SUCCESSFUL TECHNOLOGY COMMERCIALIZATION — YES OR NO? IMPROVING THE ODDS. THE QUICK LOOK METHODOLOGY AND PROCESS

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Summary

This article explores the relationships which transform new scientific knowledge into new commercial products, services, and ventures to create wealth creation. The major technology and marketing commercialization dilemmas are defined and addressed. The Quicklook methodology and related processes to quickly assess the commercial viability and potential of a scientific research project is explained. Using the Quicklook methodology and process early in the research and development process improves the success odds of commercialization.

Keywords: commercialization, innovation, market assessment, Quicklook, research, technology wealth creation, marketing

Introduction

Most inventors invent to address a specific need or problem. Once the solution to a problem is addressed, then the solution may be commercialized to help others. The successful commercialization of an invention frequently generates great societal and individual wealth. The wealth enables societies and individuals to continue to generate new knowledge. Translating scientific knowledge into technology to serve society the innovators must confront two major dilemmas: Will the invention work? Will anyone purchase it? There is a methodology called "Quicklook" which helps to address both questions in the early stages of the innovation process.

Thomas A. Edison
— Inventor and Businessman Extraordinaire

Thomas Alva Edison (1847–1931) was America's most prolific inventor as well as a successful businessman. Edison received 2332 patents worldwide. Edison's US patents totaled 1093. Edison's most famous inventions are the incandescent electric light bulb, the phonograph, and the motion picture camera. Edison was involved in hundreds of other projects ranging from storage batteries to plant research.

As a businessman, Edison created companies to commercialize his inventions which laid the foundations for entirely new companies and new industries. For example, Edison created the Edison Illuminating Company which eventually became the General Electric Corporation. To commercialize his motion picture camera, Edison started the world's first film studio which made approximately 1200 films. Edison's most significant contribution to society is founding the first industrial research laboratory in Raritan, New Jersey, USA to create new products with a focus on technology commercialization.

Though a successful inventor and businessman, Edison's first US Patent — 0,090,646 (1869) — was the electrographic vote recorder permitting rapid counting of "yes" and "no" votes in legislative bodies. The electrographic vote recorder failed since the legislators wanted time to convince their colleagues to change their points of view. What was Edison's reaction to his innovation's commercial failure? Edison learned that innovation for sake of its novelty fails to capture economic value.

Ayres (2016) reported that Edison stated, "The value of an idea lies in the using of it" (p. 7) and "Anything that won't sell, I don't want to invent. Its sale is proof of utility, and utility is a success" (p. 11).

For the remainder of his career, Edison was motivated to invent to address societal and customer needs. Wilson and Marcus (1999) quoted Edison, "I have never perfected an invention that I did not think about in terms of service it might give others…I find out what the world needs, then I proceed to invent" (p. 7).

Thomas Edison successfully solved the two conundrums that most inventors face: How will this invention help society? And how will this invention make money?

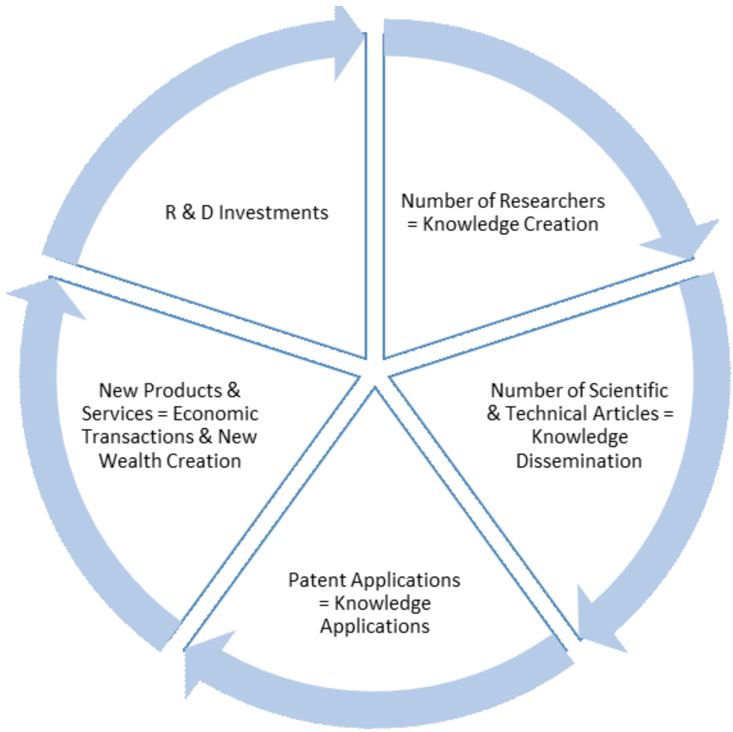
Knowledge and Wealth Creation — The Virtuous Cycle

Robert Solow received the 1987 Nobel Prize in Economics for a paper which argued that science and technology innovations are responsible for approximately 87.5% of world's increases in wealth and standard of living — not capital and labor as many economists previously hypothesized. Based on data from 1909 to 1949, Solow (1957) concluded, "It is possible to argue that one-eighth of the total increase [in wealth] is traceable to increase capital and man hours [labor], and *the remaining seven-eighths to technical change* [emphasis added]."

The relationship between science and technology and economic growth is very complex and encompasses literally trillions of separate economic transactions globally. At the Meta level, the science — economic relationship may be hypothesized as increased societal wealth catalyzes increased investments in research and development by both government and businesses. Consequently, as the number of researchers increases, they, in turn, generate new knowledge which is disseminated via scientific and technical articles.

Some of the new knowledge has commercial value and is patentable. New products, new services, and new ventures are developed based on the patent foundation which in turn generates new wealth necessary to repeat the cycle. Figure 1 illustrates the cyclical nature of the process.

Figure 1. **Meta Relationship among Research and Development Investments, Knowledge, and Economic Transactions**

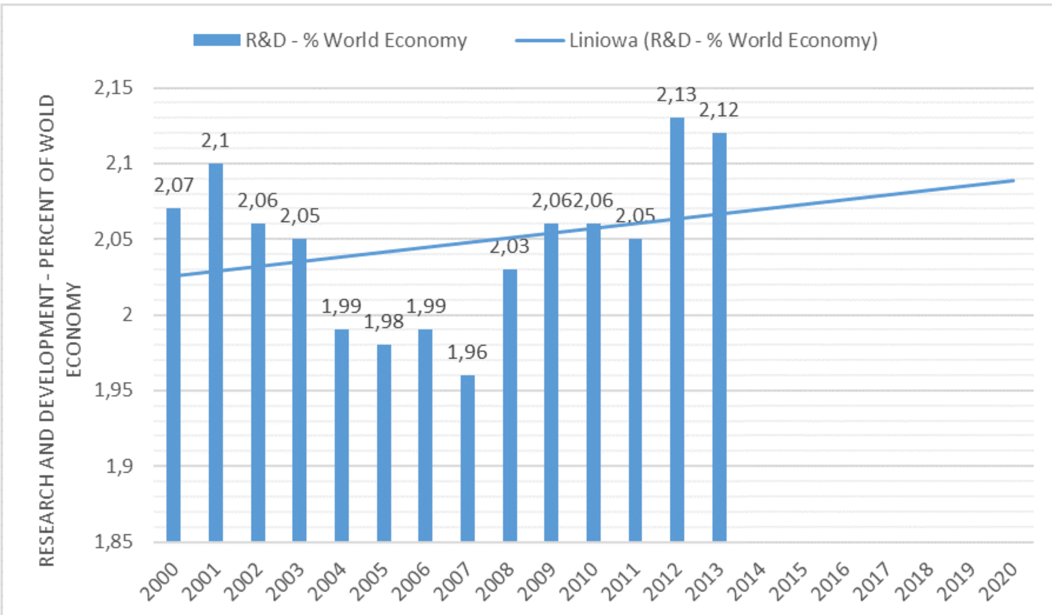


Source: ZZehner, W., Williams, C., and Pletcher, G. (2016). Technology Creates 21st Century Wealth — Processes, Problems, and Prognosis. Marketing of Scientific and Research Organizations, no. 2 (20), pp. 17-38.

Globally, the total investment (money) in research and development (knowledge and technology) is fairly constant at approximately 2% of the world's annual economy since 2000 — but the world economy has increased from approximately $5436 USD per capita in 2000 to $10,743 per capita in 2014 (Zehner, Williams, and Pletcher, 2016, p. 18).

Figure 2 illustrates annual investments worldwide investments in research and development between 2000 and 2013 as a percent of the world's economy.

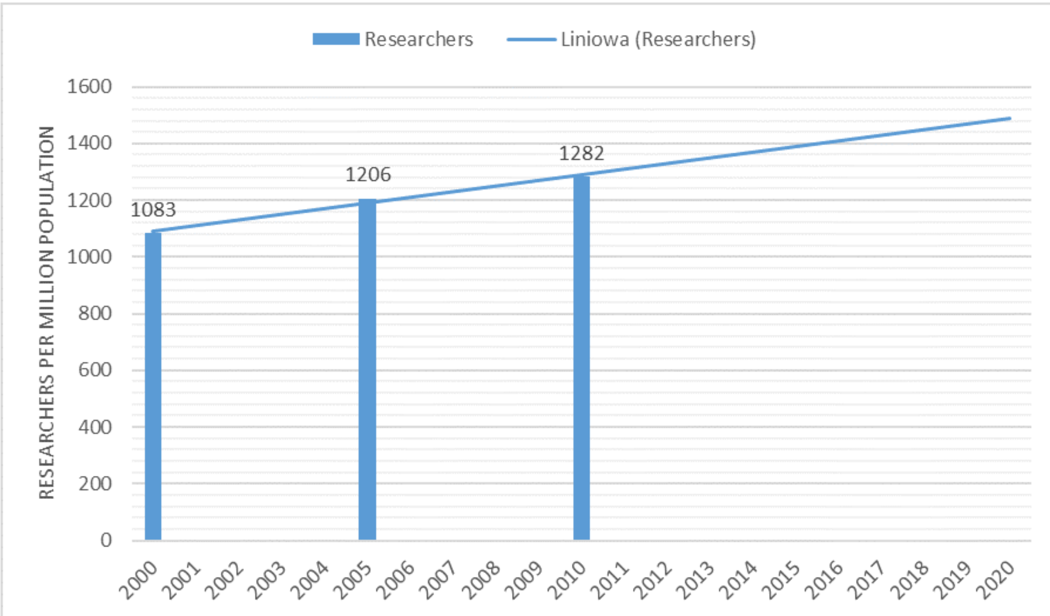
Figure 2. **Annual Investments in Research and Development as Percent of World Economy**



Source: World Development Indicators — World Bank, 2016

Figure 3 shows that as more money flows into research and development in the world economy, an increasing number of researchers are supported. Today, there are 17% more researchers today than in 2000 generating knowledge (Zehner, Williams, and Pletcher, 2016, p. 20).

Figure 3. Number of Worldwide Researchers — Per Million Population



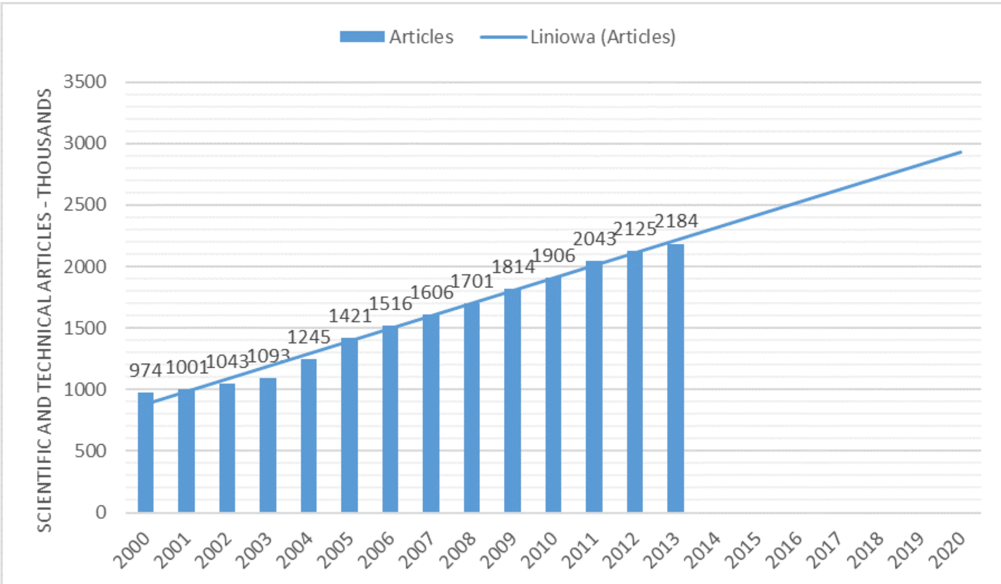
Source: World Development Indicators — World Bank, 2016.

The increased number of worldwide researchers generate more and more new knowledge resulting in increased publications of scientific and technical articles. Also, important is the fact that research productivity as defined by scientific articles has increased at approximately 11.3% annually from 2000 to 2010 (Zehner, Williams, and Pletcher, 2016, p. 23). The number of articles published is increasing faster than the 2.9% annual increase in funding and faster than the increased number of researchers that is growing at 1.3% annually (Zehner, Williams, and Pletcher, 2016, p. 23).

See figure 4 which shows the number of scientific and technical articles published globally from 2000 to 2013.

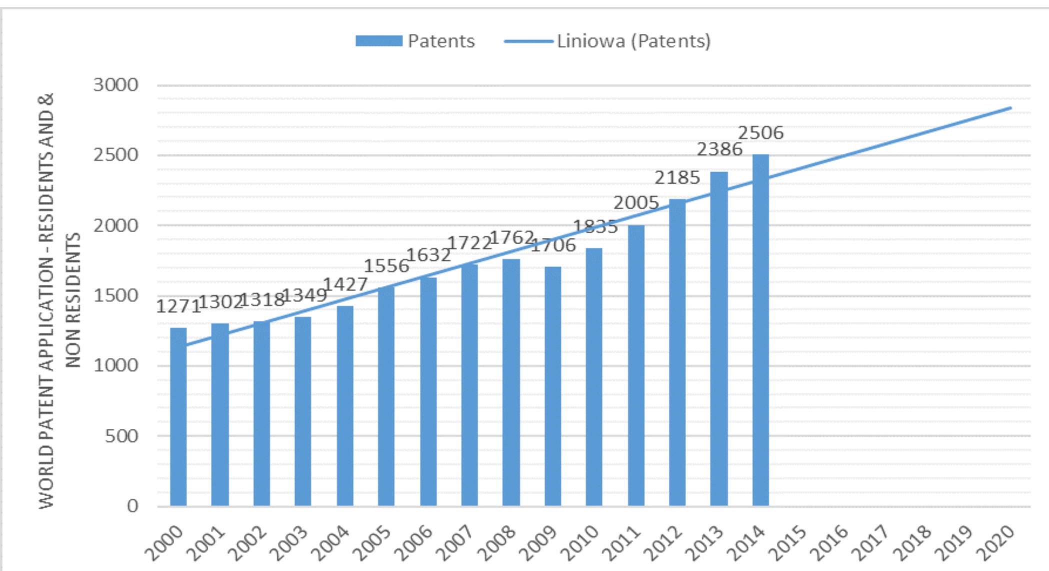
Eventually, as the commercial possibilities are identified among the new knowledge created, patents are applied for to create a legal barrier to prevent the use of the knowledge by other parties. Globally, the number of patent applications has increased more by 124% from approximately 974,000 applications in 2000 to approximately 2,184,000 in 2014 as illustrated in figure 5:

Figure 4. **Number of Scientific and Technical Articles Published — Thousands**



Source: World Development Indicators — World Bank, 2016.

Figure 5. **Number of Worldwide Resident and Non- Resident Patent Applications — Thousands**



Source: World Development Indicators — World Bank, 2016.

Both world knowledge and world wealth per capita are rapidly increasing due to the virtuous cycle. Zehner, Williams, and Pletcher projected that the world per capita GDP would increase from $5,436 USD in 2000 to over $15,000 in 2025. This will accelerate research and development spending and new knowledge and products/services creation.

The Technology Commercialization Perspectives

Dilemmas

The dilemma faced by innovators desiring to commercialize new knowledge and technology may be captured in the questions: Will the new product/service sell? Who will purchase it? Why will potential customers purchase the product/service? What price is necessary to facilitate an economic transaction?

Moriarty and Kosnik (1987) identified four specific concerns creating market uncertainty for innovative products/services:

1. "The customers themselves are unsure about the technology's potential uses and benefits" (p. 3).
2. "Market uncertainty also arises when there is no history or track record for a new type of product. As a result, no one really knows how large the potential market really is or how quickly the new technology will spread "(p. 3).
3. "Another source of market uncertainty is rapid or unpredictable changes in the needs a product must satisfy" (p. 3).
4. "Market uncertainty may arise because compatibility standards for the technology have not been established" (p. 3).

The dilemma faced by the customer adopting innovative products and services is simply technological uncertainty: Will this innovative product or service actually work? And assuming it works, how will it help me personally or my business?

Moriarty and Kosnik (1987) identified the following issues of technological uncertainty:

1. "Lack of information about the reliability of the technology" (p. 3).
2. "Lack of information about a product's functional performance" (p. 3).
3. "Lack of information about unexpected side effects" (p. 3).
4. "Unreliable delivery patterns" (p. 3).
5. "Technological obsolesce" (p. 4).

Moriarty and Kosnik (1987) conclude, "Whereas market uncertainty is not knowing what the market wants, technological uncertainty is not knowing if a technology can meet a set of needs in a more dependent and effective way than alternative approaches (p. 3)." Thomas Edison successfully addressed these issues over a hundred years ago both as a technology innovator and a businessman.

Perspectives

To successfully translate a new technology into a successful product is challenging. The odds of success are very low. A study by Hansen (1995) found to create one successful new product in the marketplace began with 333 ideas. Twenty-three ideas were deemed as original and six ideas were identified as patentable. Two products were introduced to the marketplace leading to one success. Starting with 333 ideas to create one successful product are long odds.

A similar study by Stevens and Burley (1997) found similar findings. Beginning with 3,000 raw ideas led to 125 exploratory projects. The 125 exploratory projects were refined to nine significant projects which were further refined to four projects introduced to the marketplace. Net result: one successful new product. The odds of success are low.

The cost of moving a product from the lab to the market is very costly. V.J Jolly postulated in Commercializing *New Technologies — Getting from Mind to Market* (1997) that "if the cost of discovery is $1 USD, then developing it to a prototype costs $10 USD, and getting a marketable product ready is $100. But this how cost is distributed, not [customer] value" (p. 19). Note that the ratio among the stages is 1:10:100. Introducing a new product to the marketplace is costly.

If an innovator introduces a product to the marketplace that is commercially successful such that a company is created to produce and deliver a product, the company is likely to be short-lived. Arie de Gues (1996), formerly Director of Planning for Shell, points out, "A recent study by Ellen de Rooiji of the Stratix Group in Amsterdam indicates that the life expectancy of all firms, regardless of size, measured in Japan and much of Europe, is only 12.5 years. I know of no reason to believe that the situation in the United States is materially better" (p. 2). De Gues speculates that "there is accumulating evidence that corporations fail because the prevailing thinking and language of management are too narrowly based on the prevailing thinking and language of economics. To put it another way: Companies die because their managers focus on the economic activity of producing goods and services, and they forget that their organization's true nature is that of a community of humans" (p. 3).

Given both the complexity of the technology challenges as well as the economic costs of research and marketing, is there any way a researcher in a lab can address the challenges to improving the odds of commercialization success? This is the significant question for science-based organizations. To be successful as a science-based organization the newly created knowledge must ultimately be translated into social and economic benefits for society. There is a process, called the Quicklook process or simply, Quicklook, to help the science-based organization and the research to improve the odds of commercialization success.

Quicklook Methodology and Process

There are several methodologies to determine the potential commercial viability of research. One methodology is to retain a consulting firm to assess the probability of technological success and possible market opportunities and success. The consulting process is expensive and might involve several thousands of person hours of consultants' time at normal consulting rates of $800 USD per hour. For example, a typical consulting study might take 1000 to 2000 person-hours times $800 USD per hour for a total cost of $800,000 to $1,600,000 USD. Very few science-based organizations are willing to spend a significant sum on market research when the organization is focused on technical development.

A related issue is the time necessary to complete the study. The typical consulting study will normally involve a relatively long time to complete, as long as a year, during which time the technology, competition, and market are all changing simultaneously and some of the changes may be significant.

An example is Motorola's Iridium project (Bloom, 2016) to develop a satellite-based worldwide phone and data system. Motorola invested over $5 billion USD over 10 years, 1988 to 1998, to develop the Iridium system which included launching 66 satellites for global coverage. The Iridium system was technologically successful, and Motorola received over a thousand patents, but it was a financial disaster. Iridium was sold for about $25 million USD about a year after becoming operational and catalyzed Motorola's bankruptcy. The issue was the Motorola financial model assumed about 50,000 subscribers who would purchase the phone for $3,000 USD and be willing to pay $6 to $30 per minute for connection time. Between 1988 to 1998-time period cell phone technology improved to the point where a cell phone cost about $200 USD and the connection time was about $.05 USD per minute.

Quicklook Defined

The IC^2 Institute of the University of Texas at Austin defines Quicklook as a "market assessment technology methodology to provide [a university] technology transfer manager with an early indication of the probable commercial interest in a new technology at the university or research laboratory (Cornwell 1998; Jakobs et al. 2015).

Quicklook History and Perspective

Quicklook is a methodology involving about 40 to 60 hours of research to determine the commercial readiness and viability of a technology. The

Quicklook process was developed in the mid-1980s by the US National Air and Space Agency (NASA) via Mid-Continent Technology Center to determine the commercial viabilities of US space technologies as the US Space Program wound down.

The Quicklook process was refined in the 1990s by Brett Cornwell, currently Associate Vice Chancellor at the Texas A&M University System which encompasses 12 universities and a Health Science Center. Brett Cornwell directs the commercialization of the Texas A & M University Systems' intellectual property. The Quicklook methodology is currently taught in the MS in Technology Commercialization program at The University of Texas of at Austin and in universities (Maltby, Zehner, & Difford 2006) throughout the world.

The IC^2 Institute — "a think and do tank" — at the University of Texas at Austin under the leadership of Mr. Sid Burback, director of the Global Communization Group, has disseminated the Quicklook methodology around the world via a number of government funded programs. Several thousands of researchers, scientists, and engineers — from Asia to Latin America to Europe — have successfully used the Quicklook methodology to assess commercialization possibilities of their scientific research.

The advantage of the Quicklook methodology is that the organization or the researcher can quickly assess the commercial viability of research. It is also helpful for research managers to direct resources toward projects that are closer to commercialization. The Quicklook process is a valuable tool for directors of research programs to rate and rank multiple research projects and allocate limited economic resources accordingly. Successful commercialization projects dramatically enhance the reputation and funding of the organization.

The disadvantage of the Quicklook methodology is since the look is "quick" there may be more type I (false positive) or type II (false negative) errors than with a major market study. The Quicklook methodology is not designed to replace a full-scale market research study. However, the Quicklook methodology moves scientific research organizations much nearer toward making optimal decisions on their directions and future actions by providing additional information to more optimally allocated scientific research resources (Maltby, Zehner, & Difford 2006).

How to Do a Quicklook

There are four steps to complete a Quicklook:

1. Identify potential applications and markets for the scientific knowledge and technology.
2. Identify potential users, distributors, and licenses.
3. Contact experts and companies to explore the feasibility of the technology and related markets.
4. Write a formal report to document the process.

Step 1 — Identify potential applications and markets.

The Quicklook process begins by interviewing the researcher to identify potential applications and related markets. The following questions are addressed: Why is this technology being researched and developed? What features does this technology potentially offer that are not available today? What are the specific benefits to a customer? What other applications might this technology address? For example, a Quicklook team at the University of Texas at Austin studied a technology to extract collagen from crab shells. The original idea was the use of collagen to treat burns. The collagen treatment for burns was not as effective as some current burn treatments. However, in the process, the research team found that collagen could be used as a meat tenderizer — a much larger market.

The specific questions must be tailored to the technology and market. Typical questions are:

Would a technology or product with the following characteristics be interesting? Who would purchase it? Use it? Do you think there is a large market for a product such as this? How large? How is the customer's challenge solved by products currently in the market? Which organization makes these products or offers solutions? What do the products on the market cost? What do you think would be a fair price for the product/technology with described characteristics?

After interviewing the researcher/innovator, a number of Quicklook questions are written and refined. The objective of the questions is to focus on the market — customers — benefits early in the research and development process to identify prospective customers and determine how much the potential customers will pay for the benefits.

Step 2 — Identify potential customers, distributors, and licenses.

The objective is to make a list of 10 to 15 knowledgeable individuals to interview re the marketability of the technology. This is an easy but time-consuming task involving researching the directories of trade and professional associations, universities doing similar research, distributors and sales agents familiar with the target marketplace and customers, companies offering similar products, and potential customers.

The second list of experts in the technology must be developed who may be interviewed to gather data on the probability that the technology will actually work and do what it claims to do. At this point, the Quicklook researcher has a list of focused questions as well as a list of knowledgeable technology and marketing experts to interview.

Step 3 — Contact the experts.

A 15 to 30-minute structured phone interview is the best process since it yields the most information as well as giving the researcher the opportunity to ask "follow-up" clarification and questions. The last question the researcher might ask the expert is: Who is knowledgeable that you would recommend I chat with? The respondent is frequently a source for additional thought leaders in the field which were not discovered by secondary research. In many cases, the interviewee is willing to "make the introduction" to facilitate the research.

During the interview process, extensive notes should be taken for later analysis. Only about 8 to 12 interviews are required to ascertain commercialization possibilities. After the third interview and analysis of the notes, the researcher may formulate some hypotheses about the commercial potential of the technology. The researcher then "validates" the hypotheses in later interviews with questions such as, "This is what we are finding, what do you think?" By the sixth interview, the hypotheses are refined and may be validated in subsequent interviews.

After any interview you should send a thank you note to begin to build a long-term relationship with the experts you interviewed. This is a common courtesy which is highly appreciated and will facilitate quick responses to future questions you may have.

Step 4 — Write a formal report.

A formal report should be written to organize and disseminate the information collected. Also, writing a report helps to identify gaps in the market research for future research.

The technology segment of the report begins a non-technical description which is understandable by a lay person. This is followed by a statement of the problem that the technology addresses as well as the customer benefits of the technology. In this section, you might also address the development status of the technology. What is the stage of the technology development — an idea, bench model, prototype, or pre-market introduction product form? Is the technology or product patented or patentable?

The next section should identify and analyze potential markets and marketing issues for the technology. Specifically, the following questions must be addressed based on the interview data:

1. What are the products, services, or processes that could be developed from the knowledge or technology?
2. What are the benefits of the technology sought by potential customers? Why?
3. What is the estimated size of the potential markets by the number of units purchased multiplied by average selling price over the next three years? A "best estimate" is sufficient at this point since you are simply trying to establish an order of magnitude number for possible revenues.
4. What is the level of interested expressed by the interviewees? Excited or not?
5. What are competing technologies used today to address the customers' needs?
6. Who uses or supplies the customers' solutions today? These may be potential licensees for your technology.
7. What is the demonstrable and sustainable advantage of your technology over competitive alternatives currently in the marketplace? Estimate quantitatively how much "better, faster, or cheaper" is your technology solution than competitive solutions.

8. Are there any barriers to market entry? If so, what are the barriers and how might you breach them?
9. Any other technology or marketing challenges you found during the interviews such as compatibility with current organization processes and procedures.

The next segment of the Quicklook report may be the most critical and practical. Clearly, state the yes or no decision without equivocation. If yes, research and development should proceed to the next stage. If no, the research and development should be terminated and the resources invested into more promising projects. The report must clearly explain and explore all the significant reasons for the yes or no decision.

If the decision is yes, to proceed to the next stage then the steps to develop the technology and introduce the technology to the marketplace should be addressed as well as related resources required.

The Brilliance of the Quicklook Methodology

The most important contribution of the Quicklook to the commercialization process is that improves the odds of commercialization by introducing the idea of the practical use of the technology early in the RESEARCH AND DEVELOPMENT process. Who will purchase this technology, product, or service, why will they purchase, and what will price might they pay. The brilliance of the Quicklook methodology is:

1. It focuses the scientific researcher on the benefits of his or her work to society.
2. It engages the scientific research in the commercialization process early in the research and development stage.
3. It is quick — 40 to 60 hours — to develop "good enough" data vs. a major 1000 to 2000-hour consulting study. The Quicklook methodology is not designed to address the same issues as a major market study. When the researchers have no or little data, the Quicklook is designed to provide some data and quickly.

4. Additionally, a Quicklook study may be utilized by the scientific researcher to raise additional funding for his or her research from universities, research and development organizations, or commercial sources. The incremental funding may enable the scientific researcher to accelerate the completion of his or her research.

Historia sukcesu Quicklook

The real question is *Does the Quicklook methodology and process really facilitate wealth creation by identifying commercialization opportunities in the research and development laboratory which can be translated into new products, new services, and new ventures?* The IC^2 Institute at The University of Texas at Austin has been engaged by a number of countries in the North and Latin America, Asia, Europe, and the Middle East to educate their scientists and researchers in the Quicklook methodology for over fifteen years and has a number of success stories.

One of the most interesting Quicklook success stories takes place in Mexico. When Vicente Fox was elected President of Mexico, President Fox wanted to create some high-tech companies to demonstrate to the Mexican people that Mexico has a strong scientific and technological base. President Fox appointed Dr. Jaime Parada to his cabinet and charged Dr. Parada with the task of showcasing Mexico scientific and technological foundations.

Mexico has 27 research institutes which are perceived as excellent as judged by the scientific papers published but had never commercialized any of their research. To identify research in the 27 research institutes with commercial possibilities, Brett Cornwell and one the authors educated approximately 70 researchers from the 27 research institutes in the Quicklook methodology.

The Quicklook educational program target metric was to identify 200 potentially commercial able technologies from Mexico's 27 research institutes. Over 800 technologies were actually identified with commercial potential from which 44 new companies were created exceeding the program goals.

Discussion

As more and more knowledge is created by the world's investment in research and development, the question becomes how the knowledge might be transformed into new products, new services, and new ventures to capture the knowledge's economic and commercial values to fund future research. Much research remains to be done on the virtuous cycle of innovation.

The innovative researcher's dilemma is, "Who will buy this knowledge and technology and what will they pay?" The early adopter customer's dilemma is, "Will this knowledge and technology really work?" The Quicklook methodology incorporates these dilemmas into the research and development process early so the researcher incorporates commercialization challenges into the research process to improve the odds of creating a successful new product, new service, or new venture.

Based on both professional experience and an increasing body of empirical data, the Quicklook methodology and process works by developing and gathering empirical date on the market opportunity. Some of the interesting questions for future research are, "What is the impact of the Quicklook methodology on the research process itself? By what mechanism does the Quicklook methodology change the research process? What is the extent that the Quicklook methodology focuses the research processes per se? Does the Quicklook methodology change the role of the researcher relative to the project? Many questions remain to be researched.

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