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THE MEDTEK CORPORATION

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John Torrence, Senior Vice-President of the Medtek Corporation and Director of the company's R&D division, was talking with several members of a consulting team he had brought in to help him with some challenges he was facing within the R&D group.

> We have a basic problem of performance here in the R&D division. Related to this problem is the low morale in my division, and increased pressures from other parts of the company. We have a bad case of R&D constipation; this division has not brought out a successful new product in two years. Given our competition, if we don't do something about this problem soon, the whole company is going to be in big trouble.

COMPANY BACKGROUND

The Medtek Corporation is an international company that designs, manufactures, and markets automated instruments for the analysis of blood and serum as well as for similar industrial applications. The company was founded in the 1950's as a small operation in a Bronx loft by the late Paul Torres; the father of the present chairman and chief executive officer, Arthur Torrence; and the grandfather of the present senior vice-president for research and development, John Torrence. Mr. Torres started Medtek by hand-crafting a new device called the Automed, a product still manufactured by the company. This product automated the preparation of human tissue for microscopic examination by pathologists.

The firm continued to grow until, ten years later, it employed approximately twenty-five people. The R&D section at that time was composed of two engineers and two draftsmen. The organization was very informal. New employees and consultants were brought in as needed to work on specific tasks.

During this period, Beth Kless, one of Medtek's salespeople, met an inventor named Dennis Rettew. Rettew was employed in a Cleveland hospital. After observing both the kidney dialysis and laboratory procedures in the hospital, Rettew applied the mechanical techniques used in dialysis to the development of a rudimentary device that could automate one laboratory procedure.

Rettew and his invention were brought to Medtek. R&D development of this device resulted in the single channel Autoxam--an innovation which today is still the basic technology for the company's major products.

The single channel Autoxam works by plucking up a small blood sample and pumping it through a continuous system in which the sample is properly diluted; reagents added and mixed; the solution heated and/or cooled, filtered, pigmented and spectrographically analyzed; and the results analyzed and compared to a norm. Successive samples can be introduced continuously to the Autoxam. The innovation of separating

the samples with a small air bubble both permitted the continuous flow of samples and scrubbed the pathway clean of the previous sample. Prior to the Autoxam, each sample was handled manually by a lab technician. Obviously the new device allowed a saving in lab technicians' time and in the amount of reagents used. Further savings were realized by the Autoxam's ability to examine a much larger number of samples per day than a technician.

Five years later, the Autoxam was introduced to the market. It was a great success and ushered the firm into an era of rapid and continuous growth. The firm grew to about 125 employees. The bulk of the research and development work was centered around the blood analyzer. Development work during this period focused on a multichannel version of the Autoxam that could automate additional laboratory tests and could also automate some industrial tests, such as the measurement of trace metals in water used in generating electricity. New applications and new clinical procedures compatible with Autoxam technology were developed both internally and by users and researchers external to and independent of the company. Medtek received widespread recognition and accelerated research in the field, as scientists elsewhere were inspired by the introduction of the Autoxam.

The next several years brought a crisis to Medtek. This crisis was precipitated by the development of the 60/12, a second generation analyzer that produced a patient profile of 12 lab tests from one sample at the rate of 60 tests per hour. First, an internal fight arose over whether to finance an expansion of the company to tap the possible profits of the 60/12 or whether to restrain the firm's growth. Second, the rapid growth resulted in substantial engineering errors as well as cost and timing slippages. A consulting firm proposed a basic change in the formal organization in order to better handle these accountability and coordination problems. Vice-presidents, senior vice-presidents and a divisional structure were introduced. Some believed that the switch to this formal structure was too quick and that the company did not have enough properly trained personnel to staff the new organization.

The choice was made to expand. It was a time of extremely rapid growth. The R&D division grew to 150 employees and its budget was five times greater. Lou Bidder, who was brought on in to work on the Autoxam hydraulics, became the first R&D division vice-president.

The 60/12 was an instant success. During this period, the company moved to suburban Washington, D.C. and greatly expanded its facilities. None of Medtek's competitors could match or duplicate 60/12's technology, speed or versatility. Given the success of 60/12, development was initiated on HORSE (High Operation Repeated Sequential Examiner), a third generation computer-controlled blood analyzer with a capacity of 20 tests per profile and 150 tests per hour.

After the HORSE, work began on Scan-Lon - a complex high-speed diagnostic instrument oriented to the pharmaceutical industry. Scan-Lon was designed to take advantage of Medtek's core technology. Medtek also produces a white cell testing and diagnosis device, and the company has developed and patented a range of reagents for its analyzers.

In addition, Medtek produces an infrared analyzer and a hospital oriented management information system. These two products, however, constitute only a small, but growing, part of Medtek's sales of systems and associated reagents.

Recent years have not been easy ones for the company. Besides having to cope with the organizational consequences of growth, Medtek faces a range of external pressures. First, federal cutbacks to hospitals have decreased their ability to buy Medtek's products. This problem is acute because most of Medtek's new (and expensive) products are oriented to large clinical settings. Second, underwriters' requirements for insuring diagnostic equipment have been changing in a number of cities and in the international market. These changes require making numerous modifications to fit local conditions. Similarly, the government, mostly

through the Food and Drug Administration, began to require extensive testing and product documentation before it would permit the diagnostic machines to be sold. Finally, a number of major companies have begun to directly compete with Medtek's diagnostic product line. The organization charts for the company are included as Exhibits 1 and 2.

THE R&D DIVISION

As the research arm of Medtek, the R&D division is responsible for basic and applied research in areas relevant not only to present but future products of the firm. Its major goal, however, is the development of new product ideas that can be developed successfully into new commercial products for the firm. In addition, the division is responsible for development and refinement of existing products as well as investigating and responding to problems with products already in the field.

John Torrence, age 30, was given the assignment of heading up the R&D division about a year ago after having rotated through a number of different positions within the company at large. He has been charged with revitalizing the division and increasing its performance. He expressed his views on the strategy of the R&D division to the consultants:

> As my father has articulated it, we are in the business of benefiting mankind by serving the health care community. The best way to do this is for Medtek to develop innovative technology and be first to the market with new and patentable products. We are a "me first", not a "me too" firm.
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> The R&D division is integral to this strategy and I believe that fully two-thirds of the division's time should be spent in generating new and creative ideas which can be developed into unique commercial products for the firm. The remainder of the division's time should be spent in developing and refining existing products.

The organization chart of the division can be found in Exhibit 2. Structurally, the division is organized into several departments. These departments are briefly described in the order of their involvement in the work flow of a typical project.

RESEARCH

Research concentrates on areas that relate to Medtek's basic technology and processes. There are small projects (4-6 members) investigating phenomena such as wave scattering properties and electrochemical principles.

ADVANCED DEVELOPMENT

This department is chartered to do advanced development research (generating new knowledge or utilizing existing knowledge to solve a particular problem). The hydraulics, cell, and programming projects each conduct applied research on particular product problems in small teams. Each team's overall objective is to demonstrate the R&D feasibility of a product idea.

Both these areas deal with state-of-the-art technology and are therefore particularly sensitive to new information from areas external to Medtek (universities, governmental agencies, professional societies). The R&D personnel in these areas typically have advanced scientific or engineering degrees and are generally younger (with less organizational experience) than the rest of the staff in the division. Besides conducting research, these two departments are also responsible for assisting other divisional areas with R&D problem solving.

CHEMISTRY METHODS

This department is in charge of developing the clinical test methods to be used in each system. As such, the department is divided into areas covering new system methods, existing system improvements, and reagent development. Different from the research and advanced development departments, this area not only develops the feasibility of a particular analysis but also develops the processes and reagents used in the analyses. This department is staffed with a range of professionals including biochemists, physicians, hematologists, organic chemists, computer scientists and hydraulic engineers. These professionals must also keep track of information from areas outside Medtek. Furthermore, since their products are at an intermediate stage of the work flow, the chemistry methods staff requires information not only from other departments in the R&D division but also from areas in the larger corporation, such as manufacturing and marketing.

ENGINEERING SERVICES

This department provides support services to other departments in the division as well as to the larger corporation. The drafting design and model shop areas provide services to each product development program. This area works on mechanical and electrical packaging questions as well as on technology problems for each product line. A material assurance area monitors quality on all incoming R&D components. The work in this department tends to be routine and requires less extradivisional communication than the other areas. The staff in this area tends to be older, more experienced within Medtek, and less educated than the rest of the division.

SYSTEMS MANAGEMENT

This department has overall responsibility for taking a "feasible project" and developing a manufacturing prototype (that is, a working model, with detailed designs, to be handed over to manufacturing). The department is organized into product-line program areas (HORSE, 60/12, Scan-Lon) as well as a systems support (computer) area. Each program has a product manager who has full responsibility for the project and a full-time R&D project team. Since these teams do not have all the competence to carry a project to completion, the product manager must make arrangements with the different functional areas for assistance. Frequently a project will "buy" support teams from other areas for the full development phase of a project. Particularly important interfaces within the division are with chemistry methods and the service areas. Of vital importance to program development are effective links with manufacturing and marketing areas since the ultimate product must meet manufacturing constraints yet still meet market needs. The R&D staff in this department are all engineers of different types with varying amounts of experience at Medtek.

PRODUCT PLANNING

This is a two-person department whose responsibility is keeping track of and evaluating existing programs as well as investigating the possibilities of new products and new acquisitions. Product planning is a new department whose members are not yet sure of their roles. Indeed, there is a general confusion in the division as to the legitimate role of this department.

The product line programs carried out in the division are each *unique systems* focusing on some aspect of clinical information and data analysis. Each system is made up of a range of components to handle the various stages in the work flow from material preparation, material transfer, and multiple diagnostic tests to automatic analysis and interpretation. The various system components have to be integrated to produce an automated, high-speed, and precise system. In order to be commercially successful, each system has to be tailored to fit the particular market as well as the legal requirements in the different locations.

The Scan-Lon system provides an example of the complexity of a particular program. To meet a need in the pharmaceutical industry, Medtek initiated a program to develop a system that would allow high-speed assays of the most critical parameters facing the pharmaceutical producer. The system required the development of a new form of photometric analysis to be integrated with continuous flow core technology. Once the measurement concept was found feasible, the program team had to come up with specially designed test procedures, mechanics, power systems and hardware and software. Each of the component systems had to be compatible with the overall design and within cost specifications. The system is now in production but not without some accuracy and maintenance problems.

SOME CURRENT ISSUES IN THE R&D DIVISION

In order to probe the reasons for the problems with both R&D innovation and with morale, the consulting team conducted a number of interviews in all parts of the laboratory.

The most frequently discussed problem was one termed "fragmentation." As one researcher suggested:

> The structure of the laboratory only encourages separate disciplines, each with a desire to do it their own way and with their own set of objectives. An example of this fragmentation problem was the initial photometric development by the advanced development department. Even though the research department had done substantial groundwork in the area, the advanced development group essentially started without the benefit of this in-house expertise.

Another researcher suggested:

> I think part of the fragmentation problem is that people in the various departments are so different. The guys in engineering services feel inadequate around us because, after all, their work really is not as important in the overall scheme of things as ours is. However, when we do need them, they aren't very helpful.

A result of the fragmentation problem seemed to be inefficient transfer of work between departments. There was a tendency for each area to overlook or fail to take into account other related areas. "Communication and

coordination among areas can be best characterized as hit or miss," said one division member.

The fragmentation problem was not unique to the R&D division. Important marketing or manufacturing information was often not available in the formative and problem-solving stages of a project. As one researcher put it,

> "I am sick of receiving memos from marketing that give me out-of date information. What's the point of my doing feasibility studies for a product without knowing about the regulations out there which directly affects the product?"

Another major problem was the role of the product managers. Product managers were assigned between one and three projects. Their role was to marshal the needed resources and shepherd the project to completion. The power of these product managers varied greatly. As one manager described it:

> We have full responsibility for projects, but we don't have the influence, over budgets and staffing and so on, that we need to get the job done. The department heads have the authority here except for one of us. We call him the Czar - he's a buddy of the chairman of the board. He gets all the resources and support he needs.

Day-to-day decision making seemed to present a basic problem for the product managers. In short, their real influence over divisional staff and other corporate personnel was minimal - coordination and joint problem solving suffered.

Another major problem faced by the division (and particularly by the product managers) was the absence of laboratory plans and project priorities and the attendant lack of systems to track and evaluate project progress. Ongoing projects were not subject to formal review procedures; there were no formalized cost, schedule, or timing systems. A product manager commented:

> Not only are reviews done on a "catch-as-catch can" basis, but it's also unclear whether I am supposed to be doing the evaluating or not. Sometimes, Torrence Senior suddenly takes over and sometimes it all gets so confusing that a department head does it. To make it all worse, Arthur Torrence has actually been known to walk into the lab and unilaterally start or stop a project. We don't have formal controls, so it leaves us open to unpredictable tampering by top management. One project was started and stopped three times over a two-year period. We call it the "yo-yo effect".

Contributing to the confusion of the staff was the problem of project definition and interproject coordination. Since projects changed direction so frequently and since the product managers did not always have current information, project members often did not know either what their own objectives were or how they should fit into the overall project objectives. This lack of general project direction reinforced the fragmentation problem and the feelings of "isolation in the midst of chaos" and further undermined the influence of the product managers. The lack of control and the general planning problem also adversely affected the coordination among projects:

> Decision making about resourse allocation - space, time, budgets, staff - among projects is often made arbitrarily and by the seat of management's pants; the point is that there are just no priorities to systematically guide project decision making.

A final problem that was frequently mentioned was the role of the research and advanced development departments. One researcher complained:

> We're supposed to be doing real applied research, but we hardly ever get a chance to actually do any. We spend all our time fire fighting on existing products. What research work we do is all but ignored by top management. I helped develop a process a few months ago, and then we heard that top management had gone outside to get exactly the same process. I still feel terrible about it.

Another example often given of management's lack of support for in-house expertise was the fact that the basic technology of Scan-Lon was not developed in-house, but was bought from an outside laboratory. These actions by management dramatically impacted the motivation, performance and probably helped explain a lack of real research activity in a firm dependent on new technology and new clinical processes. As one interviewee put it:

> The researchers have just stopped thinking; their creativity has been burned out by management's neglect. To top it off, the whole R&D division looks like an army barracks, maybe it once was. Drab green walls, cubbies for lab work. If they want to have a meeting, they need to see if the board room is available - a stuffy, snooty, dark-walled place that feels like a monastery, not a place for innovation. Either that or go to a nearby coffee shop and get accused of slacking off.

While particularly an issue in the research areas, the problem of employee motivation and morale existed throughout the R&D division. Many employees felt either that their work was not recognized by management or that they were simply not being used to their full potential. A survey indicated that a full 70 percent of the division's staff did not believe that they were effectively utilized. Further, more than two-thirds of the staff felt that the pay and career systems did not recognize or reward creative work. Despite the problems, many employees also felt a real loyalty to Medtek and felt that they could offer much more to the company if some of the key issues that bugged them were resolved.

These problem areas seemed to feed on each other. The lack of planning and control procedures and the resultant start-stop of the projects only accentuated the fragmentation problem as each functional area focused on its narrow task. Further, the lack of clear project objectives also contributed to the narrow focus of the departments. Defects in the planning and control system and weakness of the product managers worked to drive the departments away from each other. The lack of project stability, the poor structure of reward systems, and the nature of the stop-and-start work each reduced commitment and involvement of the staff. Similarly, the "yo-yo effect" undermined the role of the product managers and further reduced their ability to develop motivation within their project and to influence others in the larger organization.

These interrelated problems, along with the lack of any real research activity, contributed to the feelings of frustration and low morale in the division. Between departments, communication decreased, as did the amount of effective collaboration and cooperation. The HORSE project developed a number of clinical and engineering problems, while the 60/12 system and the Scan-Lon system could not shake off persistent R&D problems. The reputation of the division had fallen sharply in the eye of the rest of the corporation, and the R&D personnel were openly complaining of the lack of leadership and direction in the division.

JOHN TORRENCE'S PERSPECTIVE

John Torrence was clearly frustrated. In discussions with the consulting team, Torrence provided some perspective on the problems faced by the R&D division.

> Something is rotten here. Given our corporate objectives and our commitment to R&D, the laboratory should have the highest status in the company. Instead, our morale is low, and our reputation could not be lower within the firm as a whole. Our biggest problem, of course, is the failure to come up with new products. The future of the company depends upon our developing new technologies that will be commercially successful. Many of the problems, I think, stem from the way that we manage ourselves. With a few exceptions, we have high quality people here in the division. We do have the necessary scientific and R&D talent. The problem is that they are not coming up with new ideas; also, they don't seem to be able to get through the process of moving an idea to the product stage. Part of our problem, I think, is the way we are organized within the division. I have too many people reporting to me, and I am thinking about changing the structure. Beyond that, however, there are problems in the attitudes of people. When I talk to people in the division, they just don't have too much drive or ambition. They don't seem fired up. This attitude is reflected in the large number of projects that are either behind schedule, over budget, or both. Finally, we don't seem to have a good feel of where we are going as a division, where we ought to be putting our resources, and how we determine priorities.

Given their initial diagnosis, Mr. Torrence asked the consulting team for their analysis and interpretation as to what was going on. He also asked if they had suggestions for changes and action steps that should be taken to create a dynamic, innovative R&D division that would lead Medtek into the future.

EXHIBIT 1. ORGANIZATION CHART OF MEDTEK

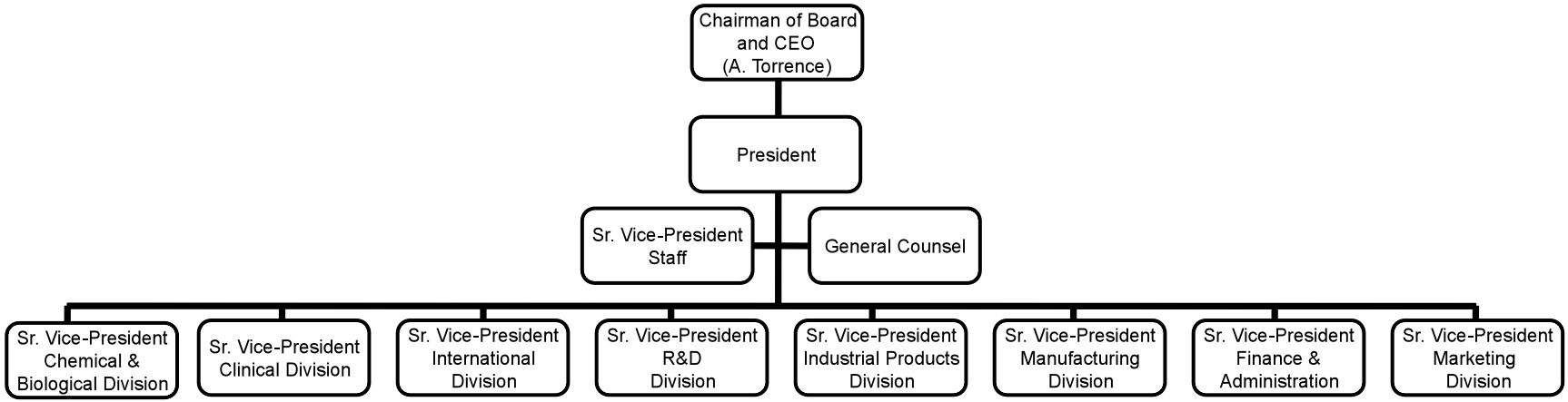

EXHIBIT 2. ORGANIZATION CHART OF THE R&D DIVISION