improved product.

I want to say that projects to us are totally enclosed, complete, operating units which are set up to do a job, and only one job. We set up our first project in 1926. Masking tape had been conceived by a member of our quality control department who was out in the field studying a problem. He couldn't make much progress, he was so busy putting out fires at home. So he was about ready to quit, but we looked things over and decided to give him a separate place to work and some help. Thank God, we did. Masking tape was born, which has been worth hundreds of millions of dollars. Cellophane tape followed, electrical tape, sound-recording tape--you name it--some 400 kinds.

Now it should be clear how a project which is a complete task force can become a powerful tool of management.

(Chart) Now let's examine the route to improvements and new products. We have a theoretical route. You make a research discovery. You go through product development. There is your market. But a most common industrial practice is that somebody identifies a market need and comes back and develops a product. Lots of times these people didn't have to do research. On many of the products we didn't have to stop to do research. We just made the product and moved it out to the market.

However, if you have a problem which cannot be solved, then you've got to do some research. You've got to solve this problem. New knowledge is required. So you have a feedback over to research and back. This is quite a common industrial practice. It has great advantage. The market is standing ready, open, hungry.

Up here we've had the problem where we had wonderful ideas and nobody wanted them.

(Chart) Now we have an assembly line. I apologize for using our own, but I have to talk about what I know about. First, up above here are sources of ideas. We have nontechnical sources. Some of our best ideas came from nontechnical people--not how to do it but what to do.

Our divisional laboratories have ideas. Our scientific laboratory has ideas. Our new product division that builds new businesses has ideas. We also search constantly through universities and institutes and private inventors outside and in the United States and in foreign countries.

These ideas are brought in. Every time they come in they are given a pre-project study by an operating division or, if it is an unusual idea,

by a staff laboratory, a new product division, with the help of central research, and so forth. This brings it to a point where it either goes down the right here, which is the sewer--which you can't see but will see at the bottom--or it is referred to the management committee with a recommendation for funding, the next step. So you come to a management decision. What is management's decision? It sends it to the sewer or sends it over to an industrial division because it is related to something they are doing and it's in their technology, or it moves on down into project formation at staff level.

Now the project is formed and every six months the manager of this team has to report to the management committee what he has done with the money, what he wants, what he is going to do, and how much it will cost.

More often he is in trouble, incidentally, and he moves on down the line to product development, experimental production, and market development.

You will notice that these lines also show, "sold, shelved, or abandoned." This can happen any time. It had better happen to some of them as early as possible. Or it can be sent over to a division when it's finally reached.

You see you have your points of review. Our new businesses--and we have developed over 40 of them, homegrown--have come out first as a department or as a whole division, and the project team has moved out. Approximately three-quarters of our general managers today are managers of projects. They were the intense advocates of an idea. They sold

management on doing it. They were given a little money. They worked, they bled, they sweat, and finally the project came through. More money was required. The valve was opened, but under control. As they come to commerciality more and more money is required. Hand it over to somebody else at this point? You wouldn't have a man in 3M if you did that--not the kind that we want. He goes with it and his team goes. It's their baby, their brain child, and they put it across.

This has brought us some tremendously important technical products, including the new President of our Company, who was trained as a non-technical man in this technical marketing section of our laboratory. I hired him in 1926. He was too bright. He was smart. He kept getting ahead of everybody else. So we kept loading him up. Finally, a few years later he came back and solved this new idea we were working on--reflective signs. He said, "Give me this and nothing but this and let me work on it." We did. It took five years of support and blood and sweat. The product entered the market in rather poor state. It was then refined constantly and it's quite a business today. Because he succeeded so well, he took preset-die lithographic plates, he took thermofax as it came off the assembly line. He took the whole team. He built new businesses and became a group Vice President, and then President.

So this is one way of building people while you are building products.

Now let's examine why modern industry has developed such a complete assembly line.

(Chart) All products are like human beings. They are born, go

through a gestation period to maturity and then senility. You've got to have a new product to take such a product's place if you are going to grow, and maybe two of them. This is something that you should always keep in mind. If I were down there I'd use a pencil now.

(Chart) These are theoretically nice things that can happen. Maybe this is kind of an average of things. You go through an investment phase. These are years down below, and on the left are the dollars annually. When you start out you don't spend much money at the research level. As you get into development your expenditure increases. You are in the red. We've been in the red $20 million in our program. This for a Scotch company is a lot of money. This was before the rate of investment decreased. This happened because we started to sell something.

Somebody said, "Just let me have it at your factory cost and I'll do some work on it." I said, "You couldn't afford it. I think the first drop to the first floor probably may cost us about $2 million."

Then you enter into a period where sales are increasing rapidly and profit is rising. Then you enter into a period where your competition sees what has been done, so it's easier for them to make an imitative thing. They used to call it a Chinese copy, but we're told that isn't good language now. So then there's competition, patents die, if there were patents, and profits fall off. And you'd better have something else on the firing line. And you won't have it without technical operations.

I think I have used my time, but I'll just show you the next one,

so that you can ask me questions about it.

(Chart) Here's how you integrate a technical operation into a major corporation at staff and at line. Here are your assembly lines. These are relationships.

It's obvious that you would know what to do with it if you were President, of course.

I want to say in closing that modern industrial management has learned that it is essential to have a complete and competent technical organization to process ideas and that its vitality must be maintained. It can never be permitted to become rigid and inflexible. Men must be able to promote their ideas. Research and development must be in constant communication because with all departments and with management they are interdependent. Each one stimulates and guides the other. Properly integrated and related, they are successful.

These are some of the instruments and work methods modern industrial management employs to earn the security and the profits which are desired and for which they are responsible. To the extent that they invest their time as well as their money and truly manage and choose and train their technical men they will be successful in meeting the challenge of the future.

Thank you, gentlemen.

COLONEL KNIGHT: Gentlemen, Mr. Hatch doesn't know I am going to say this. I am sure he couldn't resist the opportunity of displaying the next model of the overhead projector that we now use so heavily in our seminar rooms. Since he developed it, I think it is right and proper that he also show it. This is one reason we are showing it here.

MR. HATCH: May I make just one more statement.

COLONEL KNIGHT: Yes, sir.

MR. HATCH: There is another model beyond that that is just about out, and it's even better.

COLONEL KNIGHT: Technical marketing.

MR. HATCH: Yes. It's a feedback on what you people want and need that this doesn't have. If we keep always sensitive, then the new products come.

COLONEL KNIGHT: Mr. Hatch is ready for your questions.

QUESTION: Would you expand on the product called Tartan, that Minnesota Mining and Manufacturing is working on for race tracks and so forth?

MR. HATCH: That's a wonderful question. I could almost have asked you to ask that question, not because it's Tartan, but it illustrates. When I took over as staff after being in line as the General Manager of one of the businesses myself, I went to Roger Williams, who was VP of R&D for Du Pont. I was now staff, Vice President of Material and Development and I was Vice President and General Manager of a business. I had been the first chemist and started the laboratory. But I was obsolete

as blazes. It was only because we wanted to build new business and I could hire better chemists and better engineers than I was. But I took this job, and so I went down to see Roger Williams and I asked him some questions. One of the questions I asked was, "Where do you find ideas?" "Well," he said, "they are like fish. They're where they are and not where they ought to be." Incidentally, 7 or 8 of Du Pont's 14 major programs have come in from the outside. That's why I emphasize that. However, we can grow better businesses than we can buy.

You remember the 100,000-mile tire? I'm sure you are that old. Of course, no one every told you that it would cost more than the automobile. But this is a very interesting new high polymer. They did a lot of work on this in the thirties. There was lots of steam generated and they were going. The war came on and they had to stop. After the war they looked over what they were doing. They picked this one and started to work. The first thing they had to do was try to get a patent on this molecule and how to make it. They began to see some references in the literature from Germany. So they sent a couple of men to Germany. Do you know what they found? A complete report on the chemistry and production of this molecule in a German university, in a research memorandum for a doctoral thesis, dated 1892.

Why was it there? They hadn't the means by which they could make it into anything, you see. The scientist who did this got his kudos because he had done a terrific job in developing a new molecule. But it hadn't gone to work for anybody. Sure, it provided him his thesis

and his doctorate. But it wasn't doing anything for anybody. This is completely incompatible with Americanism.

Du Pont went to work with this molecule, but they couldn't get any basic patent. However, they began to put their attention on the end product. They began to see this molecule. It was tough, and elastic.

They came to us. They wanted us to do this. Of course we weren't interested in making mattresses or upholstery. A lot of people do that. We sought a technical use. We began to devise some technical products, thinking of roughness and elasticity. Then we began to make our own kind of polymer things that met our new requirements. We started to make a joint for a sewer pipe in the field, and we wanted to make it so that roots couldn't get through it, and so on, so that pipes could move in California with ground heating, and so forth. It was terrific. It was expensive. It was copied by others who made less expensive things. They didn't do as well but they kept working.

Then came the idea of the race track, first of a running track, then a jumping track, a high vault. Now the thing is moving for a lot of uses. It is a tough molecule, a special one, incidentally. And this is Tartan.

You see that. The idea started in Germany. They didn't develop it. There wasn't the motivation. They didn't have the people. They didn't have the market.

That's why I thought there would be some questions.

QUESTION: You mentioned that your task team heads frequently go out and become managers. I'd like a little more information in this area.

Are your groups college-oriented? On the tasks you establish, just how do they get started?

MR. HATCH: When management decides that the proposal to set up a project is to be reviewed, this generally has been carefully studied and so forth, and so far as anybody can know, this is what we ought to do. Then a project is established and a project manager is selected. Now, we make mistakes at that point, but this project manager is being trained on the job, and he has the right to become a general manager if he makes his project go. This is motivation. It's on-the-job training, with responsibility. It is not theoretical. He is not reading about it. You pick a man who has also already the initial skills and arts of management to the extent he can in his age group, you know. We pick our potential managers, and they become the project managers, and they begin to operate a complete task force. If they succeed they move out. This is why three-quarters of our general managers are technical men, and have been the advocates of ideas and have sold them to management. They have put them across. There is nothing that beats motivation.

Now, they have to have help, staff, all sorts of staff help. But they have to have one thing, and one thing only, to do. One of my friends said that his people were very unhappy and he couldn't figure out why. I asked him some questions, and it turned out that each one of his engineers was supposed to have three projects simultaneously. Unless he's got a three-headed man with 100 hands, he can't run my kind of project that way. I don't know what kind of projects he has. A project is a job to

do, a task-force job. It's a complete thing to get done. It is cleared and the money is made available in a controlled way.

The Navy has had the task-force idea for a long time, to get a specific thing done and nothing else. The people aren't worrying about one thing else but that. This is the same as our project. Maybe other people have other ideas, of course. This is our way. It's on-the-job training of the whole team. So, when it comes to commerciality, 2, 3, 5, 7, 10 years later, depending on the kind of subject matter, all these people have worked together and they are integrated. No ball is passed over to another group. They go on. Believe me, this is tremendously important.

QUESTION: Sir, what do you do when research uncovers a product which will be in competition that will hurt your production if it is thrown out at that time?

MR. HATCH: Well, defensively, we had better be the one to uncover it. That is why we do it. Someone else is going to do it. We haven't any monopoly on brains. So, if it's better, or cheaper, we had better do it. We had better obsolete our own business. It's only smart management that does that. The other kind sit back and wish to shoot that guy, or they do worse things.

I don't know whether I have answered your question. It's defensive to get on the job and obsolete your own business if somebody else is going to do it.

STUDENT: I've got a further question. Is it often like on the razor blade that someone else's product can hurt your business?

MR. HATCH: Well, my friend, who is Vice President for Research and Development for Gillett, said that he spent quite a lot of time trying to get his company to do some of these things ahead of time. But in the final analysis he has to take this responsibility. He wasn't a good enough salesman. And management must take the responsibility, because they weren't receptive enough. They were not involved in the market and in the problems of the laboratory, in the new, emerging knowledge. When management is not doing that they are going to get hurt.

They can decide that they aren't going to, but, believe me, this doesn't stop new knowledge from emerging, and it didn't. Now it's a me-too thing, and less profitable, I might add.

QUESTION: You mentioned sir, about smaller companies contracting out their research. Do they do this for the basic phase or the development phase? Where should they start, and what about patent rights?

MR. HATCH: Well, let's take the last question first. Every reputable research institute provides that the person who pays the bill gets the patent rights. They shouldn't be dealing with any other kind. Secondly, research is a search for new knowledge. It is not development. He is going to do the development. He had better have that kind of team or he shouldn't start.

Out at Stanford Institute my friend said they got a contract from General Electric and a contract from Du Pont, and that if they got a contract from the 3M this year they would think they were in the big time. I laughed and said, "You are in the big time now. But tell me, why

should General Electric and why should Du Pont come to you when they have terrific research organizations?" He said, "It's easy. They didn't have a critical mass." I said, "What do you mean? I think I know, but please explain." He said, "They didn't have a critical mass of brain power in this field. They were subcritical. They didn't know whether they wanted to be in it or not. So they contracted to have somebody do this initial work so that they could make a decision somewhere along the conveyor toward commerciality, instead of starting back at the beginning and acquiring a lot of very highly specialized people and then being responsible for them or throwing them out on the open market, which does nobody any good."

This is a little bit the idea, you see. You can have exploration. You can have problems solved by contract without the responsibility of keeping these people on that you wouldn't normally have in your industry. Small companies had better do that rather than to accept the other expense, in my opinion.

QUESTION: Sir, if you do R&D work for the Government, do they get the patent rights to all your inventions or ideas?

MR. HATCH: Thank you, sir. I understand this is a closed session. I may get shot on my way out. If you were in industry, how would you feel if you knew the Government had given a certain company $100,000 to develop a 5-watt source of electricity for an orbiting object which had to have no moving parts, and it was around a certain concept? They called it Snap I. Some months went by and nothing happened, so they let Snap II and another $100,000 to another company. Both of these are good companies, and I'm

not mentioning their names. Some of you may be graduates from them. Months went by. Finally they came to 3M. We refused a $100,000 contract. We said it would take too long. We said, "You want it at a certain time and it would take too long just to negotiate a contract. We've already got #5 million in here and we aren't about to give you free rights on $5 million. You didn't pay for them and you aren't going to buy them for $100,000. But we will contract to deliver to you, if you will give us just a purchase order for $15,000, one in 90 days." This took 30 days to negotiate, believe it or not. They didn't want us to give it to them for $15,000. They wanted rights which we weren't about to give.

Now, they have the complete right of eminent domain. They can take away all we have and all you have. They have the right to do it, but they have to use due process. We weren't about to hand over what we had spent $5 million on for $100,000. But we were anxious to give them an off-the-shelf item, which wasn't off the shelf but we could make it for them, because we had everything done and we had made models of this type. We did it. We finally got the contract. In the meantime we had worked and had delivered in less than 90 days the item. When President Eisenhower broadcast from a satellite he was uuing this Snap III generator. This was a thermal electric generator. That's the way it was.

Now, what's your reaction? I believe that the Government should have the right to all work done for them and for which they pay. This is almost always built on a foundation belonging to other people. It may be general and open knowledge. It may be in all the textbooks.

They don't have to pay for that. But it may be also and quite often is very specific to the company. Why did they want 3M to work on it, or why shouldn't they want us to work on it? We had already done the work. All they had to do was to buy the end product. They didn't have to pay for all the rest. We did. What rights should they have? For making what they want? Yes. For making what we want? No. I am trying to answer the question rather oversimplified. But this is the case.

I'll tell you this: If the Government grants the rights for civilian use for many of the things, they are going to get a motivation on the part of industry that is going to help them do a lot better job than if they take away all right and take away all motivation.

Of course there are things that there is no civilian use for. I sat through a White House conference where there was a wonderful opportunity given for us to understand how all of the new knowledge of satellites was going to spill over into industry. Maybe some of it will, sometime. I hope so. I am more than willing to listen and try.

This is trying to answer your question about patent rights. I don't believe that I should take away from you what is yours. I don't think the Government should take away from you and me what is ours. I am perfectly willing to give the Government what I do for them, but not what I do for myself.

That's why every major company isolates the government contract in a separate place. They've got to for accounting purposes. This is one reason why a lot of major companies are very reluctant to take government

contracts. We were asked to take 75 of our best men to work on a Navy need. The Navy did this. We think the Navy has a terrific technical organization. We did a job during the Korean War, a very radical job, for them. A certain man who has just become an Admiral during this last year thought we should do this research job. We did a development job for them, and he thought we should do a research job. This was on a high-energy propellent. We already had over 20 years' experience in this. They wanted us to put 75 of our top scientists and engineers on this job.

We were very reluctant to do it. In the first place, we wouldn't make any money. In the second place, the 75 men would be doing other things, and they were reluctant. Finally, the Chairman of the Board said, "This might be more important to our grandchildren than many other things we are doing, so we'll do it." So we did it.

This is what happens. We isolated it immediately. We took the people and put them on this. We developed this high-energey propellent that is just now being tested. We saved the Government 10 years of work to find out what we knew when we started it.

But the things that went into this were made in a plant already built. The science and technology had been worked out and could be fed into this new organization. But the particular kind of peopellent is the Government's.

Have I made it a little bit clearer, or have I confused you more?

STUDENT: No. I might ask another question. Does this mean, then,

when the Government takes title to all patents that we are building up a big storehouse of patents that will not be given back to the public?

MR. HATCH: Well, I would question that the Government would be as interested in getting out and beating the bushes to put to work this new knowledge as the industry would be, who has fewer things on its mind than has our Government.

QUESTION: Mr. Hatch, my question concerns the ability of U. S. industry to be competitive in world markets. You've indicated that you expect production unit costs to become lower in U. S. plants than in overseas plants. Does this mean that American labor is truly more productive, or does it mean that production plants overseas would be less automated and less efficient?

MR. HATCH: You missed the most important reason. In the United States there is a market. People can pay for what they want. This is not true all over. There is more volume, therefore lower costs. This is important--volume. That cuts costs vaster than anything else.

Secondly, costs are lowered by putting technology to work instead of muscle. In the United States this has advanced very far. Although we have built automated plants in foreign countries, this really doesn't pay, because labor is cheap and the volume is small, and you really don't need automation. The force forcing automation is higher costs. But we do have the main thing here, which is the market.

COLONEL KNIGHT: Mr. Hatch, thank you very much for a most instructive session this morning.