Case 10A

EMI AND THE CT SCANNER [A]*

In early 1972 there was considerable disagreement among top management at EMI Ltd., the U.K.-based music, electronics, and leisure company. The subject of the controversy was the CT scanner, a new medical diagnostic imaging device that had been developed by the group's Central Research Laboratory (CRL). At issue was the decision to enter this new business, thereby launching a diversification move that many felt was necessary if the company was to continue to prosper.

Complicating the problem was the fact that this revolutionary new product would not only take EMI into the fast-changing and highly competitive medical equipment business, but would also require the company to establish operations in North America, a market in which it had no prior experience. In March 1972 EMI's board was considering an investment proposal for £6 million to build CT scanner manufacturing facilities in the United Kingdom.

DEVELOPMENT OF THE CT SCANNER

Company Background and History

EMI Ltd. traces its origins back to 1898, when the Gramophone Company was founded to import records and gramophones from the United States. It soon established its own manufacturing and recording capabilities, and after a 1931 merger with its major rival, the Columbia Gramophone Company, emerged as the Electric and Musical Industries, Ltd. EMI Ltd. quickly earned a reputation as an aggressive technological innovator, developing the automatic record changer, stereophonic records, magnetic recording tape, and the pioneer commercial television system adopted by the BBC in 1937.

Beginning in 1939, EMI's R&D capabilities were redirected by the war effort toward the development of fuses, airborne radar, and other sophisticated electronic devices.

Assistant Professor Christopher A. Bartlett prepared this case as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. Information was obtained from public sources and third parties. Although employees of the subject company discussed with the researcher events referred to in the case, they did not participate in the preparation of the document. The analysis, conclusions, and opinions stated do not necessarily represent those of the company, its employees or agents, or employees or agents of its subsidiaries. Thorn EMI PLC, on its own behalf and on behalf of all or any of its present or former subsidiaries, disclaims any responsibility for the matters included or referred to in the *study*.

The company emerged from the war with an electronics business, largely geared to defense-related products, as well as its traditional entertainment businesses. The transition to peacetime was particularly difficult for the electronics division, and its poor performance led to attempts to pursue new industrial and consumer applications. EMI did some exciting pioneering work, and for a while held hopes of being Britain's leading computer company.

Market leadership in major electronics applications remained elusive, however, while the music business boomed. The 1955 acquisition of Capitol Records in the United States, and the subsequent success of the Beatles and other recording groups under contract to EMI, put the company in a very strong financial position as it entered the 1970s. In 1970 the company had earned £21 million before tax on sales of £215 million, and although extraordinary losses halved those profits in 1971, the company was optimistic for a return to previous profit levels in 1972 (see Exhibits 1 to 3 for EMI's financial performance).

[Exhibits 1, 2 and 3 about here]

Around that time, a change in top management signaled a change in corporate strategy. John Read, an accountant by training and previously sales director for Ford of Great Britain, was appointed chief executive officer after only four years in the company. Read recognised the risky, even fickle, nature of the music business, which accounted for two-thirds of EMI's sales and profits. In an effort to change the company's strategic balance, he began to divert some of its substantial cash flow into numerous acquisitions and internal developments.

To encourage internal innovation, Read established a research fund that was to be used to finance innovative developments outside the company's immediate interests. Among the first projects financed was one proposed by Godfrey Hounsfield, a research scientist in EMI's Central Research Laboratories (CRL). Hounsfield's proposal opened up an opportunity for the company to diversify in the fast- growing medical electronics field.

CT Scanning: The Concept

In simple terms, Hounsfield's research proposal was to study the possibility of creating a three-dimensional image of an object by taking multiple X-ray measurements of the object from different angles, then using a computer to reconstruct a picture from the data contained in hundreds of overlapping and intersecting X-ray slices. The concept became known as computerized tomography (CT).

Although computerized tomography represented a conceptual breakthrough, the technologies it harnessed were quite well known and understood. Essentially, it linked X-ray, data processing, and cathode ray tube display technologies in a complex and precise manner. The real development challenge consisted of

integrating the mechanical, electronic, and radiographic components into an accurate, reliable, and sensitive system. Figure A provides a schematic representation of the EMI scanner, illustrating the linkage of the three technologies, as well as the patient handling table and X-ray gantry.

[Figure A about here]

Progress was rapid, and clinical trials of the CT scanner were under way by late 1970. To capture the image of multiple slices of the brain, the scanner went through a translate-rotate sequence, as illustrated in Figure B. The X-ray source and detector, located on opposite sides of the patient's head, were mounted on a gantry. After each scan, or 'translation," had generated an X-ray image comprising 160 data points, the gantry would rotate 1° and another scan would be made.

[Figure B about here]

This procedure would continue through 180 translations and rotations, storing a total of almost 30,000 data points. Since the detected intensity of an X-ray varies with the material through which it passes, the data could be reconstructed by the computer into a three-dimensional image of the object that distinguished bone, tissue, water, fat, and so on.

At about the time of the CT clinical trials, a John Powell, formerly managing director of Texas Instrument's English subsidiary, joined EMI as technical director. He soon became convinced that the poor profitability of the nonmilitary electronics business was due to the diffusion of the company's 2,500-person R&D capability over too many diverse small-volume lines. In his words, "EMI was devoted to too many products and dedicated to too few.'

Because the CT scanner project built on the company's substantial and well-established electronics capability, Powell believed it gave EMI an important opportunity to enter an exciting new field. He felt that this was exactly the type of effort in which the company should be prepared to invest several million pounds.

DIAGNOSTIC IMAGING INDUSTRY

During the first half of this century, diagnostic information about internal organs and functions was provided almost exclusively by conventional X-ray examination, but in the 1960s and 1970s, several new imaging techniques emerged. When the CT scanner was announced, three other important technologies existed: X-ray, nuclear, and ultrasound.

EMI management believed its CT scanner would displace existing diagnostic imaging equipment in only a few applications, specifically head and brain imaging.

X-ray

In 1895 Wilhelm Roentgen discovered that rays generated by a cathode ray tube could penetrate solid objects and create an image on film. Over the next 40 to 50 years, X-ray equipment was installed in almost every health care facility in the world. Despite its several limitations (primarily due to the fact that detail was obscured when three-dimensional features were super- imposed on a two-dimensional image), X-rays were universally used. In 1966 a Surgeon General's report estimated that between one-third and one-half of all crucial medical decisions in the United States depended on interpretation of X-ray films. That country alone had more than 80,000 X-ray installations in operation, performing almost 150 million procedures in 1970.

The X-ray market was dominated by five major global companies. Siemens of West Germany was estimated to have 22% of the world market, N.V. Philips of the Netherlands had 18%, and Compagnie Generale de Radiologie (CGE), subsidiary of the French giant Thomson Brandt, held 16%. Although General Electric had an estimated 30% of the large U.S. market, its weak position abroad gave it only 15% of the world market. The fifth largest company was Picker, with 20% of the U.S. market, but less than 12% worldwide.

The size of the U.S. market for X-ray equipment was estimated at $350 million in 1972, with an additional $350 million in X-ray supplies. The United States was thought to represent 35- 40% of the world market. Despite the maturity of the product, the X-ray market was growing by almost 10% annually in dollar terms during the early 1970s.

A conventional X-ray system represented a major capital expenditure for a hospital, with the average system costing more than $100,000 in 1973.

Nuclear Imaging

In the mid-1960s a nuclear diagnostic imaging procedure was developed. Radioisotopes with a short radioactive life were projected into the body, detected and monitored on a screen, then recorded on film or stored on a tape. Still in an early stage of development, this technology was used to complement or, in some instances, replace a conventional X-ray diagnosis. Both static and dynamic images could be obtained.

Following the pioneering development of this field by Nuclear-Chicago, which sold the first nuclear gamma camera in 1962, several other small competitors had entered the field, notably Ohio Nuclear. By the late 1960s larger companies such as Picker were getting involved, and in 1971 GE's Medical Systems Division announced plans to enter the nuclear medicine field.

As new competitors, large and small, entered the market, competition became more aggressive. The average nuclear camera and data processing system sold for about $75,000. By 1973, shipments of nuclear imaging equipment into the U.S. market were estimated to be over $50 million.

Ultrasound

Ultrasound had been used in medical diagnosis since the 1950s, and the technology advanced significantly in the early 1970s, permitting better-defined images. The technique involves transmitting sonic waves and picking up the echoes, which when converted to electric energy could create images. Air and bone often provide an acoustic barrier, limiting the use of this technique. But because the patient was not exposed to radiation, it was widely used as a diagnostic tool in obstetrics and gynecology.

In 1973 the ultrasound market was very small, and only a few small companies were reported in the field. Picker, however, was rumored to be doing research in the area. The cost of the equipment was expected to be less than half that of a nuclear camera and support system, and perhaps a third to a quarter that of an X- ray machine.

U.S. Market Potential

Because of its size, sophistication, progressiveness, and access to funds, the U.S. medical market clearly represented the major opportunity for a new device such as the CT scanner. EMI management was uncertain about the sales potential for their new product, however.

As of 1972, there were around 7,000 hospitals in the United States, ranging from tiny rural hospitals with fewer than 10 beds to giant teaching institutions with 1,000 beds or more (see Exhibit.4)

[Exhibit 4 about here]

Since the price of the EMI Scanner was expected to be around $400,000, only the largest and financially strongest short-term institutions would be able to afford one. But the company was encouraged by the enthusiasm of the physicians who had seen and worked with the scanner. In the opinion of one leading American neurologist, at least 170 machines would be required by major U.S. hospitals. Indeed, he speculated, the time might come when a neurologist would feel ethically compelled to order a CT scan before making a diagnosis.

During the 1960s the radiology departments in many hospitals were recognized as important money making operations. Increasingly, radiologists were able to commission equipment manufacturers to build specially designed (often esoteric) X-ray systems and applications. As their budgets expanded, the size of the U.S. X- ray market grew from $50 million in 1958 to $350 million in 1972.

Of the 15,000 radiologists in the United States, 60% were primarily based in offices and 40% in hospitals. Little penetration of private clinics was foreseen for the CT scanner. Apart from these broad statistics, EMI had little ability to forecast the potential of the U.S. market for scanners.

EMI'S INVESTMENT DECISION

Conflicting Management Views

By late 1971 it was clear that the clinical trials were successful and EMI management had to decide whether to make the investment required to develop the CT scanner business. One group of senior managers felt that direct EMI participation was undesirable for three reasons. First, EMI lacked medical product experience. In the early 1970s EMI offered only two very small medical products, a patient-monitoring device and an infrared thermography device, which together represented less than 0.5% of the company's sales.

Second, they argued that the manufacturing process would be quite different from EMI's experience. Most of its electronics work had been in the job shop mode required in producing small numbers of highly specialized defense products on cost-plus government contracts. In scanner production, most of the components were purchased from subcontractors and had to be integrated into a functioning system.

Finally, many believed that without a working knowledge of the North American market, where most of the demand for scanners was expected to be, EMI might find it very difficult to build an effective operation from scratch.

Among the strongest opponents of EMI's' self- development of this new business was one of the scanner's earliest sponsors, Dr. Broadway, head of the Central Research Laboratory. He emphasized that EMI's potential competitors in the field had considerably greater technical capabilities and resources. As the major proponent, John Powell needed convincing market information to counter the critics. In early 1972 he asked some of the senior managers how many scanners they thought the company would sell in its first 12 months. Their first estimate was five. Powell told them to think again. They came back with a figure of 12, and were again sent back to reconsider. Finally, with an estimate of 50, Powell felt he could go to bat for the £6 million investment, since at this sales level he could project handsome profits from year one. He then prepared an argument that justified the scanner's fit with EMI's overall objectives, and outlined a basic strategy for the business.

Powell argued that self-development of the CT scanner represented just the sort of vehicle EMI had been seeking to provide some focus to its development effort. By definition, diversification away from existing product-market areas would move the company into somewhat unfamiliar territory, but he firmly believed that the financial and strategic payoffs would be huge. The product offered access to global markets and an entry into the lucrative medical equipment field. He felt the company's objective should be -to achieve a substantial share of the world medical electronics business not only in diagnostic imaging, but also through the ex- tension of its technologies into computerized patient planning and radiation therapy.'

Powell claimed that the expertise developed by Hounsfield and his team, coupled with protection from patents, would give EMI three or four years, and maybe many more, to establish a solid market

position. He argued that investments should be made quickly and boldly to maximize the market share of the EMI scanner before competitors entered. Other options, such as licensing, would impede the development of the scanner. If the licensees were the major X-ray equipment suppliers, they might not promote the scanner aggressively since it would cannibalize their sales of X-ray equipment and consumables. Smaller companies would lack EMI's sense of commitment and urgency. Besides, licensing would not provide EMI with the major strategic diversification it was seeking. It would be, in Powell's words, “selling our birthright."

The Proposed Strategy

Because the CT scanner incorporated a complex integration of some technologies in which ENU had only limited expertise, Powell proposed that the manufacturing strategy should rely heavily on outside sources of those components rather than trying to develop the expertise internally. This approach would not only minimize risk, but would also make it possible to implement a manufacturing program rapidly.

He proposed the concept of developing various “centers of excellence” both inside and outside the company, making each responsible for the continued superiority of the subsystem it manufactured. For example, within the EMI U.K. organization a unit called SE Labs, which manufactured instruments and displays, would become the center of excellence for the scanner's viewing console and display control. Pantak, an EMI unit with a capability in X-ray tube

assembly, would become the center of excellence for X-ray generation and detection sub- system. An outside vendor with which the company had worked in developing the scanner would be the center of excellence for data processing. Finally, a newly created division would be responsible for coordinating these subsystem manufacturers, integrating the various components, and assembling the final scanner at a company facility in the town of Haves, not far from the CRL site.

Powell emphasized that the low initial investment was possible because most of the components and subsystems were purchased from contractors and vendors. Even internal centers of excellence such as SE Labs and Pantak assembled their subsystems from purchased components. Overall, outside vendors accounted for 75 - 80% of the scanner's manufacturing cost. Although Powell felt his arrangement greatly reduced EMI's risk, the £6 million investment was a substantial one for the company, representing about half the funds available for capital investment over the coming year. (See *Exhibit 2* for a balance sheet and *Exhibit 3* for a projected funds flow.)

The technology strategy was to keep CRL as the company's center of excellence for design and software expertise, and to use the substantial profits Powell was projecting from even the earliest sales to maintain technological leadership position.

Powell would personally head up a team to develop a marketing strategy. Clearly, the United States had to be the main focus of EMI's marketing activity. Its neuroradiologists were regarded as world leaders

and tended to welcome technological innovation. Furthermore, its institutions were more commercial in their outlook than those in other countries and tended to have more available funds. Powell planned to set up a U.S. sales subsidiary as soon as possible, recruiting sales and service personnel familiar with the North American health care market. Given the interest shown to date in the EMI scanner, he did not think there would be much difficulty in gaining the attention and interest of the medical community.

Getting the $400,000 orders, however, would be more of a challenge. In simple terms, Powell's sales strategy was to get machines into a few prestigious reference hospitals, then build from that base.

The Decision

In March 1972 EMI's chief executive, John Read, considered Powell's proposal in preparation for a board meeting. Was this the diversification opportunity he had been hoping for? What were the risks? Could they be managed? How? If he decided to back the proposal, what kind of an implementation program would be necessary to ensure its eventual success?

Exhibit 1 EMI Limited: Profit and Loss Statement, 1969–1971 (£ in thousands)

Years Ended June 30	*1969*	*1970*	*1971*
Sales			
Music	£110,554	£129,439	£128,359
Leisure	20,960	32,651	35,798
Television	4,640	10,625	13,593
Electronics	40,170	42,571	52,819
Total	176,324	215,286	230,569
Profit (loss) before Interest and Taxation			
Music	13,293	16,427	1,970
Leisure	1,691	3,875	4,146
Television	733	992	3,833
Electronics	3,741	3,283	3,090
Subtotal	19,458	24,577	13,039
Property	–	(20)	939
Total	19,458	24,557	13,978
Sales			
United Kingdom	63,144	89,069	103,824
Europe	25,987	27,017	39,673
North America	65,528	74,622	58,989
Other countries	21,665	24,578	28,083
Total	176,324	215,286	230,569
Profit (loss) before Interest and Taxation			
United Kingdom	8,301	10,465	13,113
Europe	3,176	3,230	3,113
North America	5,525	7,627	(5,754)
Other countries	2,456	3,235	3,506
Subtotal	19,458	24,557	13,978
Net interest payable	(1,857)	(3,599)	(5,010)
Total	£17,601	£20,958	£8,968
As a percentage of net assets	15.8%	17.3%	7.4%
Taxation	£8,407	£10,443	£3,541
As a percentage of profit	47.8%	49.8%	39.5%
Profit after Taxation	£9,194	£10,515	£5,427
As a percentage of net assets	8.3%	8.7%	4.5%

Exhibit 2 EMI Group Consolidated Balance Sheet, 1972
(£ thousands)

Employment of Capital		
Goodwill		80,814
Fixed assets		104,174
Other investments		14,354
Current assets		
Inventories	45,508	
Films, programs, and rights	7,712	
Accounts receivable	82,483	
Liquid funds	20,086	
	155,789	
Less		
Current liabilities		
Accounts payable	96,942	
Bank borrowings	14,168	
Taxes payable	17,174	
Dividends declared	4,202	
	132,486	
Net current assets		23,303
Total		222,645
Capital Employed		
Share capital		40,937
Reserves		90,239
Minority shareholders' interests		14,992
Loan capital		76,011
Deferred taxes		466
Total		222,645

Exhibit 3 EMI Group Projected Funds Flow, 1972 (£ thousands)

Sources of Funds	
Profit before tax	18.3
Depreciation	6.7
Sale of fixed assets	5.5
Sale of investments	5.4
Loan capital	0.3
Decrease in working capital	4.5
Total	40.7
Uses of Funds	
Tax payments	5.9
Dividends paid	5.6
Fixed asset additions	13.0
Repayment of loan capital	3.4
Reduction in short-term borrowings	12.8
Total	40.7

Exhibit 4. Numbers of hospitals in the United States, 1972

Number of beds	*Short-term*	*Long-term (chronic)*	*Total*
Less than 100	3,110	375	3,485
100-299	1,904	385	2,289
300-499	574	141	715
More than 500	537	91	628
Total	6,125	992	7,117

Figure A - Schematic Drawing of Scanner System

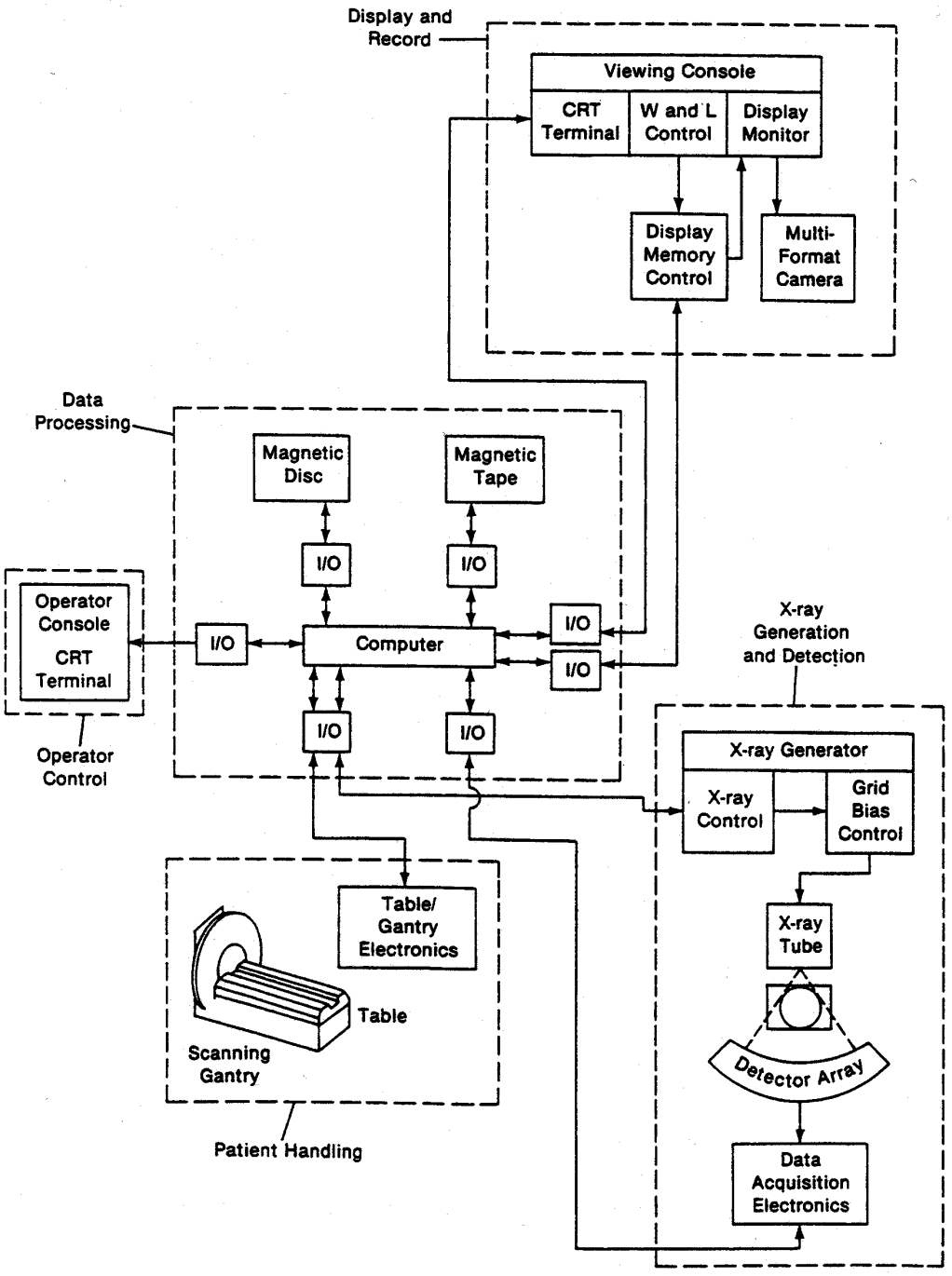

Figure B Translate-Rotate CT Scanning