INNOVATION AS A SYSTEM

Seeing the linkage between business innovation and revenue growth as a generic, closed loop system highlights the importance and purpose of innovation investments and the role of executive leaders.

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OVERVIEW: *A mathematical model of the business system that links innovation of products and services to financial growth represents both investment and revenue as a series of overlapping waves, thus more directly capturing the lagged relationship between investment and revenue growth over time. By teasing out some of the underlying non-obvious relationships, the approach provides important and often counterintuitive insights into the roles that early learning, staffing decisions, and investments in process improvements and services can play in improving the income-to-investment ratio. Executives and managers will be able to directly correlate many of their actions to results, shedding light into the black box of innovation effectiveness.*

KEY CONCEPTS: *innovation system, investment-to-payback turn time, time to payback, innovation improvement strategies.*

Innovation has been defined as *implementing ideas to create value* (*1*). Business firms invest in innovation; that is, they spend money on it with the expectation of making a profit. In fact, a primary goal of starting and maintaining a business is to create a proprietary undertaking involving innovation that generates rates of return far greater than those that can be obtained through other, more commonly available, investment opportunities. In the context of this discussion, innovation is viewed more broadly, encompassing business aspects beyond the more traditional product development realm.

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At the heart of every innovative business there must be a system focused on creating value. The nature and efficacy of this system is often hidden, sometimes obscure. Nonetheless, it is a crucial component of the firm's worth to shareholders (*2,3*). The value that this system creates, above all, must be for customers in the form of products or services that they are willing to vote for—to hire, to own—with their dollars. Their willingness to pay for this value, in turn, rewards the business with value in another form: revenue and profits. The goals of this article are to 1) broaden the perspective on innovation as a business system, and 2) outline key principles and relationships that govern system performance. The result is a new perspective on how innovation drives financial growth, and on how innovation can be more effectively managed and improved.

The Investment-to-Income System

A broadly applicable schematic for this investment-to-income system is depicted in Figure 1. Moving from left to right in the diagram, the primary system elements include an innovation engine that takes in invested funds and various kinds of information and puts out specific forms of value-added information. The nature of the activity within this element, and of the specific form of the output, varies widely from one enterprise to another. One firm may accomplish all innovation in-house, while another might use some of the innovation investment to fund external research, or to engage development partners. Nonetheless, the effectiveness of this component can be described concisely in terms of the value of its inputs, and of the value-added information that it delivers.

The output of the innovation engine enables operations—defined here to include business functions such as manufacturing, sales and field support—to implement these goods and services, deliver them to the customer and then support them as needed. Measures of success for this part of the system consider how effectively and efficiently innovative ideas are transformed into value that customers want and need. Further, they assess how completely this value is known and accepted in the marketplace. Finally, they evaluate the level of satisfaction that customers experience in doing business with the firm. If the system in Figure 1 is viewed as a racing machine, the innovation engine produces the power needed for acceleration (growth), while operations serves as the drivetrain that transforms and delivers this power efficiently to the point where the rubber meets the road—the marketplace. This metaphor is used later in the article to further elaborate key points.

At the top of the diagram, a stream of cash flow, also part of the system, flows from right to left and represents graphically the firm's income statement. This flow of currency originates with the customer and is put to various uses within the firm. First, funding for operations is extracted to cover the cost of products and services delivered as well as the cost of sales. Cash needed to cover expense items such as administration or taxes is represented as upward-pointing arrows and hence is not considered part of the investment-to-income system.

At the heart of every innovative business must be a system focused on creating value.

Funds required to support all innovation activity are pulled out last and directed to the innovation engine. This investment finances the entire R&D budget but, in addition, funds all other activities that are also essential to innovation. These vary from firm to firm but might include product marketing activities as well as strategy creation and planning related to future markets, products and technologies. Long-range technology and market development efforts will be included as well.

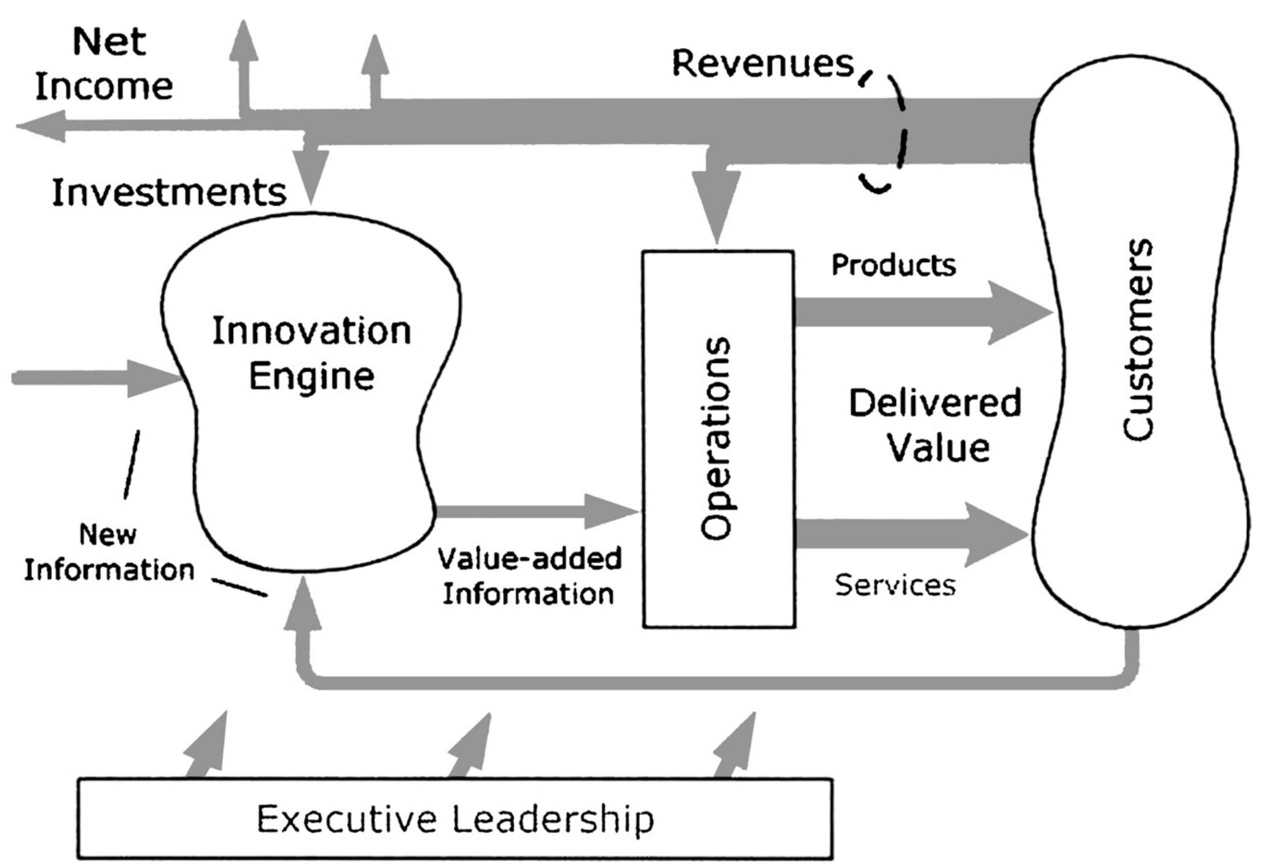

Figure 1.—The investment-to-income system links innovation activity to financial growth.

The cash that remains after innovation investments are withdrawn exits the system to the left as the net profit.

System operation is best understood in terms of the three transformations that are needed to go from investment to information to value delivered and back to investment:

1. *Innovation engine:* Transforms dollars and incoming information into value-added information out.

2. *Operations:* Transforms value-added information into delivered value.

3. *Customers:* Transforms received value back into dollars, some of which fund further innovation investments.

This creates a positive feedback loop in which increased investment, after a time-to-market delay, leads to greater revenue and, hence, to even further increases in future investment. The time response characteristic of positive feedback loops is an exponential change in output over time, either exponential growth or exponential decline.

Under most circumstances, a higher percentage of revenue invested in innovation generates a higher growth rate. Another common truism is that an increased innovation investment implies spending more money on new product activity. There are special conditions, though, that alter these general rules (*4,5*). When products are introduced too rapidly into a market segment of limited size, for instance, each new product has an increasingly dramatic negative impact on the total revenue earned by its predecessor. As more and more money is invested in new product innovation, a point is eventually reached when overall revenue growth stops responding to increased investment and, instead, stabilizes on the growth rate of the overall market addressed by that segment.

Viewed as a racing machine, the innovation engine produces the power needed for growth.

In many businesses, opportunities to increase revenues may exist in areas other than the introduction of more new products. For example, investments in improving the quality of customer support or mean time-to-repair may provide a substantial competitive edge and thereby lead to increased market share. The revenue gains offered by such measures can sometimes offer more attractive financial returns than investment in another new product. One key to success is thus the ability to identify those opportunities that yield the greatest increase in revenue and profit for each dollar invested, regardless of where in the company they may occur.

The overall value created and delivered by this system is best measured by the revenues that are generated as customers "vote" for these products and services with their dollars. An interesting method for viewing these revenues

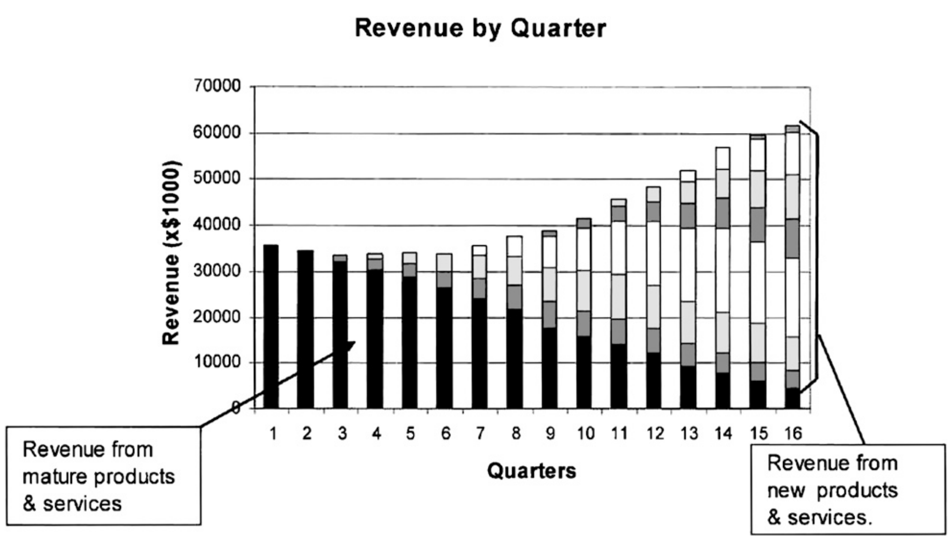

Figure 2.—Revenue growth rate depends upon the introduction rate and size of revenue waves.

is depicted in Figure 2. For any snapshot in time, revenues can be divided into two categories; those from *mature* market offerings in place prior to the beginning of the assessment window, and income from *new* products and services introduced within the time span of the assessment. The mature revenue base tends to decline over time as these offerings move toward obsolescence in the marketplace.

The impact of each new market offering introduced is then plotted as a wave of new revenue that overlies this base. As additional new products and services are introduced, these waves of new revenue stack on top of one another as shown in Figure 2. If new value is introduced often enough, and if the magnitudes of these revenue waves are big enough, the result is a healthy exponential growth in overall revenues. Otherwise revenues will remain stagnant or even decline.

In terms of the racing machine metaphor, the useful power at the drive wheels is measured by the delivered torque times the rate of revolution (RPM). In Figure 2, the rate of new introductions is equivalent to RPM while the magnitude of each new revenue wave is like the delivered torque. The useful output of the investment-to-income system is related to the average frequency of new revenue waves times their average magnitude.

The leadership team includes the driver, the mechanic and the system engineer.

Executive Leadership Roles

The investment-to-income system in a business should be owned and managed by a designated executive leadership team. This team ought to include those high-level managers who have span of control over the functional elements included in the system. The leadership team concurrently plays several important roles. Extending the racing machine metaphor, these include 1) the *driver* who operates the system in a competitive environment, 2) the *mechanic* who troubleshoots and tunes the system to ensure peak performance, and 3) the *system engineer* who designs and manages improvements that keep the system competitive.

In its role as driver, the leadership team establishes size of the innovation investment—equivalent to the throttle setting—and then allocates invested funds to specific activities, tantamount to steering the vehicle. The balance between strategic investments and development activity is established at this point. The areas of focus for investigation activity and the specific aims of new product and service programs in the development pipeline are also determined here. The portfolio of funded investigations, projects and programs is then subjected to ongoing due diligence to ensure that each specific investment continues to make business sense and deliver desired value to the firm (*6*).

As the mechanic, the leadership team provides ongoing assessment of the performance of the investment-to-income system. Members of the team then must adjust and tune day-to-day activities to resolve bottlenecks, settle conflicts, reallocate resources, and keep information flowing as needed. In carrying out these duties, each member of the leadership team needs to possess and apply an in-depth understanding of the system, how it is supposed to work and the fundamental principles that govern its operation.

The leadership team's role as system engineer requires it to 1) assess the system's capacity to outperform the competition, 2) envision ways in which competitive margins might be improved, and 3) establish and oversee performance improvement initiatives. Improvement strategies must consider seismic shifts in the technology and market terrain ahead as well as the likely actions of competitors. Once determined, improvement programs must modify the competitive machinery without disabling it while it is engaged in the heat of competition—a tricky challenge.

Modeling System Performance

Like many other business processes, the investment-to-income system is difficult to manage without a mental model that effectively reflects real-life performance. The system's response to actions we take today is often well beyond our learning horizon—that breadth of vision in time and space within which we can assess our own effectiveness (*7*). Results are often so distant from the cause that learning from experience becomes impossible.

Such a model has evolved over the past 10 years, referred to in the literature as the Patterson-Hartmann (P–H) model, that 1) accurately integrates the roles and relationships between key elements of the investment-to-income system, and 2) clearly links future results with the actions in present time that cause them (*8–11*). The following discussion describes key elements and metrics used in the model, with an expanded derivation provided on page 47.

The P–H model represents the ongoing revenue stream as a series of overlapping revenue waves, each one including the total revenues created by products and services introduced in a particular fiscal year, their so-called *vintage year*. The ongoing stream of innovation investments is represented as a series of overlapping investment waves. Each investment wave includes all of the funds required over time to conceive, define and develop the technologies, products and services that are introduced in its associated vintage year. Each vintage year, then, has related investment and revenue waves that define an innovation cycle that is characteristic of the particular enterprise. In the example provided by Figure 3, year 0 is the point in time when the associated products and services are introduced.

Innovation Gain, Φ, a key system performance measure, is defined by the P–H model as the ratio of the revenue wave magnitude, W_i, for a particular innovation cycle to the total size of the related investment wave, termed Product Creation Spending (PCS_i), for that same cycle. For the revenue and investment waves in the example below, Φ has a value of 12.5 which means that $12.50 of revenue is created for each dollar invested in innovation. Innovation Intensity, I_i, is another important parameter and is defined as the total innovation investment in any given fiscal year divided by the total revenue received in that same year.

Figure 4 illustrates other key parameters, defined in the P–H model, that are useful in analyzing system performance. In this diagram, the investment and revenue waveforms in Figure 3 have been normalized so that each has a total magnitude of 1.0. The coefficients, α_j and β_k, denote the fractions of total revenue and investment, respectively, that typically occur in a given year relative to the introduction date. These parameters are unique to a given company and can be established either through estimation or through analysis of historical and forecasted performance data (*4*, pp. 351–356). Once in hand, they unlock a detailed understanding of the nominal relationships that exist between innovation investment and revenue growth rate for that firm.

An overarching objective is to increase the impact of innovation investment on growth in shareholder value.

The effective time of investment is defined by a lump-sum equivalent to the distributed investment waveform which has a magnitude 1.0 and occurs at a point in time, t_{ie}, which produces the same present value at the time of introduction. The effective time of payback, t_{pe}, is determined in a similar fashion—a lump sum of revenue that occurs at a point in time that produces the same present value at introduction. The target annual revenue growth rate is used as the interest or hurdle rate in these present value calculations. The investment-payback turn time, t_{turn}, is defined as the interval between the effective time of investment and the effective time of payback. This interval takes the place of more familiar time-to-market performance measures. It is more clearly defined though

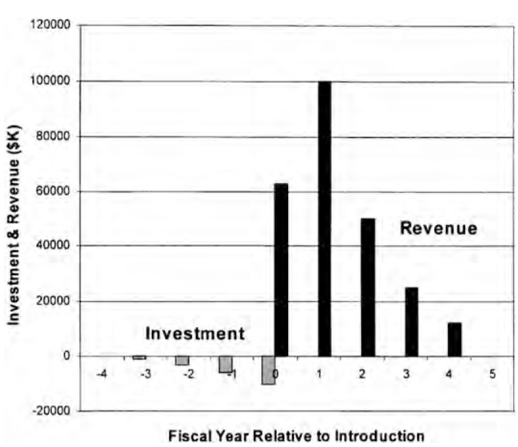

Figure 3.—Investment-to-income cycle for a single vintage year.

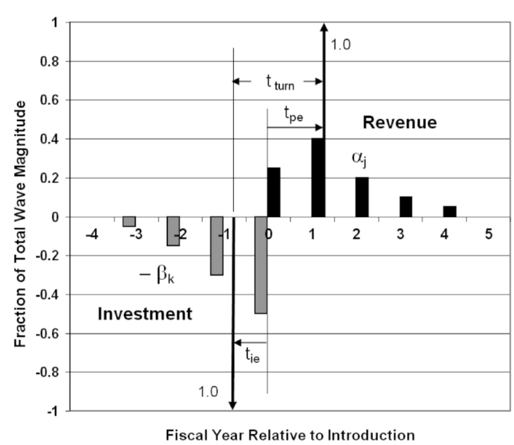

Figure 4.—Normalized investment and revenue waveforms and critical time relationships.

Linking Turn Time to Revenue Growth

In 2003 Hartmann analyzed revenue growth performance, adding waves of R&D spending to my earlier revenue wave analysis (*8*). He defined corporate gain Ω as the ratio of new revenue created in a given vintage year to the associated R&D spending. He defined R&D intensity, D, as the ratio of total R&D expenditures in a given fiscal year to the total revenues received in that year (*9*).

This article broadens the range of activities associated with innovation to include R&D efforts plus much more. Innovation waves discussed here will thus always be larger than Hartmann's R&D waves. For any given enterprise then, the following relationships hold true:

$$D = \frac{I}{C} \quad \Omega = \Phi \cdot C \quad \text{and} \quad \Omega \cdot D = \Phi \cdot I \quad \text{where } C > 1.0$$

Substituting this result into Hartmann's equation 3 gives:

$$\Phi \cdot I = \frac{\left[\sum_k \left(\beta_k (1+g)^k\right)\right]}{\left[\sum_j \frac{\alpha_j}{(1+g)^j}\right]} \quad \text{for } j = 0, 1, 2, \ldots m \text{ and } k = 0, 1, 2 \ldots n \tag{1}$$

Annual revenue growth rate is g. α_j and β_k are the fractional elements of the normalized revenue and investment waves, respectively, as depicted in Figure 4. m and n are the number of years *after* and *before* introduction in which a wave ends or begins, respectively.

The numerator and denominator above calculate the present value (with hurdle rate = g) of the normalized investment and revenue waves, respectively, at the time of introduction. Effective investment and payback times are defined, using properly timed lump-sum equivalents that produce the same present values at introduction (see Figure 4). Expressing this mathematically:

$$1.0(1+g)^{t_{ie}} = \sum_k \beta_k (1+g)^k = PV_\beta \tag{2}$$

and

$$\frac{1.0}{(1+g)^{t_{pe}}} = \sum_j \frac{\alpha_j}{(1+g)^j} = PV_\alpha \tag{3}$$

The relationships below follow from these underpinnings:

$$t_{ie} = \frac{\log(PV_\beta)}{\log(1+g)} \qquad t_{pe} = \frac{-\log\left(PV_\alpha\right)}{\log(1+g)} \qquad \text{(4) and (5)}$$

Investment-payback turn time is defined as:

$$t_{turn} = t_{pe} + t_{ie} \tag{6}$$

Combining equations 1, 2, 3 and 6 gives:

$$\Phi \cdot I = (1+g)^{t_{turn}} \tag{7}$$

Which can be transformed into an explicit equation for revenue growth rate:

$$g = (\Phi \cdot I)^{\frac{1}{t_{turn}}} - 1 \tag{8}$$

This equation is plotted in Figure 5 for various values of t_{turn}.

and, as we shall see, far more useful in analyzing and managing system performance.

After typical working values for Innovation Gain, Innovation Intensity and Turn Time are in hand for a given enterprise, the relationships between these parameters and revenue growth can be seen in Figure 5. The operating point on the horizontal axis is determined by the product of Innovation Gain and Innovation Intensity. Revenue growth rate is then determined using the value of t_{turn}. Curves for integer values of this parameter from 2 through 8 years are provided to cover a wide range of realistic situations.

Improving System Performance

The recipe for achieving best performance from the investment-to-income system will vary from one enterprise to the next and will, in general, depend upon the specific nature of each business model and market arena. To best serve these efforts, this final section will concentrate on useful generalities distilled from the discussion above that form the basis for effective improvement strategies. General areas of focus will be outlined that are useful across a broad range of business situations.

To begin, an overarching objective for performance improvement efforts is presumed: *to increase the impact of innovation investments on growth in shareholder value.* To accomplish this, the changes that are made must improve the cash flow generated by new product and service programs included in the current innovation portfolio. The financial impact of these programs will typically be estimated in the firm's current forecast, perhaps 3 to 5 years into the future. In addition, though, performance improvement efforts should also address and amplify cash flows that will occur beyond the forecast period. Studies have shown that typically 10–20 percent of the current value of a share of stock can be attributed to a firm's forecasted cash flow. The other 80–90 percent of current shareholder value depends upon cash flows that will materialize in the distant future, beyond the forecast period (*2*, pp. 70–71). The current market price of a firm's stock thus depends upon investors' expectations that the company will continually identify and exploit major financial opportunities far into the distant future.

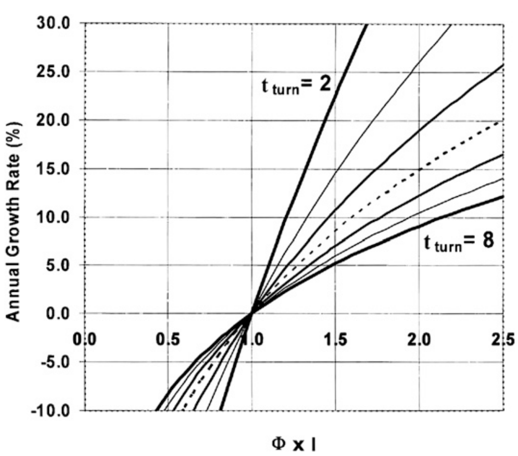

Figure 5.—Revenue growth relationships for the investment-to-income system (t_{turn} in years).

With regard to the investment-to-income system, the state of a business enterprise—and its shareholder value—at any moment in time thus depends not only on the value it currently delivers and on that in its development pipeline; it depends perhaps even more on its current strategic capacity and its ability to discern and shape the future. An effective performance improvement program will appropriately prioritize and address all of these areas.

Innovation performance drivers

For a given level of innovation intensity (I), relationships derived in the P–H model show that greater revenue growth rate can be achieved by 1) increasing innovation gain (Φ), or 2) decreasing investment-payback turn time (t_{turn}). Innovation gain can be improved by either increasing the average size of each revenue wave or reducing the overall size of associated investment waves. Turn time performance is improved by systemically reducing the average time interval between the effective times of investment and payback for each program. This can be accomplished by either compressing each wave in time, or by altering wave shapes. Effective strategies for performance improvement all emerge from these few fundamental options.

Improving innovation gain

Tables 1 and 2 outline fruitful areas of focus for improving innovation gain, many of which are quite familiar due to an abundance of earlier attention. The discussion that follows will bypass this well-plowed ground and focus instead on key insights that emerge from the system model presented.

As established above, strategic activities can have immense leverage on shareholder value. Effective strategy creation strives to establish a unique and valuable market position for a firm that calls for the execution of a unique and difficult-to-copy set of activities. When well conceived, these activities fit together and reinforce one another so that the collection is more valuable than the sum of its parts. They align with and amplify the basic strengths of the firm. Finally, an effective strategy provides focus for the firm, defining not only what the firm will strive to do in the future, but also what it will choose *not* to do (*12*). This guidance is essential in focusing both the firm's innovation investments and its efforts to build competitive capacity.

Excellent strategy creation improves innovation gain by focusing investments on richer targets of opportunity in the marketplace. In addition, though, it establishes a market position for the firm that is difficult to mimic so that competitive advantage is inherently more sustainable. Finally, the sharper focus characteristic of an effective strategy tends to minimize the level of investment required to exploit targeted opportunities. These effects work together to improve innovation gain performance.

Strategic work, however, must be thoughtfully planned, well funded and staffed, and effectively managed. Early market and technology scanning activity identifies emerging trends and opportunities. These form the basis for subsequent strategies and roadmaps. Technology development investments spawned from these insights define the range of possible solutions that might be brought to bear. Market investigations and specific business case development efforts then establish the apparent magnitude of each financial opportunity, and craft the product or service definitions that will guide development efforts.

Reducing the size of investment waves is accomplished by increasing the efficiency of innovation. This is accomplished by improving: 1) technology development effectiveness, 2) product or service definition quality, and 3) the caliber of early system design efforts.

Unforeseen technical difficulties are a common problem. When these emerge late in the development cycle, resulting delays can add months to the schedule at a point where expenditures are at their peak. This has the compound negative effect of both reducing innovation gain *and* increasing the investment-payback turn time.

A competitive system for investment-to-income must become an effective learning center for the enterprise.

New technology readiness is thus doubly important, and depends upon the excellence of early investigation and development efforts. The useful output of such activity is not only technology verification but includes the effective transfer of newly acquired techniques and principles to a product or service development team. This knowledge transfer should include the design rules needed to apply new discoveries, and essential tradeoff criteria required to guide decisions. The

Table 1.—Maximizing Revenue Waves—Areas of Focus

- Quality of proprietary investment opportunities:
  - —Business opportunity magnitude
  - —Insightful strategic directions and plans
  - —Depth, breadth of proprietary knowledge
    - Markets
    - Technology
    - Operations
  - —Competitive advantage level and sustainability
- Excellence in value creation:
  - —Insightful product and service definitions
  - —Product and service development quality
- Excellence in presentation and delivery:
  - —Introduction planning and execution
  - —Value propositions offered to the customer
  - —Product or service implementation
  - —Sales and support
  - —Customer satisfaction
- Innovation portfolio management:
  - —Choice of investments
  - —Due diligence
  - —System management

Table 2.—Minimizing Investment Waves—Areas of Focus

- Product and service engineering productivity:
  - —Information tools
    - Design and manufacturing
    - Simulation
    - Rapid prototyping
  - —Work force excellence
    - An abundance of required expertise
    - Fully engaged and motivated
  - —Program management expertise
- Scrap and rework avoidance:
  - —Gathering essential knowledge early
  - —Clear, stable product and service definitions
  - —Effective, stable system design
  - —Early integration of cross-functional wisdom
  - —Effective design reviews
  - —Effective verification tests
- Leveraging external resources:
  - —Research efforts
  - —Development partners
- Innovation portfolio management:
  - —Due diligence
  - —Bottleneck resolution
  - —System management

overall objective is to effectively change how engineering is accomplished in the firm so that new technologies can be applied effectively and predictably to customer needs.

Early product or service definition and initial system design have essentially the same effect on the size of investment waves. They both guide and shape product development activities that follow. If done well, both work together to focus effort on exactly the work that needs to be done to position an exciting new market offering right on the sweet spot in the opportunity space. If either is changed in mid-development, the result is expensive intellectual scrap and rework, sharply reduced innovation efficiency and delays in the introduction date. Both should thus be carefully managed and well staffed. Results of both activities should be carefully vetted before the program moves forward. The goal of these reviews, in each case, should be to ensure that the best wisdom the firm can muster is reflected in the work.

Improving investment-payback turn time

Tables 3 and 4 summarize areas of focus for improving investment-payback turn time. Some compress the time required while others focus on altering the shape of investment or revenue waves. Again, the discussion will focus on insights that emerge from the system model.

The timeliness and quality of information accelerate rates of innovation progress throughout the system, and thus reduce t_{ie}. Having good information when and where it is needed improves decision quality, reduces errors and minimizes delays. Good people get to the right answers quicker and with less intellectual scrap and rework. Early learning and integration of cross-functional wisdom into innovation activities both contribute to this result.

Investments in early learning also reshape the investment waveform in advantageous ways. While early investigation and development activity may substantially extend the total duration of the investment wave, the low levels of these early expenditures minimize their impact on t_{ie}. The early knowledge that they produce, however, can dramatically reduce delays and inefficiency late in the program when monthly costs are at their highest. When well planned and managed, they can substantially reduce t_{ie}.

Table 3.—Reducing Effective Time of Investment—Areas of Focus

- Quality of program planning.
- Product or service system design.
  - —Timeliness and quality
- Stable product and service definitions.
- Emphasize early, inexpensive learning.
- Identify and plan for key factors that constrain development time compression, e.g.,
  - —Regulatory requirements
  - —Production tooling
  - —Field testing
- Project staffing:
  - —Availability of required expertise
  - —Staffed for best TTM
- Early integration of cross-functional wisdom.
- Effective design reviews.
- Effective verification testing.

Table 4.—Reducing Effective Time of Payback—Areas of Focus

- Market introduction—planning and execution.
- Pre-release verification testing.
- Operational readiness at introduction.
- Field sales and support resources.
- Responsiveness to early issues, experiences.
- Product succession strategy.

Ideal revenue waveforms are tall and narrow with steep slopes on the leading and trailing edges. Effective payback time is thus minimized. A steep initial ramp to peak revenue reflects an excellently planned and executed market introduction along with superb product and operational readiness at introduction. A top-notch field sales and support capability helps as well. A steep trailing edge results from market share being transferred quickly to a better offering, hopefully one introduced by your own firm.

Improving performance in these highlighted areas will have the greatest impact on both innovation gain and investment-payback turn time. This will, in turn, dramatically improve the revenue growth rate achieved by a given innovation investment level.

Real-life Experience

Early in the author's career at Hewlett-Packard a situation arose in the San Diego division that helps illustrate the principles outlined above. The division was attempting to enter the digital hard-copy graphics market for the first time and faced tough competition. The flagship project, Black Flag, involved over 20 engineers and was stalled just a few months short of introduction. The image quality produced by production prototype plotters was terrible, apparently due to poorly understood technical issues with the motor drive and mechanical system designs. At the same time, a longstanding contract with an OEM plotter customer was due for renewal, and the customer would no longer return phone calls. Rumors from the field indicated that the customer intended to purchase and market instead a new digital plotter recently introduced by one of our competitors. No one at the San Diego division was working on a more competitive product offering for this customer. Finally, another project—Big Bertha—was barely making headway in addressing opportunities in the engineering design graphics marketplace. Staffing on this program had been reduced to just four people when a dozen or more were needed.

Several performance flaws stand out in this situation. First, clocks are ticking on turn-time performance on all projects, extending it about a month per month until constructive action is taken. Further, innovation gain on the Black Flag program is declining steadily as the size of its investment wave continues to grow while progress toward introduction is stalled. The lack of new product attention to the OEM customer's needs reflects a lapse in strategic planning. Finally, the understaffed Big Bertha project seems to reflect a poor grasp of key relationships—specifically the required balance between opportunity size, investment magnitude and investment-payback turn time.

As these efforts unfolded, victory was snatched from the jaws of defeat in every case. The Big Bertha project was put on the shelf for later, and those people were refocused on solving Black Flag's image quality problems. Concurrently, the Big Bertha project manager envisioned a variation of Black Flag that could be created quickly, and that would dramatically outperform the competition in the OEM customer's application. He reestablished contact by requesting technical details on how the OEM customer would like this new version to perform and communicate.

After a short delay, the Black Flag product was finally introduced to rave reviews and overwhelming customer acceptance. Its sorely needed revenue wave was finally launched. The OEM customer, intrigued with the capabilities of HP's new plotter technology, signed on for another year. Six months later he scooped his own competition with dramatic new functionality enabled by the newly introduced variation on the Black Flag product. A substantial second revenue wave was thus launched soon after the first, and with a very small additional investment.

Soon after these programs were finished, the Big Bertha program was rejuvenated and properly staffed. Thanks to strategic new media control technology invented at HP Laboratories during the time this program was shelved, the Big Bertha effort resulted in another breakthrough product that quickly made HP the market leader in engineering design graphics. Its high functionality and low manufacturing cost resulted in unprecedented innovation gain performance, operating profit margins and revenue growth for the San Diego division.

Learn Faster Than Competitors

The ability of a firm to discern and shape the future is closely linked with its capacity to compete and its ability to grow shareholder value. Arie P. de Geuss has written: "The ability to learn faster than your competitors may be the only sustainable competitive advantage" (*13*).

This insight has a strong ring of truth, and has been applied over the past two decades to support a wide range of diverse points of view. Its emphasis on urgency is becoming more relevant every day. To become truly useful wisdom, though, it always seems to beg for further definition of what "learning" means.

The discussion here has advanced the case for a shift in emphasis toward balanced learning:

- Short term *and* long term
- Strategic *and* tactical
- Technologies *and* markets *and* customers
- Engineering *and* marketing *and* operations *and* sales
- Program content *and* business system performance

A competitive investment-to-income system must, at various times and in various situations, become an effective learning center for the enterprise in each of these areas, and in all that require attention—in balance. Hopefully this system description and the principles that govern its operation will prove useful in highlighting the key areas of learning that any given enterprise must master to stay competitive and to achieve and maintain healthy financial growth.

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