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INTRODUCTION

The most important invention Thomas Edison gave us was not an invention at all. It was the process of invention, the codification of the discrete steps to take a raw idea to a commercial product. This idea was the basis of his invention factory concept—which later morphed into what we recognize today as team-based, corporate R&D. It is widely applicable across all sectors of the R&D community—industrial, academic and governmental.

By the time Edison died in 1931, major companies had formalized their own corporate R&D facilities, as shown below:

Edison	Menlo Park 1876; West Orange 1887
General Electric	1885
J&J	1891
Merck	1891
National Starch	1895
Du Pont	1903
Benjamin Moore	1904
Westinghouse	1904
Exxon	1919
Englehard	1920
RCA	1920
Bell Labs	1925
Mobil	1925
Union Carbide	1925
Hoffman La Roche	1929
Campbell Soup	1939
Allied Signal	1943
Nabisco	1958

During World War I, military leaders summoned Edison to Washington, D.C., to bring his inventive genius and R&D process to bear on the German U-boat problem, searching for ways to better detect them. In Washington, D.C., he assembled teams of inventors, scientists, engineers and technologists to work on the problem. After the war, such assemblies led to the formation of the Naval Research Labs in 1923. Later, he influenced the formation and structure of the Manhattan Project teams [the development of the atomic bomb], and the major national labs in the 1950s and 60s that followed, including NASA.

Today's U.S. innovative leaders include Amazon, Google, Microsoft, Tesla and 3M. These companies have encouraged innovation by giving their employees time and money to work on individual projects.

For instance, it's no secret that Amazon is one of the world's most innovative companies. Starting out as a niche service selling books online, it now is not only a dominant retailer, but has pioneered new categories such as cloud computing and smart speakers.

3M has R&D Internships for students. As an R&D Intern working in their core discipline areas, the students collaborate with senior 3M researchers on projects more focused in technologies and products that 3M is best known for. These include technologies and products based on 3M traditional core technologies—such as adhesives, abrasives, optical materials, fluorochemicals and advanced polymers. Or they could also work in any number of 3M's proprietary process technologies—including non-wovens, microreplication, extrusion processing and precision coatings.

And the innovation advancements continue on in all of these companies. Just Google them to find out what each company is up to!

R&D is powerful stuff, the lifeblood of new product development, the groundwork of what we refer to as technologically-driven progress. However, R&D is often seen as an expense that is difficult to quantify, especially in harsh economic times and tight budgets. Those who do R&D as part of their routine work activities have a powerful, visceral feel for it. Great leading companies like Du Pont and 3M swear by its application, and are noted for continuous innovation over long periods of time—especially Du Pont, one of the oldest companies in the nation. You might say it is imprinted into the corporate DNA. The business end of a company can, however, have serious doubts about just what needs to be done and financed through R&D.

If there is a place a company can quickly lose its edge, it is in R&D. Too many top-notch organizations succumbed to cutting their R&D budgets—and down the line, paid the price. To do R&D right, you must know where you are going and why; and what technologies you intend to use to get there. It is part of the strategic planning of a company, using its intellectual property and specialized knowledge to project its competitiveness out into future markets. R&D is the process that converts uncertainty into risk. It is technological due diligence.

In this volume, I shall combine my 36 years of industrial R&D experience and new product development, with 10 years of teaching the principles of R&D project management as an adjunct graduate professor at the New

Jersey Institute of Technology [Newark College of Engineering]—along with many publications/presentations on this topic. All this knowledge and experience gets mixed together with my decade of docent presentations and special lecturing at the Thomas Edison National Historical Park in West Orange, N.J. It also includes decades of experience in inventing, patenting and commercialization, along with some consulting. I hope you enjoy and profit from learning about R&D.

~Harry Roman