THE ENGINEERING OF STRATEGY:
THE GENERAL, UNIFIED THEORY OF STRATEGIC MANAGEMENT AND PERFORMANCE

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Abstract

Strategy scholars and others have long been concerned about limited relevance and usage of strategy theories and methods. This might be addressed by better integration of existing rigorous principles, including those of other management disciplines, into a general, unified theory [GUT] of strategic management and performance. A possible GUT builds on three generic principles—that firm performance at any time depends on current quantities of tangible resources, that those and other resources and capabilities accumulate and deplete over time, and that interdependencies amongst these processes, interacting with rivals and other exogenous factors, capture the dynamics of the organization's operating system and explain the resulting performance of an organization over time, on any chosen measure(s). These principles are applicable at all levels of strategy and to all contexts, including non-commercial cases. Applying the functions that operationalize the principles provides an "engineering view" of an enterprise, amenable to deliberate design and continuous management. The GUT is amenable to falsification—the search for any situation in which it can be shown to fail.

Keywords: strategy theory, strategic management, system dynamics, organizational performance

Strategy writers have long expressed concern that the field is not sufficiently relevant to the real world *(Hambrick, 2004; Ghoshal, 2005; Farjoun, 2007; Whittington and Jarzabkowski, 2008)*. There is also suggestive evidence that its tools, methods and frameworks (*hereafter, simply 'methods'*) are not widely used *(Rigby and Bilodeau, 2013)*, and may be regarded by practitioners as being of limited value and relevance *(Coyne and Subramaniam, 2000)*.

Efforts to explain this patchy deployment of strategy methods have focused on sociological explanations *(Jarzabkowski and Kaplan, 2014)* in which methods are treated as "technologies of rationality" that may prove inappropriate when confronted with the realism of experience. Consequently, rather than using such methods to inform rational decision-making *(Cabantous*

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and Gond, 2011; Jarratt and Stiles, 2010), those methods are either adapted by practitioners or used merely as conceptual frameworks to guide thinking *(Jarzabkowski and Kaplan, 2014)*.

This strategy-as-practice perspective implicitly accepts that a mismatch exists between strategy methods and the practical experience of the real world that is impossible to eliminate. Yet a strong professional field would be expected to feature methods grounded in theories that are sufficiently reliable to become embedded in real-world practice, and thus achieve high relevance; indeed, relevance so great that professional practice *requires* those methods to be employed. Among fields related to management, this is already observable across all engineering disciplines, and in Finance, where the principles of discounted cash-flow *(Burr; 1938)* and the capital-asset pricing model *(Treynor and Black; 1976)* have provided the bedrock for professional practice in corporate investment and valuation for many decades *(Koller, Goedhart and Wessels; 2010)*.

It follows, then, that the limited relevance and use of strategy methods may not be inevitable, but reflect instead an absence of strong, core theories, which has left practitioners with little choice but to do the best they can with the methods available. It has also left the door open to the fads and fashions of journalistic writing on strategy that make no pretence to theoretical validity. It is therefore reasonable to conclude that the strategy field should seek stronger theoretical foundations—ideally, a general, unified theory—that can provide substantially improved technologies of rationality. The alternative is to accept that no such rigorous theory and no reliable methods are possible, and continue to hope that strategy-as-practice can be improved in some way that will result in better strategic management of organisations and better performance outcomes.

Requirements of a general unified theory (GUT)

As the most integrative of management disciplines, a strategy GUT would need to fulfil extensive and demanding requirements. It should be consistent with, and preferably integrate, existing theories and principles recognized in the field and reflected in practice methods that have proved at all useful. It should be consistent with, and if possible integrate, accepted theories and principles in other disciplines. A GUT must handle organizations' diverse objectives, including trade-offs that may need to be made *(such as between current profitability and growth)*, and should explain fully the link from those outcomes back to their causes. Correlation alone between causes and outcomes is not adequate; a GUT should also demonstrate valid causal pathways between them.

To achieve widespread, reliable use in practice, a GUT should employ factors, concepts and measures that are identifiable and measurable in the real world, avoiding abstract concepts that are not directly observable. It should apply not only to single-activity businesses in any industry, but also to sub-units of a business, and to distinct business functions. It should be extensible to corporate strategy challenges of multi-business organizations, and to multiple participants, such as business networks.

A GUT should be applicable at all times, and deal with significant changes occurring between different points in time. It should inform the *continuous* management of strategy from period to period, as well as occasional decisions, such as choice of strategic position, acquisitions and entry to new markets. Since public services, voluntary and other non-commercial

organizations also pursue long-term aims, a GUT should be as applicable to those contexts as it is to commercial cases.

Given these already challenging requirements, it is too much to expect any GUT to deal with both strategy content *(what to do, when and how much, at all times and across all functions, with what impact on longer-term performance)* and strategy process *(how to influence whom to develop and deliver that strategy and performance)*. This paper therefore focuses on strategy content. However, a substantially improved strategy method should also assist the strategy process, since increased confidence in the rational technology would degrade uncertainty and the scope for dissent between participants engaged in developing and managing strategy.

The question to be answered

Although other objectives must be addressed, and will be considered below, financial aims for commercial firms are widespread, and so provide a useful start-point for developing a GUT. It is axiomatic Finance that the value to investors of a business or of any significant investment reflects the expected stream of future earnings—specifically free cash-flows *(profit after interest and tax, plus depreciation, minus capital invested and increases in working capital; Brealey, Myers and Allen, 2007)*. When the aim is to deliver value for investors, then, the answer required from evaluating a strategy or strategic initiative is a cash-flow forecast. (An indicator of the weakness of existing strategy methods is that no means has been documented by which they might be used to achieve such a forecast).

A GUT must therefore explain *growth* of cash flows from period to period, rather than profitability ratios, and inform management how to sustain such growth over long periods *(Penrose, 1959; Rugman and Verbeke, 2002)*. This is of practical importance because, while firms may differ by a few percentage points of profit-margin, strong performing firms deliver orders-of-magnitude more growth in cash flow than weaker rivals. It also implies that research in strategic management has for many decades largely focused on the wrong question—sustained superior profitability ratios—which are of only indirect relevance to the sustained growth in free cash-flow that is the dominant concern of business owners and managers.

For non-financial objectives, such as market share, service quality or reputation, improving the indicator from period to period is also the focus, since step changes to such items are rarely possible. A GUT should explain, and provide future estimates for two classes of objective—average *performance* over some *period of time*, such as profit per year or average service quality during a month, and targets for a *quantity of some asset* to be achieved by a *point in time*, such as customer numbers or trained staff by the end of a year.

Figure 1: EBITDA profit for Ryanair plc, 2006 to 2020.

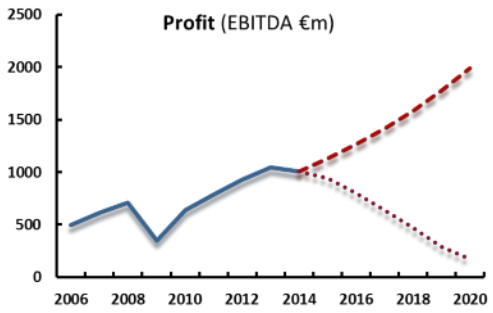


Figure 1 shows an example of the question that an aspiring theory of strategic management and performance may be expected to answer—why the cash operating profit of a company *(Ryanair plc)* has developed over time to its current value *(€1014m in the financial year ending in March of*

that year; hereafter "fiscal-2014"). The figure also shows an attractive future for the company's profit to 2020 that should result from pursuing a sound strategy in not-too-hostile market conditions, along with a less attractive trajectory that might arise from some combination of poor strategy or a challenging market environment. To be useful, a GUT should explain how the former outcome might be achieved, rather than the latter, and continue to do so from period to period.

The case of Ryanair also demonstrates the need for improved strategy methods. An assessment of industry forces (Porter, 1980) might explain why profitability in the airline industry as a whole is low, and why profitability specifically among low-fare airlines has fallen since the sector's emergence in the 1980s and 1990s, as large numbers of new entrants competed away the sector's margins (60 new firms started up in Europe between 1995 and 2010, for example). However, since the strategic positioning and operating models of the many low-fare competitors have been virtually identical for over two decades, neither industry forces nor analysis of strategic resources offer much explanation for the diversity of performance between firms. That performance varies by *orders-of-magnitude* when viewed in terms of investors' interests—Ryanair generated over €1 billion in cash operating profits in fiscal-2014, about half of which was reinvested in new aircraft, while weaker competitors generated little or no free cash flow, or went out of business. Furthermore, not only have those strategic positions and operating models been largely indistinguishable, they have also not changed significantly during the same period. Neither industry-based nor resource-based methods, then, can assist with the critical choices needed to *implement* strategy from period to period.

Explaining *immediate* performance

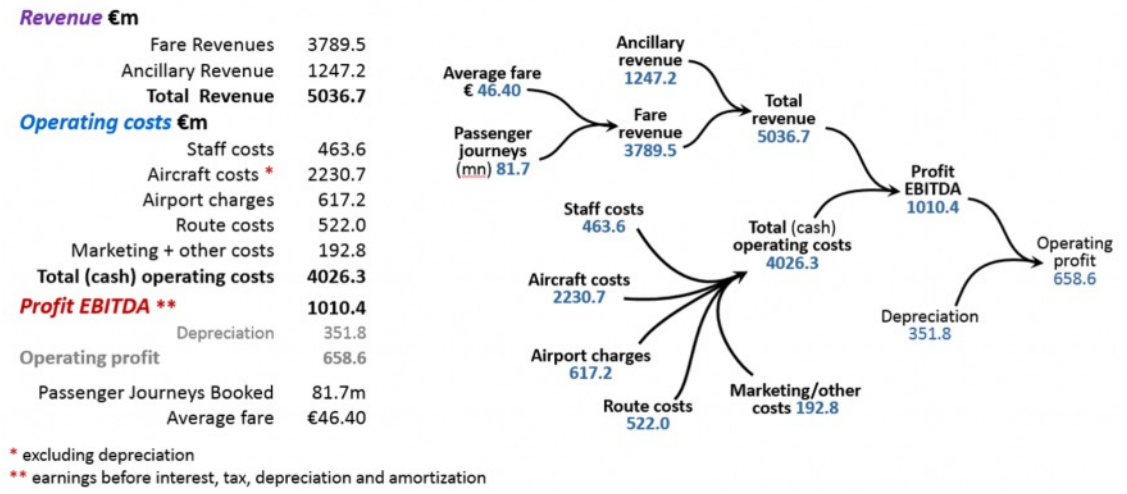
Developing a GUT to explain growth in profit and cash flow requires, first, an explanation for those values for a single period. And since investors value the receipt of absolute quantities of cash, that explanation should address absolute amounts, such as $millions/year, not any ratio. No research or statistical analysis is required to develop that explanation, since any period's operating profit and cash flows are completely explained by the accounting principles of the Income and Cash-Flow Statements. *Profit* is *revenue* minus *operating costs* (or, if value is added to bought-in items, by *gross profit* minus *operating costs*, and *gross profit* is *revenue* minus *cost of goods*). *Operating costs* are simply the total of the various cost categories required for the business to function and grow.

These relationships are set out for Ryanair's fiscal-2014 results in figure 2. The table at left presents the explanation for the year's profit in a conventional table, while the diagram at right displays the same relationships in causal form. The arrows connecting items in this diagram have a specific meaning—that the dependent variable can be confidently estimated from the items linked to it by those arrows. In this case, each item can be exactly *calculated* from those on which it depends.

In virtually all commercial cases, revenue is caused by *customers* multiplied by their *average expenditure per period*, which in turn is caused by *transactions per period* multiplied by *average transaction value*. *Customers* are a tangible, somewhat reliable asset, in the sense that many customers are likely to continue purchasing from the business from period to period. *(The gain and loss of customers is addressed below).* For Ryanair, the average customer buys flights about 5 times each year, information that allows the explanation for the company's revenue for fiscal-2014 to be completed, as shown in figure 3. The

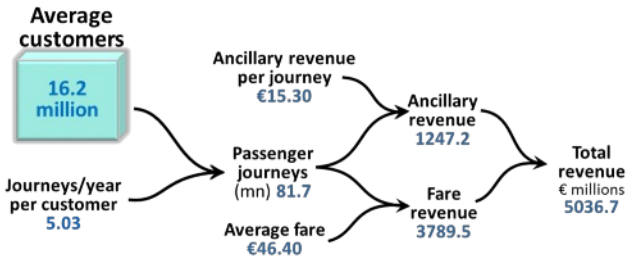
number of *Average customers* is depicted in a box to indicate that it is an accumulating asset-stock *(Dierickx and Cool, 1989)*.

Figure 2: The causal explanation for Ryanair's profit in fiscal-2014 (includes rounding differences).



With multiple customer segments, the relationship from customers to sales and revenue need merely be replicated and summed. An airline's customers, for example, will include some who take its flights frequently for commuting or similar purposes, others who are loyal but less-frequent travellers, and a few one-off customers who contribute a small fraction of sales and revenue.

Figure 3: How customer numbers, purchase frequency and price caused Ryanair revenue in fiscal-2014



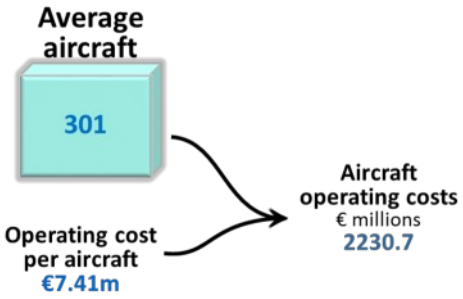
Apart from the cost-of-goods embedded in the final product *(insignificant in this case)*, costs are caused by costly assets, notably staff and capacity, and by the acquisition of those assets. *Staff costs*, for example, are caused by *staff numbers* multiplied by *average staff cost*, plus *staff hired per period* multiplied by *average hiring cost*. Some costs are simply decided upon by management, but also relate to asset-building—marketing spend aims to acquire and retain customers, for example. For physical assets and some others, acquisition costs do not appear directly in the Income Statement, but are capitalized, and their depreciation *(a non-cash item)* is charged to the Income Statement instead.

Figure 4 shows how aircraft drive aircraft operating costs for Ryanair. The average number of aircraft during the year is again depicted in a box because it, too, is an accumulating asset-stock. Other asset-stocks on the supply-side of the business are staff, the routes on which flights are offered *(the company's product range)* and the airports between which those routes are provided. The average operating costs of each aircraft is fully explained by additional items—the number of operating hours each period and the costs of maintenance and fuel

for each operating hour. The cost of fuel is an example of an exogenous variable over which management has little influence.

Supply-side assets may also comprise multiple segments, such as distinct staff groups, so these links between those assets and the resulting costs may need to be replicated and summed. Not all tangible assets need be owned, just repeatedly available from period to period—customers being the notable example, together with staff and leased equipment. In many cases, entire functions may out-sourced to third-party providers, in which case costs are typically driven by the activity rates purchased by the firm.

Figure 4: How capacity drives operating costs for Ryanair in fiscal-2014.



Staff, capacity and product range are simple, tangible resources, observable and measurable in virtually all cases. An airline's airports are an example of "points of presence" required to reach its customers—a function fulfilled in other contexts by dealers or distributors, or by physical assets such as vending machines. Certain industries feature additional types of tangible resources, such as the reserves extracted by natural resources firms, and the order-book for large-scale manufacturers. Together with customers, these supply-side categories of resources are virtually standard across any industry, and since they drive revenues and costs in a common manner captured by a company's Income Statement, they provide a completely reliable start-point for explaining the operating performance of any business, for any period.

Highly comparable assets arise in public-service and other non-commercial cases. "*Demand*" is driven by some population; numbers of children drive the need for schooling, and numbers of refugees drive the demand for food, water and sanitation. "*Supply*" is determined by the capacity of physical assets and staffing to fulfil that demand. Although profit may not be of primary concern, such organisations must nevertheless be financially viable or operate within financial constraints.

None of the relationships set out so far are discovered by statistical analysis—they are simply recognized arithmetical relationships. The causes of non-financial performance outcomes are not always so mechanical, but these too depend on quantities of assets. Service quality may be low if the current quantity of relevant staff is too small to support the demands from the current number of customers, for example.

For consistency with established terminology in the strategy field, the assets involved in these causal relationships are more appropriately termed '*resources*'. However, since most are tangible, they may not fulfil the 'strategic' criteria of the resource-based view *(RBV—Wernerfelt,1984; Barney, 1991; Amit and Schoemaker, 1993; Montgomery, 1995)*. Capacity, for example, may not be scarce or hard to imitate, whereas specialized staff are frequently valuable, rare, hard to imitate and embedded in organizational processes—the so-called VRIO criteria for any resource to be regarded as "*strategic*". Intangible factors and capabilities more frequently fulfil these criteria. However, since current performance is directly explained by only a small number of readily identified, tangible resources, such VRIO factors

can *only* affect performance by changing the quantities of those tangible factors over time. Consequently, no theory that relies solely on VRIO factors can adequately explain any measure of performance.

The reasoning to this point provides the first element of a GUT—that performance for any period of time depends on the average quantities of tangible resources that exist during that time. Two further types of factor directly affect current performance, the first being some management decisions. Raising marketing spend *immediately* cuts the profit for the current period, for example, regardless of its further impacts on changing customer numbers or purchase rates. Exogenous factors also affect current performance, such as changes in consumer disposable income, the costs of bought-in items or the prices charged by competitors. The first principle of the GUT is thus as follows:

> Performance, P, at time t is a function of the quantity of resources R^1 to R^n, discretionary management choices, M, and exogenous factors, E, at that time.
>
> $$P(t) = f\,[R_1(t), .. Rn(t), M(t), E(t)] \qquad (1)$$

When objectives themselves concern the achievement of some quantity of resource by some point in time, the dependent variable is some $R^i(t)$, dealt with by the second element of the GUT, so equation 1 is not relevant.

In both business and other cases, performance depends not just upon the quantity of each resource but also on certain attributes or qualities they possess— the purchase-rate of customers, the salaries of staff, the size of production units, and so on. These attributes are already reflected in the causal relationships described thus far, but *changes* to those values over time also need to be explained.

Since performance is commonly monitored and reported for certain *periods* of time—a financial year or a month of operations, for example—equation 1 gives the *rate* of performance for such periods, so must be reported with correspondingly appropriate units, such as sales *per month* or €million *per year*. Most non-financial performance outcomes also similar "*per time-period*" measures, or are reported on that basis, such as customer complaints per week or product-plant yield during any hour or day.

In contrast, the resources that cause performance—being asset-stocks—are measured and reported at certain *points* in time, such as the start and end of a month or a financial quarter or year. Consequently, the quantities of resources R^1 to R^n in equation 1 must be the *average* quantities that exist during the reporting period to which the value of *P* relates. This is precisely analogous to the relationship between the quantity of cash in a bank account and the rate of interest that it earns (*interest per period* = *average cash balance* multiplied by *interest rate per period*).

Since the quantities of resources and the performance they cause typically change significantly during a year, equation 1 becomes more meaningful and useful when calculated for shorter periods of time. This means that a GUT built upon equation 1 provides useful information for any required operating period, making it valuable for the implementation of strategy. In principle, equation 1 becomes most precise for the smallest possible periods

of time. The rate of sales *right now*, for example, depends on the number of customers right now, and the fraction who are purchasing each minute. Although, at the limit, this relationship breaks down due to the stochastic nature of individual transactions.

Explaining the changing quantities of resources

Since the objective is to explain *changes* in cash flow or other indicators from period to period, and these depend on quantities of resources, we must next explain how those quantities have arisen, and provide estimates for *future* changes to those resources. Since resources are accumulating asset-stocks *(Dierickx and Cool, 1989; Barney, 1989)*, their behaviour between any two points in time is readily specified.

> The current quantity of resource R_i at time t is its quantity at time $t\text{-}1$, plus or minus any gains or losses that have occurred between $t\text{-}1$ and t.
>
> $$Ri(t) = Ri\,(t-1) +/- \Delta Ri(t-1. \,.\, t) \qquad (2)$$

This mathematical behaviour, captured by integral calculus, is not a theory, opinion, or statistical observation, but is axiomatic of asset-stock behaviour. It is also a mathematical identity—cash today is *exactly* equal, to the cent, to the quantity yesterday, plus or minus any cash added or lost. Numbers of customers or staff today are likewise exactly equal to the number yesterday, plus or minus any that have been won or lost. Since this is also always true for all time periods, back to the point in time when the asset-stock was first created, the current quantity of any asset-stock can only be *fully* explained by its entire history of gains and losses, but that explanation is absolute, with no error.

This mathematical property of asset-stocks has two critical implications. Since the quantity of any resource is precisely the sum of all quantities of ever added, minus all quantities ever lost, there can be no *other* explanation for that quantity—the current quantity of cash cannot be worked out from current revenue and costs, today's number of customers is not 'caused' by marketing or price, and current staff numbers are not explained by pay rates or working conditions.

Secondly, if the current quantity of a resource cannot be explained by anything except its own history of gains and losses, then neither can any value that *depends on* those resources—notably profit. This fatally damages efforts to confirm hypothetical explanations for financial or other outcomes through multivariate regression analysis. Current performance cannot be meaningfully correlated with either the current value of other variables, except those in equation 1. Nor can current performance be explained by time-lagged values of any variables, since there exists no causal mechanism *(in strategy or any other field)* that can operate between remote points in time. For time-lagged influences to occur requires that some factor be stored through time, which is precisely what asset-stocks do.

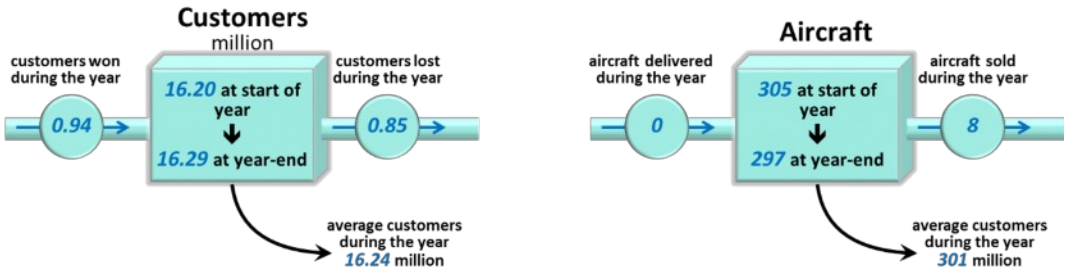
Equation 2 is readily illustrated with resources from the Ryanair example (see figure 5):

Customers (end-March 2014) = Customers (end-March 2013)
+ customers won (in fiscal-2014)
– customers lost (in fiscal 2014)

Aircraft (end-March 2014) = Aircraft (end-March 2013)
+ aircraft bought (in fiscal-2014)
– aircraft sold (in fiscal 2014)

Similar relationships explain changes to numbers of staff, routes and airports. The box in each diagram holds the stock-value for the relevant resource, and displays the opening balance and closing balance at the start and end of fiscal-2014. The icons at left and right of each stock indicate the rate at which resource flows into and out of that stock—hence the term "*stock and flow*" framework by which such diagrams are known. (*Since these icons can be thought of as pipes and pumps, the structure is also known as the "bath-tub metaphor"*).

Figure 5: Changes to numbers of customers and aircraft at Ryanair during fiscal-2014.



The units for each flow-rate in any stock-flow relationship are *always* the same as those for the stock, with the addition of "… *per period*", so *customer* numbers are changed by flows of *customers per year (or per week, month and so on)*. There is no exception to this rule, since it is axiomatic of asset-stocks' behaviour.

It is rarely adequate to report the *net* change to the quantity of any resource during a period. The distinct values for the rate of gain and loss for any resource are frequently important—winning 10 customers and losing none is not the same as winning 100 and losing 90. Moreover, the *causes* of gain and loss usually differ significantly—new customers are won for a different mix of reasons than those that cause current customers to be lost, and while the hiring of new staff is simply a management decision, losses of existing staff are caused by a variety of other factors. Since we are seeking a complete explanation for performance, each flow of resources into and out of a stock needs to be identified and explained. Note also that there can be more than one of each type of flow—staff may resign *and* be dismissed, for example.

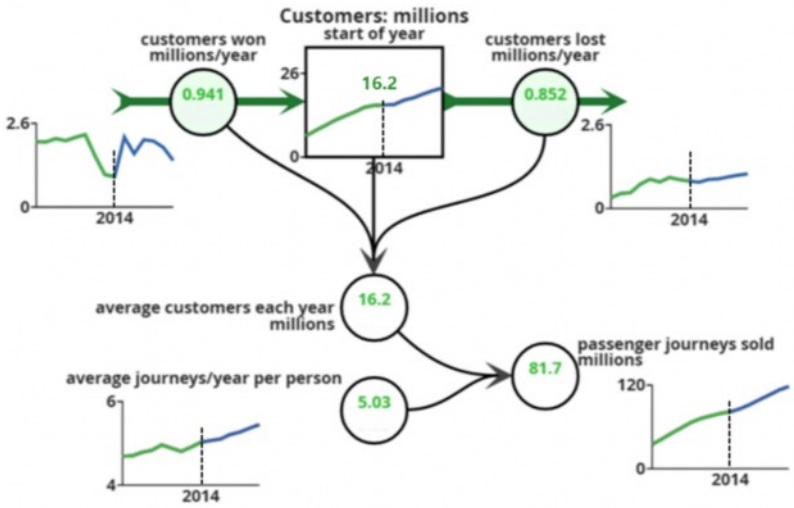
Where chosen objectives concern achieving some resource-quantity by some point in time—$R_i(t)$—rather than performance for a reporting period, the analysis starts with equation 2. For example, a target to grow a firm's customer-base from some current number today to a larger number at a future point in time, can *only* be reached by achieving gains and losses over the intervening period that result in the required net change. The same principle applies for objectives to grow numbers of staff or other assets. Retailers, for example, frequently have objectives for their numbers of stores, which can only be met by a new-store opening rate that exceeds any closures by a large enough difference to reach the goal.

Equation 2 exactly explains the change in the quantity of each resource over any desired period, and therefore explains, unambiguously, the change in performance over that same period. Explaining the changing trajectory of performance over multiple periods therefore requires only that the equation be evaluated repeatedly, for all resources across all time-periods. For example, if the changes to Ryanair's customer numbers in figure 5 applied to fiscal-2014, then they also applied for all previous years (and indeed for all periods within

all of those years) and will continue to do so for all future years. The single-period causal relationships in figure 5 can therefore be replaced with time-charts for the same items, going back in history and forward into the future as far as required.

Figure 6 shows the relationships between the stock and flows of Ryanair customers from fiscal-2006 to 2014, and plausible projections to fiscal-2020 that would account for the preferred outcome shown in Figure 1[1]. It also shows the linkage to a commonly reported key performance indicator in the industry; sales of passenger journeys. Note that the stock displays the number of customers at the start of each fiscal year, but the average number for each year *(and the year-end value)* can be calculated from that value and the two rates-of-change.

Figure 6: Changes to Ryanair customer numbers from fiscal-2006 to 2020 (rounded values).



Like earlier figures, figure 6 may again be an unfamiliar representation, although its relationships could readily be formulated in a spread-sheet and reported in a table. However, the diagram offers a more intuitive picture of how the dependencies play out over time, which proves to be of considerable value when teams seek to understand why performance is changing as it is, and plan activities and decisions to improve that performance. Also, since the relationships are totally reliable for any chosen period, the analysis may be made and presented in as much temporal detail as required. Figures 1 and 6 show changes over a long period expressed in annual rates, but could equally be examined over the same or shorter periods, in quarterly or monthly rates. This enables use of the method for continuous strategy implementation, since changes can be highlighted over short periods of time and decisions adjusted accordingly.

Exactly equivalent relationships-over-time can be calculated and displayed for changes to the numbers of aircraft and all other resource-stocks, resulting in the complete explanation

[1] *No airline, Ryanair included, reports publicly the number of customers and their journey frequency, so the values shown in figures 5 and 6 are plausible estimates. However, they must reconcile with the total quantity of passenger journeys sold in each period. If, therefore, actual journey frequency was lower than shown for any year, then customer numbers must have been correspondingly higher, and if the change in journey frequency between two years was different than shown, then gains and losses of customers must also have differed sufficiently to make up for that difference.*

for Ryanair's profit trajectory shown in figure 7. This figure is more than a visual description of the causes for the company's profit—every value displayed is the actual value for fiscal-2014 *(start-of-year values for each resource-stock and average values for the year for performance outcomes and other items)*, and every value can be accurately calculated using the causal links from items to their left. The same is true for every value indicated by the time-charts for every period prior to, and after, 2014.

Figure 7: How changes to tangible resources drive changes to Ryanair EBITDA profit over time

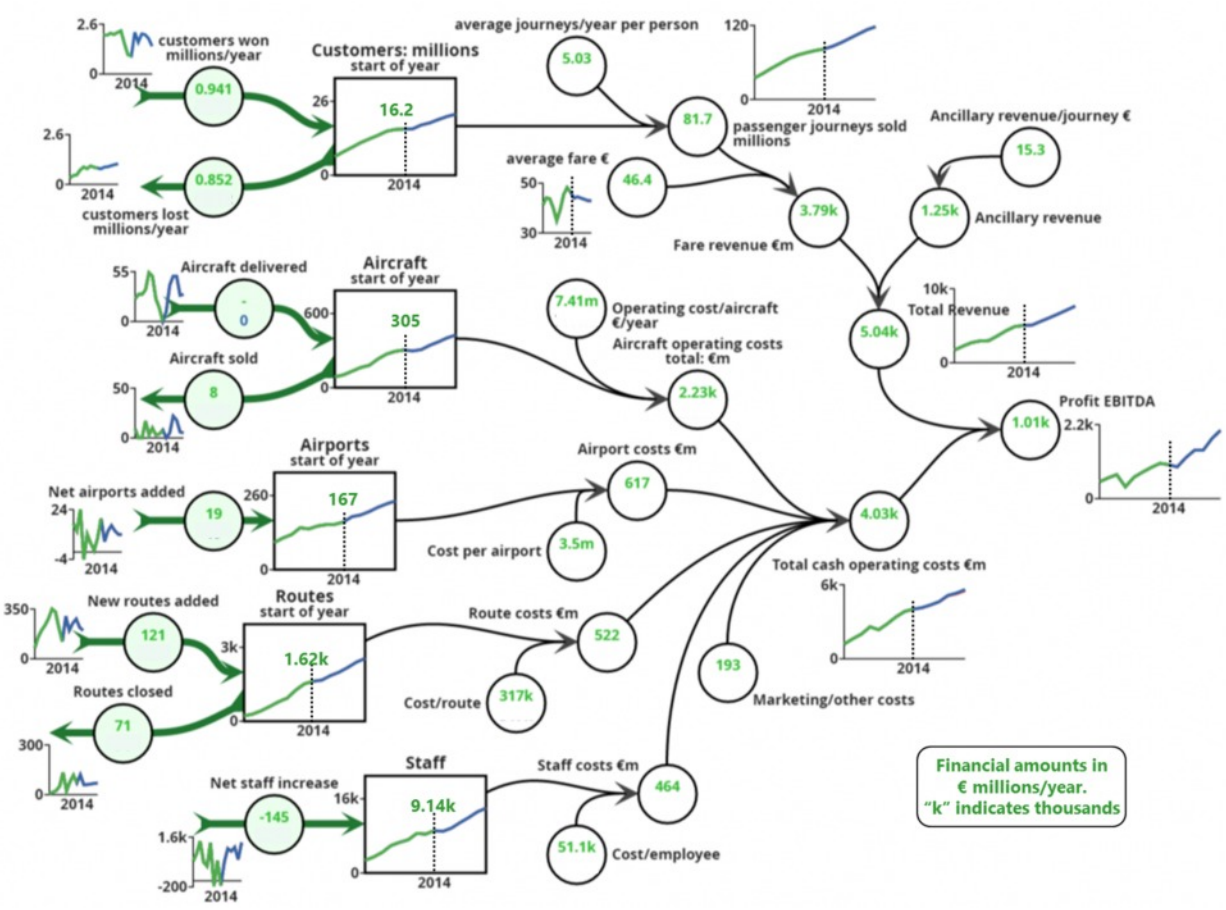


Figure 7 therefore provides a visual, quantified explanation for the company's strategic management and performance over recent years. Ryanair could have suffered a severe loss of customers and fall in passenger journeys in fiscal-2009 and 2010—the first financial years hit by the recession. However, a sharp cut in fares prevented both of these problems and enabled continued growth in sales and revenue. The loss of customers and sales might again have been expected to occur in fiscal-2011 and 2012, when Ryanair moved fares back to pre-recession levels. However, that problem too was prevented because the company opened services on large numbers of new routes in those years—additions that were possible because it had previously started operations at many new airports during fiscal-2009. Throughout the period, additions to aircraft and staff simply followed what was necessary to provide the capacity and service rates needed to support the route-services offered and sales of passenger journeys.

Explaining rates of change to resources

The remaining unknowns from eqs. 1 and 2 are the rates of change for each resource, $\Delta R_i(t-1\ldots t)$. The summary explanation for all such flow-rates, described more fully below, is as follows:

> The change in quantity of R_i from time *t-1* to time *t* depends on the quantity of resources R_1 to R_n at time *t-1* (*including that of resource R_i itself and its own potential*), on management choices, *M*, and on exogenous factors *E* at that time.

$$\Delta Ri(t-1\ldots t) = f\,[R_1(t-1),\ldots Rn(t-1),\ M(t-1),\ E(t-1)] \qquad (3)$$

Like equations 1 and 2, equation 3 may be expanded to make explicit multiple segments of resource. Also, since the items on the right-hand side of equation 3 are likely to change significantly over a whole year, it becomes more accurate and useful if the time period *t* is short enough for the change $\Delta R_i(t-1\ldots t)$ to be small, relative to the scale of resource R_i. For this reason, quarterly or monthly analysis makes it possible to use the GUT not just for long-range planning but for continuous strategy implementation.

The simplest instances of equation 3 concern rates of change that are simply chosen by management, such as capacity increases and closures, the launch and withdrawal of products, and the hiring and dismissal of staff. Not all such decisions necessarily result in exactly what management wishes, however. We may try to hire some number of staff, but cannot be certain to succeed in doing so because that hiring rate is also subject to other decisions, such as pay rates we offer, and exogenous factors such as competitors' pay rates.

The least certain flow rates concern the capture and loss of customers. Decisions on marketing expenditure, pricing and sales effort are set with the hope of winning customers at some rate and retaining existing customers *(as well as changing customers' purchase rates)*, but the outcome is also affected by other factors, including the same efforts being made by competitors. The price decision plays a distinctive role. Management is free to make any price change that they wish, and if nothing else changes, this will directly alter revenue and cash margin. But other items will be changed by that same decision—customers' may purchase less often, or be won or lost at a different rate.

The second category of factor affecting rates of change to tangible resources concerns *existing* resource quantities. Both in-flows and out-flows are subject to such influences. A wider product range resource or a larger sales force may win customers more quickly. However, a too-small customer-support team may lead to poor service and result in higher customer losses that a larger team would have avoided.

The set of existing resource-quantities affecting the rate at which new resources can be acquired includes stocks of *potential* resources. Airlines can only capture potential customers who reside in the catchment area of the airports they serve, for example, and retailers can only capture potential consumers near their stores. Many firms struggle to grow numbers of customers because the potential populations have already been captured by the firm itself or by competitors. Firms may also be constrained by shortages of certain types of staff. The challenge is not limited to commercial organisations needing engineers, IT-specialists,

experienced sales people or accountants, but applies equally to public service and other non-profit organisations—shortages of teachers and medical staff constrain hiring rates for schools and health services, for example.

Potential resources do not feature in equation 1, since they do not directly drive current-period performance, but they do feature on the right-hand side of equation 3. But potential resources are themselves *subject to* equation 3 and exhibit the behaviour defined by equation 2. This exposes them to influence by management decisions. Retailers create new potential consumers each time they open a store in a new catchment area for example. Their product range, marketing, pricing and so on then determine whether those potential consumers flow into the stock of active consumers who generate sales and revenue. Likewise, for other business types, new products or services can be launched, new dealers appointed or new sales territories entered in order to reach new potential customers. The principle is not limited to customers—some organisations sponsor educational programmes that train potential staff, to create a pool of recruits from which they can then hire.

The third and last category of factors determining the gain and loss of resources concerns exogenous factors, including but not limited to the actions of competitors. Demographic, social, and economic changes may affect significantly both the rate at which new customers can be won and the rate at which existing customers are lost. For example, aging populations raise the numbers of customers who can be won by firms offering products and services for the elderly, and urbanization creates new customers for urban transport and other services. And many businesses acquired new customers during the economic boom of 2005 to 2008, only to lose them during the subsequent recession.

Competition, of course, is an exogenous factor with considerable influence. It was already noted that competitors' activities and choices affect our own firm's *current* performance directly through equation 1—their price being the most obvious example—but their activities and choices also affect the rate at which our firm can win and retain customers and staff. However, competitors cannot usually control our ability to change our product range and capacity.

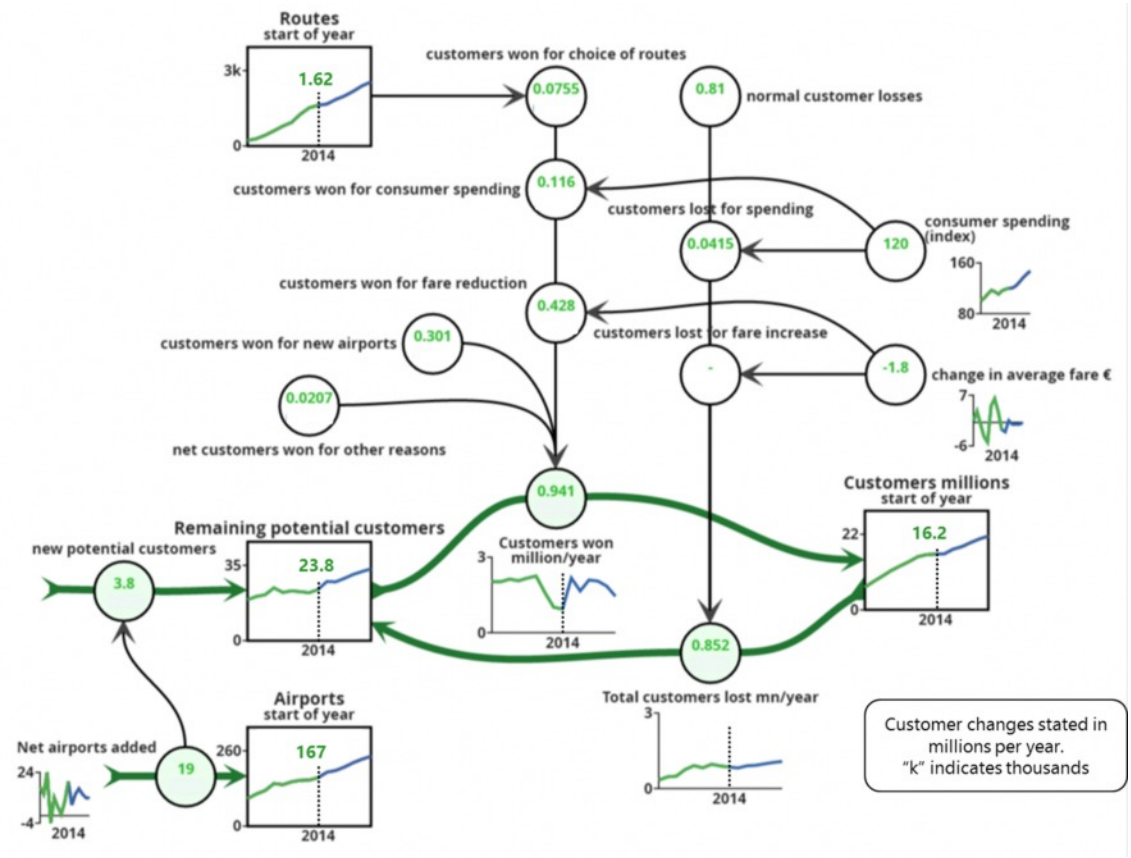
Equation 3, for the rate of accumulation or depletion of any particular resource, may be highly non-linear. Marketing expenditure, for example, may have little impact on a customer win-rate until it is sufficient to exceed some threshold of awareness or interest among potential customers at which they choose to respond. Staff losses, on the other hand, may continue at a modest rate up to a point of unacceptable work-load, at which point the rate may escalate sharply. Such thresholds are a common source of tipping points: whether helpful or harmful.

The implementation of equation 3 can again be demonstrated with the information on Ryanair plc in figure 8. The factors causing new customers to be won from the reachable potential are at upper-right— choice of routes, general rates of consumer spending *(an exogenous factor),* changes in the fares charged and accessibility to new airports. The role of competition is implicit here, in that customers respond to the *relative* choice of routes and fares charged, compared with rivals. The drivers of customer losses are at upper-right. In addition to normal losses arising from changing demographics and consumer habits, losses arise due to falls in overall consumer spending and fare increases. The population of potential

customers from which the company draws active customers is shown at lower left, driven by the opening up of flight operations from additional airports.

The exact causality for the win- and loss-rates of customers in this and other cases requires internal company information and extensive, repeated customer research, neither of which are possible with the external analysis carried out here. However, the values shown in figure 8 reconcile with the customer numbers and sales rates shown in figures 6 and 7. (The item *net customers won for other reasons* is a small residual value in each year).

Figure 8: Causes of changes to Ryanair customer numbers from fiscal-2006 to 2020



It was noted earlier that regression analysis cannot be meaningfully used to explain the value for any accumulating stock or, therefore, for any item that depends on such a stock. However, such methods can be used safely to explain rates of change. In figure 8, the customer win-rate is *some* function of items such as those shown, and statistical investigation of regular customer research such as conjoint analysis would provide the necessary estimates of those functions. This, incidentally, develops the popular strategy "*value curve*" framework *(Kim and Mauborgne; 1999, 2004)* into a rigorous method that can be used continually for strategy implementation.

Causal ambiguity, intangible factors and capabilities

It was noted in the introduction that any GUT should, so far as possible, build on existing knowledge. The strategy field has long been aware of resource accumulation and interdependence, so the contribution of equations 1-3 is, first, to operationalize those mechanisms in a form that makes them both researchable by scholars and usable by

executives, and second, to embed them in a complete theory of organizational performance and a corresponding working model.

Dierickx and Cool *(1989)* note important consequences of resource accumulation. The function in equation 3 will frequently cause time compression diseconomies that limit a resource's growth rate, and asset mass efficiencies are captured by equations 2 and 3. Resource interconnectedness is explicit in equation 3. Erosion of a resource is a negative rate of change in equation 2, arising if effort or expenditure is insufficient to sustain the level of that resource—physical assets degrade and staff skills become obsolete, for example.

The GUT also clarifies the location of the mechanisms that give rise to the causal ambiguity noted by Dierickx and Cool. Such ambiguity obfuscates the relationship between the strategic management of a business, the interaction with its market environment, and the resulting performance outcomes. There is no causal ambiguity in the relationship between tangible resources and performance—equation 1 is simply arithmetical when it concerns financial performance, and is readily confirmed in the case of other performance indicators. Equation 2 expresses a mathematical identity, so provided that it is addressed with the correct tools (integral calculus), it too exhibits no causal ambiguity whatever.

Equation 3, therefore, is the element of the GUT where causal ambiguity resides. The possibility that thresholds may arise in the function defining any resource's rate of accumulation or depletion has already been noted. The resulting non-linear relationship between any change to elements on the right of equation 3 and the flow-rate they determine will certainly hamper any effort to discover that causal relationship. In addition, resource gains and losses other than direct management decisions often reflect choices made by others, notably customers and staff. The uncertainty in these behavioural responses clouds any explanation for rates of resource gains and losses, even for the firm itself, let alone for competitors or external analysts and researchers. This challenge is exacerbated by the fact that the resources on the right-hand side of equation 3 include intangible factors.

Extensive efforts have been made to clarify intangible resources and their impact in the RBV of strategy *(Wernerfelt, 1984; Barney, 1991; Mahoney and Pandian, 1992; Amit and Schoemaker, 1993; Peteraf, 1993; Collis and Montgomery, 1995)*. However, it has proved hard to do this in a manner that makes these items tractable in practice. To understand the impact of intangible factors requires *both* that those factors be properly specified and measured *and* that their causal influence on the flow-rates of tangible resources in the business system be defined. Reputation, for example, undoubtedly influences the rate at which many firms win customers. But not only is that influence rarely precisely known, so too are the reasons why that reputation level itself rises or falls.

Intangibles, too, conform to equations 2 and 3, and typically fall into one of three categories.Reputation is one example of a *state-of-mind factor*; others include customer annoyance, staff skills and motivation. Organisations increasingly measure and monitor such items, knowing them to be important, but need means by which to better manage both the intangibles themselves and their impact on the business system and performance. Besides state-of-mind factors, other intangible asset-stocks include certain *quality factors*, such as the reliability of equipment or systems, and *information-based factors*, ranging from the simple customer-information used to ensure good service to specialist technologies and the sophisticated knowledge-bases employed by professional-service firms.

Capabilities are a further source of causal ambiguity, but differ from resources, since they represent the ability of a firm to undertake strategically important activities, notably the building and retention of resources *(Collis, 1994; Dosi, Nelson and Winter, 2000; Dutta, Narasimhan and Rajiv, 2005; Chmielewski and Paladino, 2007; Hoopes and Madsen, 2008)*. Such strategic capabilities are themselves distinct from *dynamic* capabilities, which refer to the ability of an organization to change its strategy *(Teece, Pisano and Shuen, 1997; Winter, 2003)*.

Like intangible resources, however, it has proved hard to specify both capabilities and their influence mechanisms in a tractable form. This purpose is assisted by conforming to terminology consistent with common language usage. Since a capability is about how well something is *done*, it is expressed in grammatical terms as a verb's present participle—market*ing*, hir*ing*, serv*ing* customers, develop*ing* products—or the noun describing these processes, such as recruit*ment* or product develop*ment*.

In order to incorporate capabilities in the GUT, the questions to be addressed are (1) in what way do they affect the accumulation and retention of the tangible resources that drive performance (2) what measurements indicate the scale of that influence and (3) what exactly constitutes each capability itself? Since previous reasoning has shown that the flow-rates building and sustaining levels of tangible resources are critical determinants of how performance changes over time, the clearest benefit that a capability offers it to enable faster accumulation and/or slower depletion of some resource. In addition, a strong capability would enable those flows to occur at lower cost, and ensure that resources built and retained were of high quality *(high-value customers, skilled staff, appealing products and efficient and reliable capacity)*. Measurements of such a capability should therefore include indicators for each of these three features.

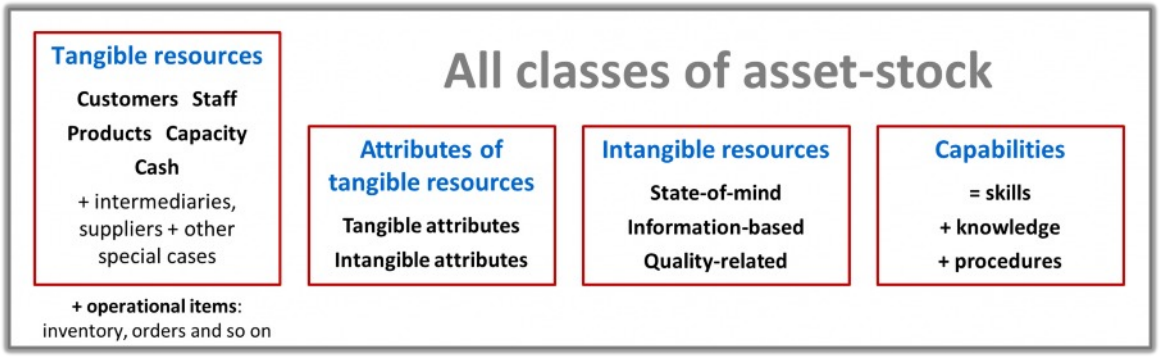
An organisation's capability, specified in this way, clearly depends on the scale of tangible resources required; more sales people enable customers to be won faster and lost more slowly, and more product development staff and equipment enable more and better products to be developed more quickly. This element of capabilities is already captured by equations 2 and 3. However each capability is enhanced by the skills of the relevant staff-groups, the data and other information available to them *(an intangible resource)*, and the processes and procedures by which that information is deployed *(a further intangible resource)*. A capability is therefore a composite asset-stock, reflecting the numbers of relevant people, together with their skills, available information and processes. In combination, these enable the resource-building activity to be done "well", as measured by the speed, cost and quality with which it is accomplished. Learning is also readily specified, as the rate at which any capability itself increases over time, driven by the experience that comes from having repeated the activity many times.

Specified in this way, organizational capabilities and their impact on firm performance are readily observable, measurable and manageable. Ryanair, for example, opens new routes more quickly, at lower cost, and with greater impact on customer numbers than its rivals, and it can do so because it has more experience, built over many years, from undertaking that task many times. The same capability-enhancing learning applies to major strategic moves. General Electric, for example, acquires and integrates large numbers of companies quickly and effectively because it has done so many times. The development of both types of capability can be substantially enhanced by deliberate practice, codification and deployment of effective procedures, as has been the case for both of these examples. This

deliberate formulation of effective procedures also lies at the heart of "*The Toyota Way*" which has made that company so strong in its industry.

Combining the arguments above with the specification of tangible resources earlier in this paper leads to the taxonomy of asset-stocks offered in figure 9, including for completeness operational asset-stocks that are not usually of strategic importance *(Warren, 2008; chapters 9 and 10)*.

Figure 9: A taxonomy of resources (tangible and intangible) and capabilities.



Feedback, and the business system

The fact that equation 3 includes the current quantity of the same resource whose rate of change is to be explained gives rise to feedback processes that add to the sources of causal ambiguity already identified (thresholds, the behaviours of system participants, intangible factors and capabilities). Feedback may take two forms *(Forrester, 1961, 1968; Sterman, 2000)*.

In *reinforcing* feedback, the current quantity of a resource determines either an in-flow to, or out-flow from its own stock, resulting in a change to its quantity in the next period that has the same effect once again. If this occurs with the in-flow to a resource, it produces what is colloquially known as a virtuous circle. An initial customer-base may win *new* customers through word-of-mouth, for example, so that the next period starts with more customers who drive a still greater win-rate in the next period. Such mechanisms need not rely on explicit recommendation, but simply reflect individuals' tendency to follow role-models. Even then, the resulting explosion of growth can be spectacular, as in cases such as Facebook.

Reinforcing feedback can also drive decline, when an asset-stock's current quantity causes its own loss in what is known as a vicious cycle. For example, a staff group suffering over-load may lose individuals, leading to still greater pressure on those who remain and causing still greater losses in the next period.

The second form of feedback is *balancing* feedback, in which a flow-rate gives rise to a change to its associated resource that then slows that flow-rate in the next period. Such feedback damps any tendency of the resource and the system of which it is a part to grow or decline, and commonly arises due to limited quantities of the resource itself or other stocks. External factors causing balancing feedback include the limited quantities of potential customers or staff noted previously, and internal factors include inadequate staffing or physical capacity. A resource may also limit its own decline. Customer or staff losses may slow, for example, simply because fewer customers or staff remain to be lost.

Each form of feedback may arise both from direct causal dependency of a flow-rate on its own related stock-quantity, and indirectly through changes to other stocks. If more consumers purchase a product, for example, more stores may stock it (accumulation of a second resource), causing still more consumers to start purchasing it. Whether feedback arises directly or indirectly, however, the functions required to describe it are already captured by equations 1 to 3, so the GUT requires no additional functionality in order to explain the performance consequences arising from such feedback.

The system-behavior arising from feedback mechanisms, whether alone or in combination, are well known *(Senge, 1990)*. These include exponential growth, limits to growth, and S-shaped growth when reinforcing and balancing feedback combine. The impact of delays that arise when slow or multi-stage development of stocks exist in the feedback loops can lead to boom-and-bust and cyclicality.

Competition

Adding intangible factors and capabilities as defined above, together with their behavior and impact, to the system of tangible resources previously developed completes the GUT for a single enterprise. Competitors, too, operate business systems that are subject to exactly the same mechanisms specified by equations 1 to 3. Competitive interactions and relative performance can therefore be captured in a highly explicit manner, by confronting our own firm's resource-system with the corresponding systems of competitors and the potential factors in the markets where they compete *(notably potential customers and staff)*. Implementing these mechanisms gives rise to three characteristic rivalry mechanisms that may operate alone or in combination, depending on the nature and stage of development of the relevant market.

Type-1 competition occurs in its pure form with entirely new product or service propositions, where no actual customers are yet purchasing, so only *potential* customers exist. The functionality, price and marketing of any firm therefore competes against others by seeking to win customers from that potential population at a faster rate than do those of competitors. This mechanism is clearly observable, for example, on every occasion when a new generation of cell-phone technology is introduced—existing users of the old technology (plus any remaining non-users) form the potential pool from which the new-generation rivals race to build a subscriber base. That potential pool may itself be added to by the collective actions of competitors, through the enhancement of the products and services offered, falling prices, and marketing spill-over that grows customer demand for the product/service *category*, not just for the specific item being marketed.

Type-2 competition occurs in its pure form only where all potential customers already exist—a fully saturated market—so any competitor can only grow its customer base if its functionality, price and marketing can steal existing customers away from competitors. Competition amongst cell-phone operators with established technology comes close to this extreme case. However, in this and virtually all other cases, some residual element of Type-1 rivalry continues, if only to capture new potential customers who arise due to demographic changes, or new-business formation in business-to-business cases.

Both Type-1 and Type-2 rivalry occur in their pure forms only in cases where customers must be exclusive to a single provider. This is generally the case for cell-phone services, but

is also common in other contract-based sectors, such as mortgages, insurance and utilities. It is also common in business-to-business markets, such as the supply of IT-services. Where disloyal behavior by customers is feasible—buying routinely from more than one provider, such as for consumer packaged goods—Type-3 rivalry is observed, in which any supplier's product/service functionality, price and marketing seek to capture a larger share of those purchase decisions.

Competition in every circumstance can be captured by one or more of these three types of competition, enabling a full explanation for the relative performance of as many competitors as may be involved. New entry is simply the arrival of an additional firm's resource-system, initially populated with no active customers or revenue, but seeking to grow that population by one or more of the mechanisms above. Firm failure and exit is simply the cessation of one rival's operations, at which point its products, staff, capacity and customers may be absorbed by remaining rivals. These phenomena, together with the changing functionality and price of rival products and services explain the dynamics of entire industry sectors, a phenomenon that has proved difficult to explain in more than descriptive terms *(McGahan, 2004).* None of these extended applications of the GUT, however, require any addition to the core principles captured in equations 1 to 3.

Fulfilling the requirements for a GUT

Only a limited review of strategy principles and methods is possible here. Links with RBV have already been noted. The cost and margin make-up of strategy's value chain analysis *(Porter, 1985)* is identifiable through eq. 1, to any level of detail required. Value-curve factors *(Kim and Mauborgne; 1999, 2004)* drive customer transaction rates in eq. 1, as well as customer win and loss rates in eq. 3—variables for which other strategy tools and frameworks may be used. The experience curve, in which unit costs fall by some fraction as cumulative output rises, is precisely expressed with the three equations (Boston Consulting Group, 1972; Hax and Majluf, 1982). Organizational procedures constitute a resource, so eq. 3 applies.

The GUT assists choice of strategic position by identifying stocks of potential customers, feasible development of products that could be attractive to them, and the feasibility of building other supply-side resources of sufficient scale and quality to capture those customers and thus grow revenues and cash flows. It also informs continuous choices from period to period on all significant decisions, and in response to changing competitive and other exogenous conditions. It offers more rigour for steering strategy than is typical in balanced scorecards *(Kaplan and Norton, 1996 and 2004)*, and goes beyond such scorecards by including competitive and other exogenous factors.

Since all significant interdependencies are captured, the GUT handles multiple objectives, and trade-offs between them. Properly applied, eqs. 1 and 3 gain support from evidence, rather than from abstract and ambiguous terminology, or proxies. Adequate explanations for historic performance, and estimates of future performance can be obtained from factors, concepts and measures that are practical for executives to identify and measure.

Industry structure is itself affected by its participants *(Porter, 1980; McGahan, 2004).* Each firm, new entrant and substitute runs its own set of eqs. 1-3, with dynamic impacts on industry growth and levels of price and profitability. Pricing and capacity-building affect the rate at which new potential customers develop, make new entry by others unfeasible, and slow

customer losses to substitutes. An industry's entire dynamics are captured by a stock of firms, the arrival of new entrants, and loss of exiting firms *(Christensen, 1997)*. In strategic groups *(McGee and Thomas, 1986)*, firms in each group operate near-identical architectures that differ from those operated by firms in other groups, whether in scale, segmentation or featured resources.

Eqs. 1-3, being highly generic, capture principles of other disciplines and business functions. Eq.1 follows basic finance and accounting concepts, and eq. 2 is the link between balance sheet and cash flow statements, where cash is the resource. Resources commonly move through stages—junior staff are promoted to senior levels, customers become aware, then informed, then start to buy, and so on. The equations describe such development chains, so can handle marketing's various customer development models (*Palda, 1966; Bass, 1969; Kotler and Keller, 2006)*, product development *(Ulrich and Eppinger, 2007)* new product adoption *(Utterback, 1996; Christensen, 1997; Rogers, 2005), human resource strategy (Gratton, Hope, Stiles and Truss, 1999),* and the sustaining of physical assets and knowledge *(Spender and Grant, 1996; Alavi and Leidner, 2001; Jardine and Tsang, 2006).*

These considerations make the GUT as applicable to departments and functions, as it is to whole organizations. For multi-business corporations, eqs. 1-3 can be replicated for each business unit, and for each division serving distinct geographic or other market segments. Resources and capabilities developed collectively by, and for the benefit of several units, such as shared sales forces or IT services, simply appear repeatedly in the architectures of each unit. This makes explicit the concept of 'relatedness' in corporate strategy *(Porter, 1985; Grant, 1988; Bowman and Helfat 2001)*, and assists decisions on diversification, acquisition, alliances and other corporate strategy choices. The same principles allow portrayal of vertical relationships between firms, and other forms of business network.

The elements and concepts in eqs. 1-3 are applicable with little modification to public services, voluntary and other non-profit cases. Such organizations pursue objectives over time, serve identifiable constituencies with identifiable products or services, and develop capacity, people and other supply-side resources for this purpose. The GUT is as applicable, then, to non-commercial organizations as it is to profit-oriented firms in competitive commercial markets—a purpose not currently well-served.

The GUT's equations have no meaning in the absence of time passing, so are inherently suited to the *continuous* management of strategy from period to period, responding to constantly changing circumstances—true 'strategy dynamics'. They can incorporate a wide range of theories, concepts, and principles from strategy and other disciplines, and thus offer the basis for a rigorous, integrated and cumulative body of knowledge.

Conclusions

Taken together, implementing equations 1-3 creates what can be termed a "*strategic architecture*" of an organization's operating system, displaying all significant components, relationships and outcomes, to any level of detail required for confidence in the findings. That procedure brings the same rigour to the management of customers, staff and other resources that is taken as normal in other disciplines. The relationship between a stock and its flows is identical to that between a company's financial values reported on its Balance Sheet and the changes in those values laid out in its Cash Flow Statement. This is also how

production and supply-chain operations are understood and managed. The method also extends that rigour to the interdependent relationships within the entire enterprise, and beyond, resulting in a true, working business model *(Osterwalder and Pigneur, 2010)*. Like any worthwhile theory, the GUT is amenable to falsification—the seeking of any case where it fails.

The equations' relevance is not limited by the location of firm boundaries—distribution facilities, IT services or staff-recruitment, for example, are equally represented, whether owned and operated by the firm, or bought from third parties. Indeed, the GUT can help identify preferable choices on such issues.

The design and management of feedback mechanisms in physical systems is already well understood and addressed by engineering control theory. For a production system to produce goods efficiently and reliably, it must be engineered so as to make that performance possible and then controlled with information feedback systems to ensure its continual effective operation. A for-profit business is also a "designed system", whose desired output is rising cash-flow, so it too can be (and often is) engineered to be capable of strong performance and controlled with information feedback systems. The same core principles of engineering control theory can therefore be applied *(Forrester, 1961, 1968; Sterman, 2000)*. Furthermore, since public-service and other non-profit organisations are *also* designed systems intended to generate some output *(albeit other than growing cash-flow)*, those too can be engineered and controlled using the same principles.

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