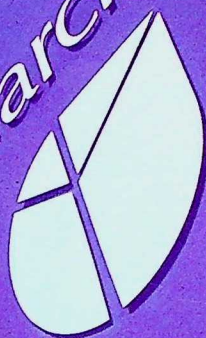


Bell-Northern research



central

Identity

Bell-Northern Research is a world centre of excellence in telecommunications development, and the focal point of telecommunications progress in Canada. It's also the largest industrial research and development organization in the country, and ranks as one of North America's top one

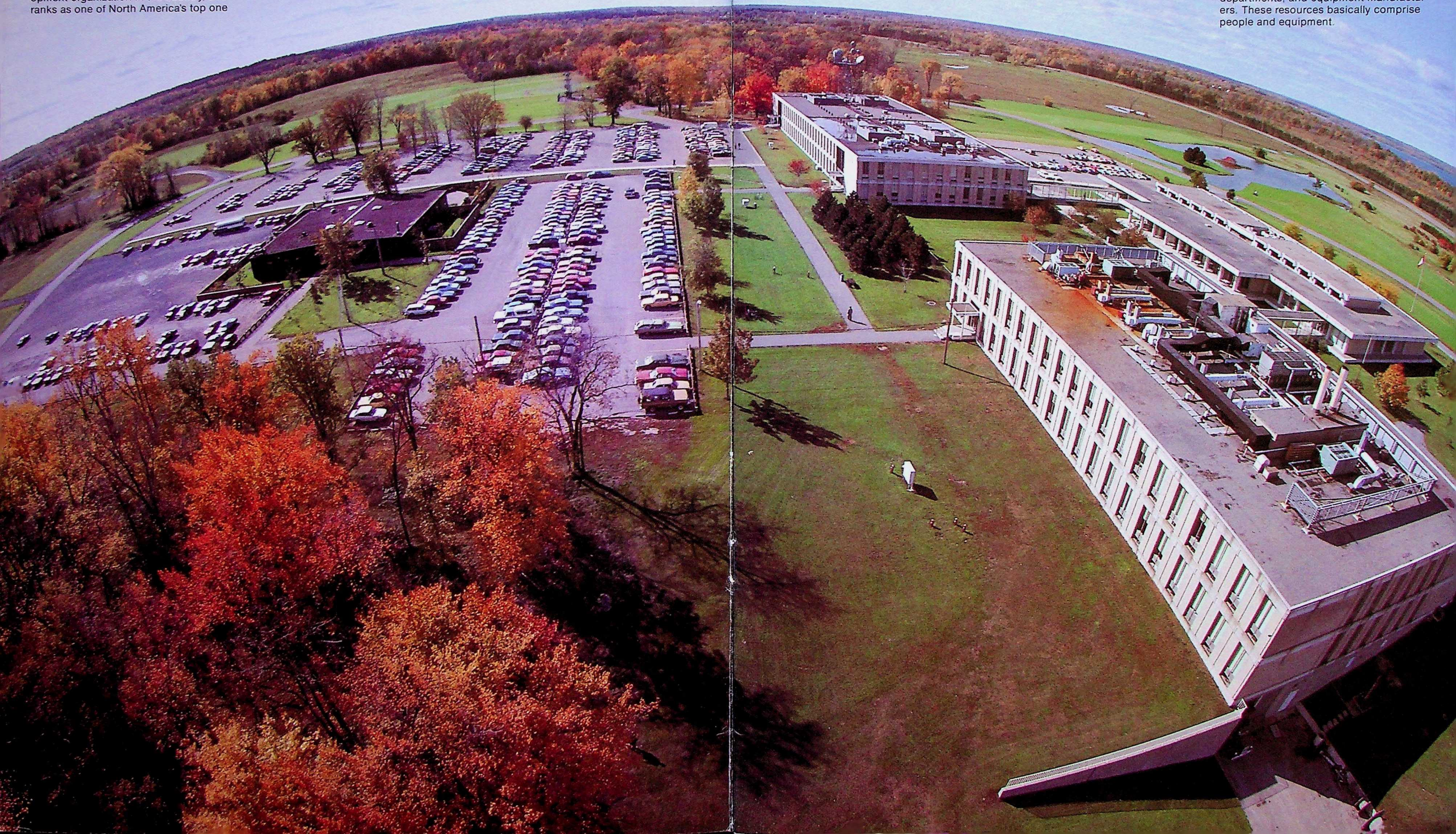
percent of research centres. With headquarters in Ottawa—the location of its Central and Corktown laboratories—BNR also has facilities in Toronto and Montreal. In the USA, a wholly owned subsidiary,

BNR INC, provides a source of expertise in product development and systems engineering in Palo Alto, California.

BNR's research and development capability is integrated with the operational experience of Bell Canada, the pre-

mier telephone company in Ontario and Quebec, and the manufacturing depth of Northern Telecom Limited, the multinational manufacturer of telecommunications equipment. Two main tasks shape the research and development program:

product design and development for Northern Telecom, its major owner, and long-range planning and systems engineering for Bell Canada. Since 1973, BNR has offered its resources on a contract basis to clients in North America, among them telephone companies, government departments, and equipment manufacturers. These resources basically comprise people and equipment.



People: BNR's strength

BNR's staff consists of 2000 men and women selected from all over the world for their special knowledge or skills. Of these, the 1200-member research staff spearhead BNR activities. Almost 600 hold degrees beyond the bachelor's level, and over 150 have PhDs. Their expertise is directed towards many fields: for instance,

research in physics and chemistry; software writing and documentation; human factors studies and industrial design; and electrical engineering. BNR is large enough to marshal the multidisciplinary teams needed to handle today's complex communications projects, but small enough to remain organizationally responsive and flexible.



Equipment: a vital resource

More than \$50 million has been invested in equipment in BNR's laboratories. One of the most important items is a design, development and prototype supply facility for integrated circuits, vital elements for today's communications systems. Located at the Corkstown campus, it is complete from computer-aided design through wafer fabrication and packaging, to testing and reliability evaluation. It features some of the most advanced software, fabrication processes, and hardware capability in the industry.

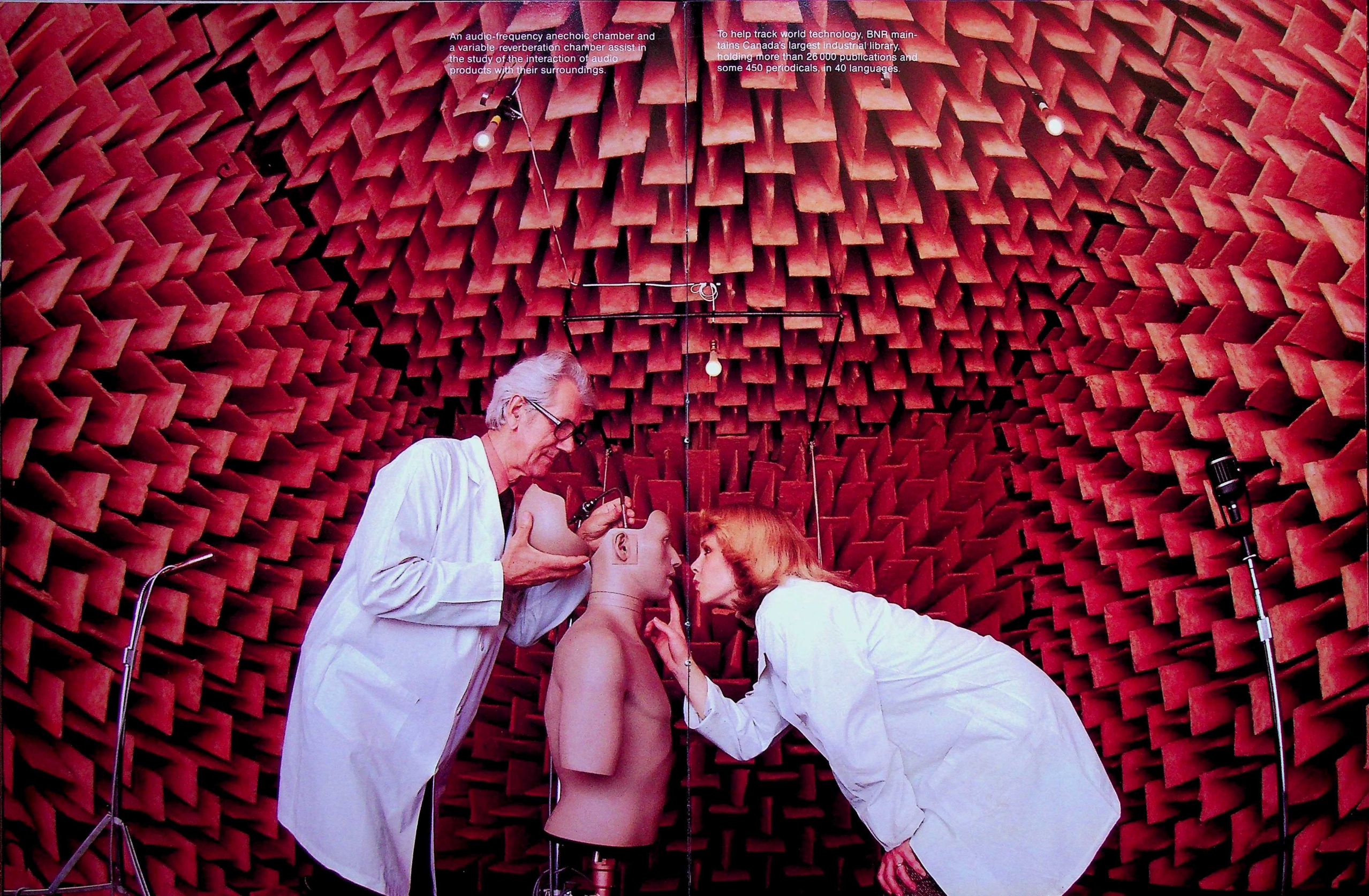
A major time-sharing computer system, accessible through a variety of terminals at all BNR locations, handles many tasks, including design analysis and calculation, writing and testing of software for switching machines, and compilation of design information and documents.

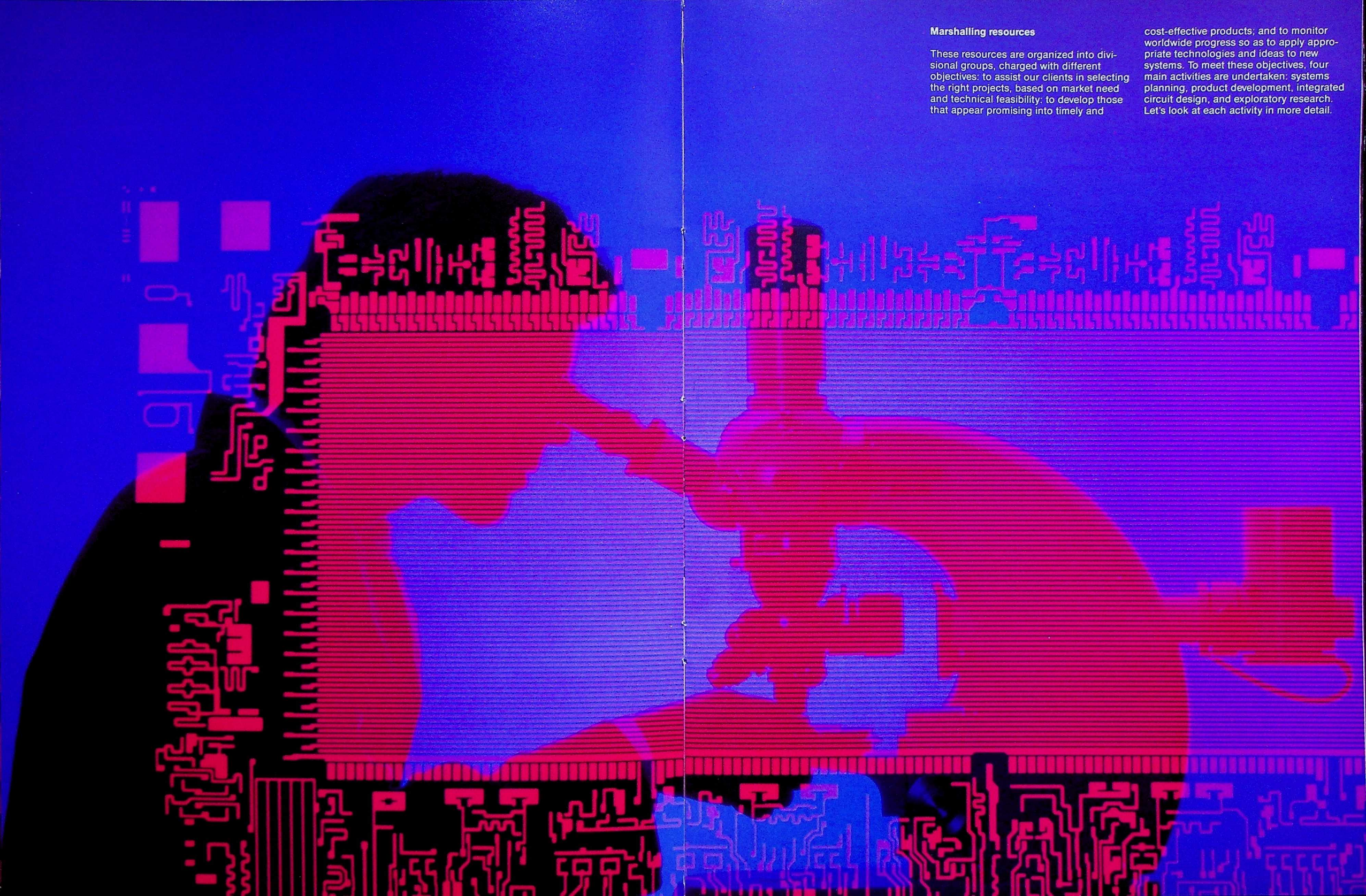
Scanning electron microscopes and microprobes are used to glean knowledge of the properties of materials, their performance and modes of failure.



An audio-frequency anechoic chamber and a variable reverberation chamber assist in the study of the interaction of audio products with their surroundings.

To help track world technology, BNR maintains Canada's largest industrial library, holding more than 26 000 publications and some 450 periodicals, in 40 languages.

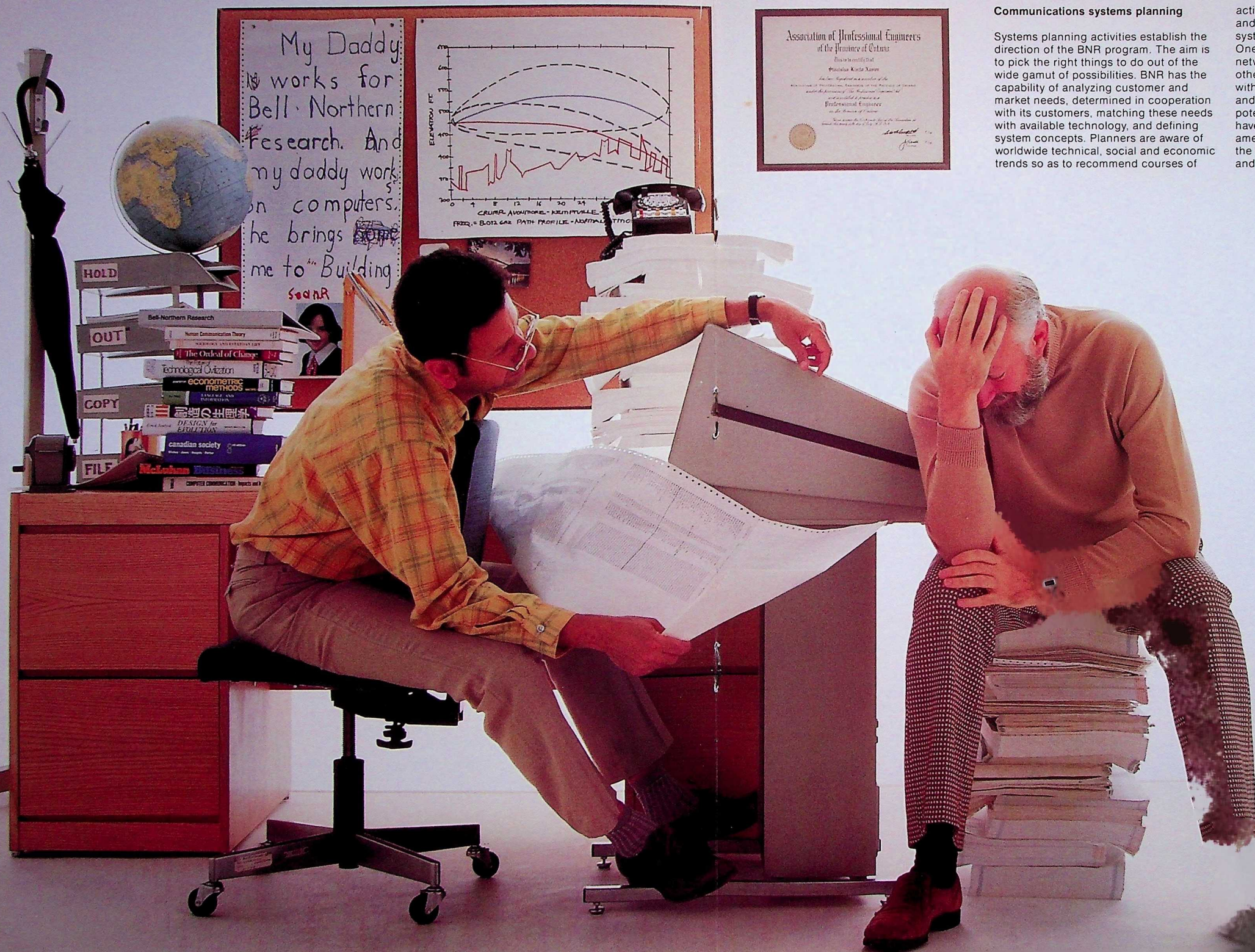




Marshalling resources

These resources are organized into divisional groups, charged with different objectives: to assist our clients in selecting the right projects, based on market need and technical feasibility; to develop those that appear promising into timely and

cost-effective products; and to monitor worldwide progress so as to apply appropriate technologies and ideas to new systems. To meet these objectives, four main activities are undertaken: systems planning, product development, integrated circuit design, and exploratory research. Let's look at each activity in more detail.



Communications systems planning

Systems planning activities establish the direction of the BNR program. The aim is to pick the right things to do out of the wide gamut of possibilities. BNR has the capability of analyzing customer and market needs, determined in cooperation with its customers, matching these needs with available technology, and defining system concepts. Planners are aware of worldwide technical, social and economic trends so as to recommend courses of

action that are in tune with local, national and international policies. In BNR, systems planners have two major tasks. One is to see that telecommunication networks evolve in an orderly way. The other is to see that services and systems within each network are serving real needs and are coordinated with planned and potential network growth. BNR personnel have made the planning process more amenable to computer analysis, reducing the time taken to reach planning decisions and yielding better justified conclusions.

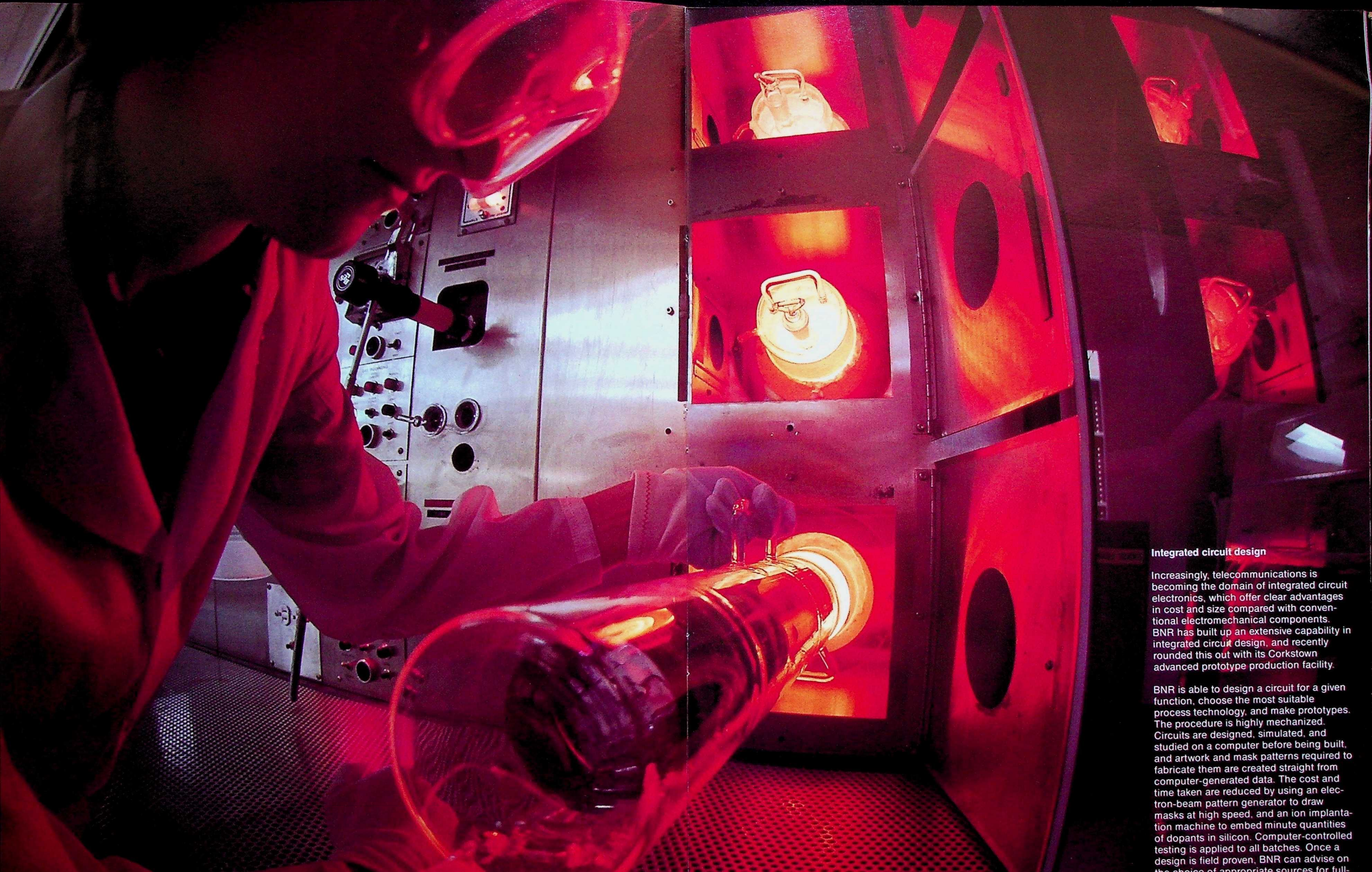
Product development

As the organization charged with creating Northern Telecom's product portfolio, BNR has capabilities that extend from the inception of a product to analysis of its ultimate performance. Once product opportunities have been identified, the most appropriate technologies are applied on a cost-effective basis. Product design and development combines design and engineering skills, innovative flair, careful experimental work, and consideration of the end user from the early stages. Then comes prototype construction, preparation for manufacturing, and accurate and comprehensive documentation. BNR's involvement continues with the validation of predicted total life performance and cost through analysis of in-service data.



BNR's abilities are evident in its record of product development for Northern Telecom. The latest example is a comprehensive range of digital switching and transmission products designed as elements of an integrated digital world to serve telecommunications needs into the future. These include the DMS* family of switching machines, the LD-1 and LD-4 cable transmission systems, and the SL*-1 business communications system. Earlier BNR-designed products have won wide acceptance: for example, the SP-1 family of stored-program-controlled switching machines, with more than 1.5 million lines ordered, and the Pulse* electronic private automatic branch exchange, which has outsold all competing systems in its class in the USA.

* Trademark of Northern Telecom Limited



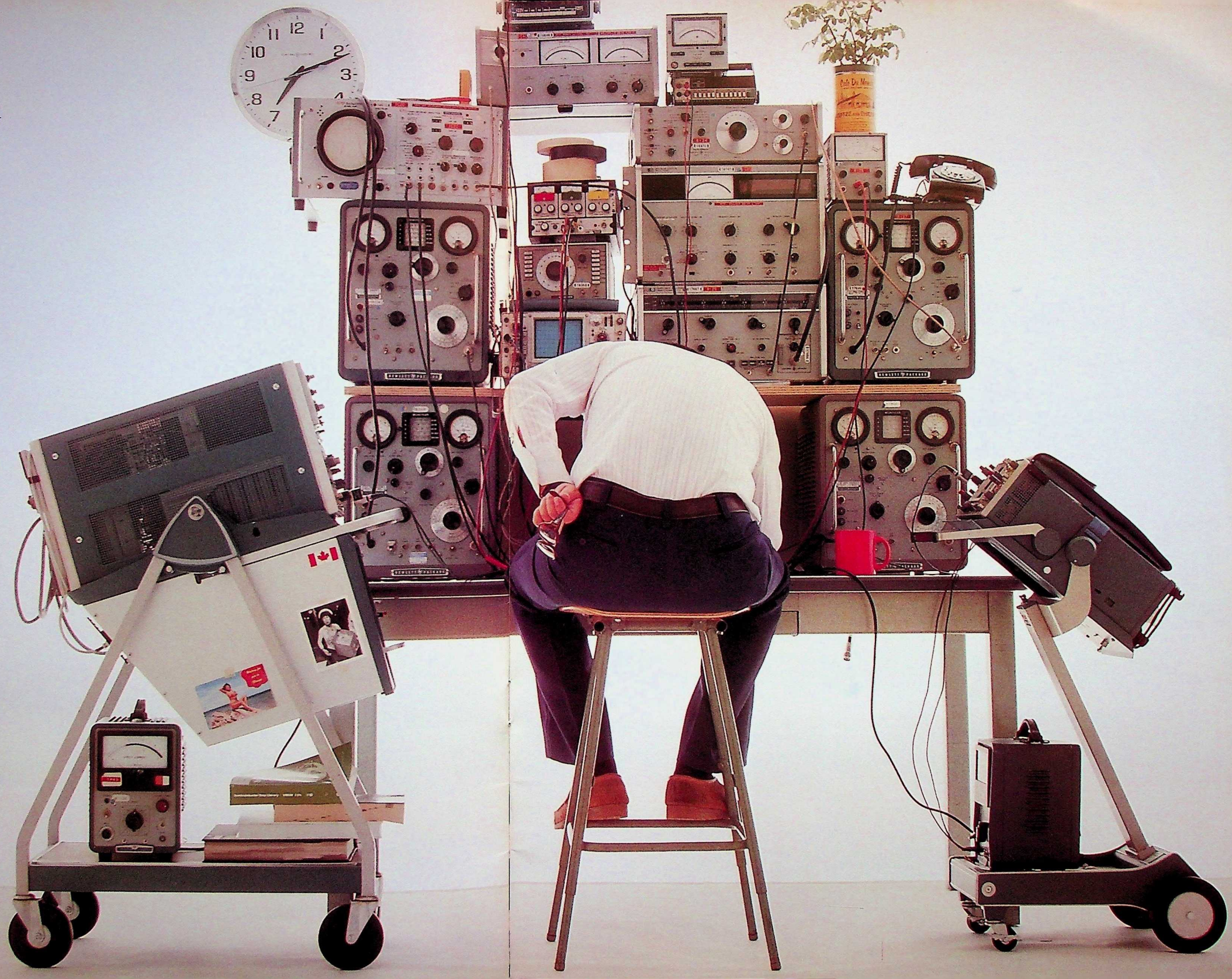
Integrated circuit design

Increasingly, telecommunications is becoming the domain of integrated circuit electronics, which offer clear advantages in cost and size compared with conventional electromechanical components. BNR has built up an extensive capability in integrated circuit design, and recently rounded this out with its Corkstown advanced prototype production facility.

BNR is able to design a circuit for a given function, choose the most suitable process technology, and make prototypes. The procedure is highly mechanized. Circuits are designed, simulated, and studied on a computer before being built, and artwork and mask patterns required to fabricate them are created straight from computer-generated data. The cost and time taken are reduced by using an electron-beam pattern generator to draw masks at high speed, and an ion implantation machine to embed minute quantities of dopants in silicon. Computer-controlled testing is applied to all batches. Once a design is field proven, BNR can advise on the choice of appropriate sources for full-

Exploratory research

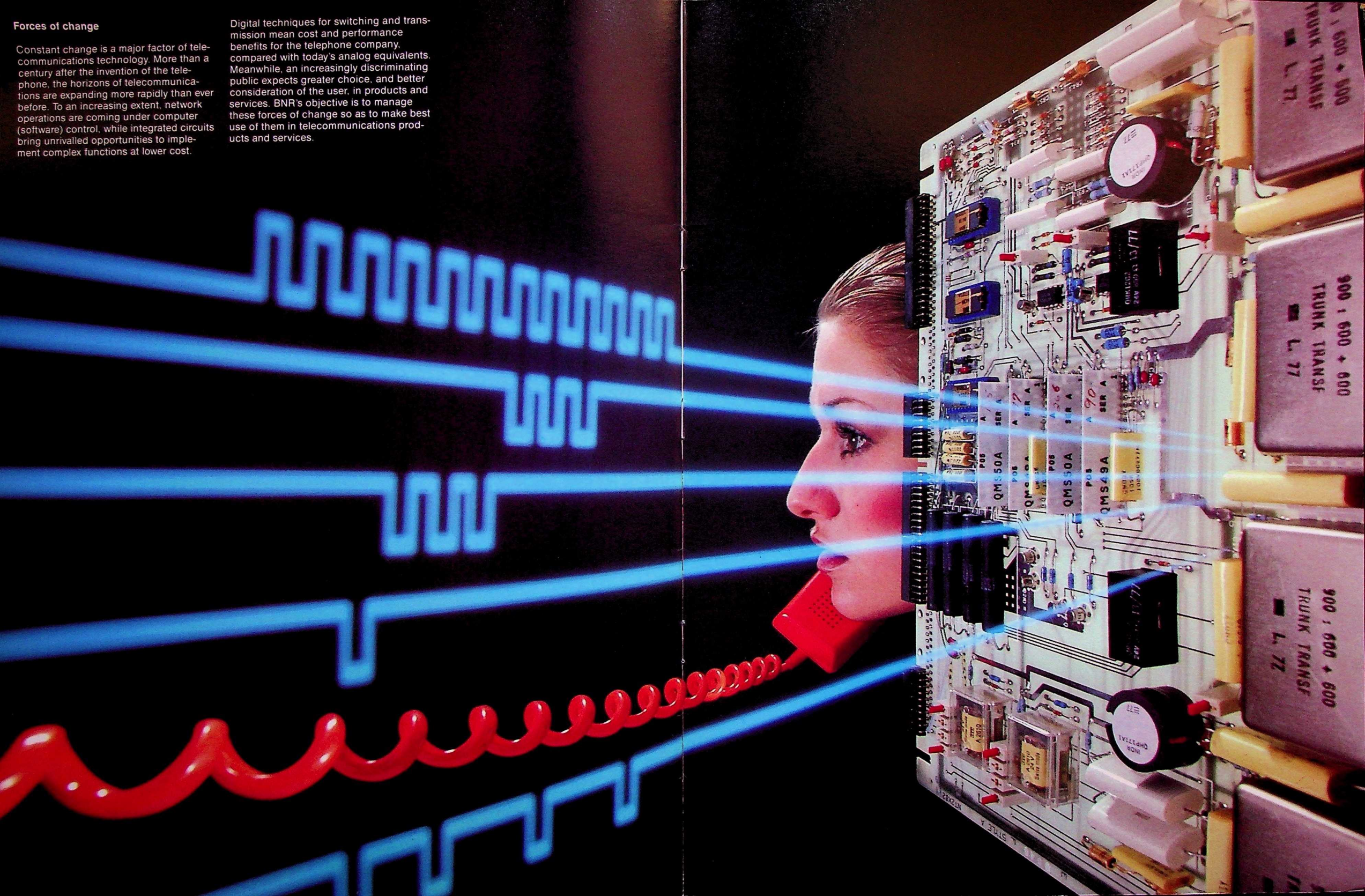
Exploratory research and development is an investment in advanced technology for future products. This work is conducted using an extensive array of laboratory equipment. Typical activity in this field has produced long-life, high-intensity LEDs for optoelectronic communications, fibre optics communications systems, and a plasma etching process for silicon which makes processing more efficient and accurate, leading to circuits with more densely packed elements.



Forces of change

Constant change is a major factor of telecommunications technology. More than a century after the invention of the telephone, the horizons of telecommunications are expanding more rapidly than ever before. To an increasing extent, network operations are coming under computer (software) control, while integrated circuits bring unrivalled opportunities to implement complex functions at lower cost.

Digital techniques for switching and transmission mean cost and performance benefits for the telephone company, compared with today's analog equivalents. Meanwhile, an increasingly discriminating public expects greater choice, and better consideration of the user, in products and services. BNR's objective is to manage these forces of change so as to make best use of them in telecommunications products and services.





The changing picture

BNR is an agent of change, but change directed towards real communication needs. The corporate symbol links the themes of man, world and direction, in a graphic representation of our mission: man reaching out to the challenge of his environment.

BNR itself has altered a lot since it began. We can be sure that our projects and activities will also change. But BNR will remain a major driving force behind the evolution of telecommunications into the future.

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