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Capturing Synergy in the Growing Multi-Business Firm

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Abstract

A feedback simulation model is presented which operationalizes a dynamic theory linking managerial policies to under performance of a related diversified firm. Simulation experiments demonstrate how boundedly rational managerial policies for resource sharing unintentionally undermine the gains in performance, even when the economies of scope benefits are considerable. Overstretching shared resources results in rising coordination costs, specifically opportunity costs of lost sales, which decrease sales across the combined businesses. Unless the implementation of resource sharing is managed properly, these coordination costs may undermine the economies of scope benefits for a related diversification move. Allocation of shared resources between business activities or business units is a crucial corporate policy, and is an important behavioral element in the model. The growth and underinvestment and eroding goals generic structures, which have been highlighted in numerous single business models, are also prominent components of the multi-business model discussed in this paper.

Key words: Corporate growth, Resource Sharing, Coordination costs, Diversification

§1. Introduction

There are persuasive economic arguments to suggest that leveraging or sharing existing firm resources across functional areas or business units may result in improved performance through capturing synergy between these activities. However, the task of extracting the potential synergy of resource sharing from a related portfolio of business activities has proven very difficult. As evidence, the empirical results are mixed regarding profitability differences between related diversification versus unrelated or single business strategies (Amit and Livnat, 1988; Christensen and Montgomery, 1981; Grant et al, 1988; Hill, 1983; Hill et al, 1992; Montgomery, 1985; Palepu, 1985; Park, 1997). This paper investigates the implementation of resource sharing within a firm by formalizing a mathematical simulation model of resource sharing. The model explores the crucial role of managerial policies in determining the success or failure of resource sharing in a related diversification move in which there are obvious potential economies of scope.

The feedback simulation model was developed by: (a) drawing on previous empirical and theoretical research and (b) grounding the work in a detailed, model supported multi-business case study. The findings indicate that diversification can lead to overstretching shared resources in a related firm, which elicits locally rational organizational responses. This local rationality results in escalating, and often times invisible, resource sharing co-ordination costs which may well undermine any relatedness, synergy benefits. The next section reviews the theoretical background for the simulation model. Section 3 discusses the in-depth field work with Smith & Nephew Plc, and Section 4 presents the formal simulation model. Section 5 discusses the simulation experiment results, and Section 6 provides a summary and concluding remarks reviewing the contribution of this research.

§2. Theoretical Background

Sharing a resource across multiple product portfolios, business activities or SBU', enables either an increase in utilization of the resource, leading to economies of scope (Milgrom and Roberts, 1990); or an increase in organizational learning through competence transfer (Markides and Williamson, 1994 and 1996; Prahalad and Hamel, 1990). However, firm growth through related diversification also increases internal organizational complexity along numerous dimensions resulting in administrative diseconomies. Increases in task uncertainty, environmental uncertainty, in mediating technology employed and in the degree of customer

contact leads to an escalation in the expected value of allocation errors and poor investment decisions (Sutherland, 1980). Constraints on the bounds of rationality suggest that as organizational complexity increases, costs of co-ordination and control may grow at a faster rate than aggregate real output. This suggests that managerial decision making and implementation play an important role in rising co-ordination costs, and that understanding the coordination problem (Milgrom and Roberts, 1990) is key for understanding the impact of resource sharing within the firm.

The importance of process issues surrounding the implementation of resource sharing between related business units within a firm have yet to be fully understood, but we know that strategy implementation has a major impact on the firm's ability to achieve synergy and therefore is likely to have a significant effect on the relationship between diversification and performance. Fundamentally, we need to understand more about how diversified firms are managed to reach performance objectives. There have been several previous studies which discussed the importance of management's role in the performance of diversified firms (Hill and Hoskisson, 1987; Hill et al., 1992; Markides and Williamson, 1996; Morecroft, 1999; Pitts, 1976 and 1977). This paper builds on and extends this previous body of work by focusing on the role of more micro-level managerial policies in coordinating resource sharing in the related diversified firm, and the next section discusses the extensive field investigation of resource sharing, at the operational level, within a related multi-business firm.

§3. In-depth Field Work

A detailed case study was undertaken with Smith & Nephew Plc (S&N), a global company that develops, manufactures and sells medical devices and products for the repair of tissue in the area of bones, joints, skin, and soft tissue. The Company has business activities aligned with each of these tissue areas in endoscopy, orthopedics, wound management, casting support and consumer healthcare. For the year ending 1999, the Company reported sales of over £1 billion and profits before tax of £182.1 million based on operations in 36 countries. Table 1 summarizes the Company's portfolio of businesses in terms of sales, percent of sales, and growth.

Insert Table 1 about here

The Wound Management Global Business Unit (GBU) has been identified as one of the growth sectors for S&N and management is therefore driving sales and profits of its existing brands and looking for opportunities to introduce innovative new products. The value of the advanced wound management market, world wide, is over £1.1 billion, and is growing at 5% per year. In 1998, S&N was ranked number two in the world in wound management, with a 17% market share. Growth in the wound management market is driven by an aging population and by a steady trade up to high technology, higher margin products that are more clinically efficient and cost effective than their conventional counterparts. These actives wound management products are medical devices incorporating a medicinal substance with ancillary wound healing action. Examples of such devices are wound dressings, surgical or barrier drapes, with an antimicrobial agent. The Company believes that the future of the wound management market lies in these advanced and active products, with their ability to accelerate healing rates, reduce hospital stay times and cut the cost of nursing time and aftercare in the home.

At the end of 1997, S&N decided to make a related product diversification move into actives wound management products. The in-depth case study focused on this related diversification to understand the performance implications this move has had on the Wound Management GBU. A series of semi-structured interviews within the Company and weekly working sessions with a member of the management team over period of several months focused on identifying shared resources across diversified business activities and the associated managerial policies responsible for coordinating resource sharing at the operational level. Until this point, S&N did not have any active products in their wound management portfolio, and the diversification was intended to secure a foothold in the emerging actives product market which S&N believed would be a fast growth sector. The gradual shift into actives products was expected to help increase sales growth to high single digits and enhance margins through technology upgrade.

The diversification move took the form of a small acquisition consisting of an actives product portfolio. Historically, the acquisition target had shown sporadic performance with poor overall growth and profitability. In fact, the business had been loss making since its inception in the late 1980's. However, the business had some very interesting actives wound care products which S&N were interested in acquiring. S&N acquired the brand assets for the actives products, but without the buildings or personnel, and believed the history of losses were principally due to excessive infrastructure developed ahead of sales. S&N management believed that the actives portfolio would form a useful addition to their conventional Wound Management portfolio with only minor degree of overlap and cannibalization, and only modest additional expenses.

The primary synergy benefits were expected from extending sales of the actives portfolio into all S&N territories through the Company's existing Sales and Marketing network. S&N would immediately be able to sell the new actives portfolio into the UK, South Africa, Australia, New Zealand, France and Sweden, thereby capturing additional selling margin in most of the Company's principal territories of interest. Subject to regulatory constraints and existing distribution agreements, S&N expected gradual capture of other markets over the next two to three years. All distribution agreements were to be terminated as soon as possible and the actives portfolio sold through S&N's direct sales force in each country. Manufacture of the actives portfolio was to remain with the original manufacturer or another qualified contract manufacturer, since the actives portfolio required a complex polymer manufacturing process that S&N did not have the capability or necessary regulatory approvals to take over. S&N's five year global performance projection summary for the actives portfolio is given in Table 2. This data and all subsequent numerical case data are disguised, using a consistent transformation, to prevent revealing sensitive information about the Company. The data for 1997 is pre-acquisition financials, followed by S&N's projections for 1998-2002. Projections in this and all subsequent tables were obtained from S&N's final acquisition plan, but does not include revised forecasts post acquisition.

Insert Table 2 about here

As indicated in Table 2, in 1997 the actives business reported a loss for the year. S&N expected to grow sales in the actives portfolio, as discussed above, by extending sales to other geographic markets and by growing sales more quickly in established markets through the Company's considerable Sales and Marketing network. S&N also expected substantial synergy in Operating Expenses to result in immediate positive profitability with rising margins over the five year period. Given these projections, S&N expected the actives portfolio to payback the acquisition cost in five years as shown in Table 3.

Insert Table 3 about here

Leveraging S&N's existing Sales and Marketing global network to increase actives portfolio sales is a straight-forward expected synergy benefit of the related diversification move. However, to understand the exact nature of the expected cost savings synergy in more detail, Table 4 provides a breakdown of the global projected operating expenses for the actives portfolio. Again, the 1997 column represents the pre-acquisition performance, followed by S&N's projections for 1998-2002.

Insert Table 4 about here

Pre-acquisition Sales expenses, in 1997, include A&P expenses; and the R&D expenses also include Regulatory/Clinical expenses. S&N only purchased the brand assets, and fully expected to leverage existing Wound Management GBU resources in absorbing the related actives portfolio. The acquired business had an existing sales force, R&D group, Regulatory/Clinical group, and head office that would be stripped out of the operating expenses altogether. As indicated in Table 4, there was substantial expected savings in Sales expenses under the assumption that S&N's existing direct sales force and associated marketing network would absorb the actives product portfolio. R&D expenses were also expected to decrease under the assumption that S&N's existing R&D infrastructure would take on responsibility for new and follow-on product development for the actives portfolio, and that

S&N's existing Regulatory Affairs and Clinical Research groups would absorb the new actives portfolio. SG&A was also expected to decrease under the assumption that S&N's Wound Management GBU head office would take on the management and administration for the actives portfolio. Lastly, depreciation expenses were certainly going to disappear since all manufacturing was to be handled either by the original manufacturer or another contract manufacturer. Outsourcing the manufacture of the actives portfolio was expected to initially result in lower gross margins compared with pre-acquisition figures. However, gross margins were expected to improve over the five year period as increasing projected sales would result in spreading out the manufacturing fixed cost base over more units.

The acquisition plan did assume some minor additional resources in these areas would be required to fully resource the actives portfolio without having an adverse effect on the conventional portfolio. These planned additional resources are listed in Table 5, but there was a dramatic increase in cost pressure within Wound Management just after the diversification move into the actives portfolio which limited expansion of resources considerably.

Insert Table 5 about here

In the first 12 months after the diversification move, actives portfolio global sales were in line with S&N projections. However, the second year after the diversification into actives, for the year ending 1999, global sales fell below the projected level as shown in Figure 1. This time chart compares Smith & Nephew's projected or expected sales taken from the initial acquisition plan to the actual sales for the first two years after the diversification move.

Insert Figure 1 about here

During this same period global Operating Profit for the actives portfolio displays a similar pattern. Operating Profit also started with a first year post-acquisition boom, exceeding projected profit by 53% and resulting in an astounding turn-around for the previously loss-

making actives portfolio. However, in the second year of operations, by the end of 1999, actives portfolio Operating Profit decreased significantly from the 1998 value and also failed to meet the projected profit level, as shown in Figure 2.

Insert Figure 2 about here

In 1998, profit margin reached 34%, but had fallen to 16% by the end of 1999 which was well below S&N's expected profitability for the actives portfolio. Interviews with numerous managers, who themselves played important roles in the diversification into actives over the first two years after the move, suggested several possible reasons for the boom and bust in sales and operating profit results. Overall, the primary reasons cited were regulatory approval delays, distribution agreement termination delays, and inadequate sales force resources. This data was used to develop and calibrate a system dynamics simulation model which operationalized sales force sharing between the core and new businesses. A very narrow focus was deliberately chosen to understand the implementation of sharing just one resource in one sales territory. The objective was to test the fundamental proposition, suggested by previous model supported field work, that resource sharing co-ordination costs may undermine the synergy benefits of the related diversification move into the actives portfolio.

To implement this focused approach, we decided to explore sales force sharing between actives and conventional product portfolios in just one sales territory and ignore other geographic areas. The sales territory chosen was one in which the acquired specialist wound care business already had an established sales history to use as a benchmark performance metric, and a territory in which there were no regulatory approvals required or any distribution contracts to terminate. The sales territory will be referred to as Atlantis, and the disguised historical actives sales are provided in Figure 3. Profitability for the first two years after the diversification move is also provided in Table 6. Figure 3 and Table 6 indicate that the actives portfolio, within the Atlantis sales territory, experienced the same boom and bust in sales and profitability that was previously discussed for the global actives portfolio.

Insert Figure 3 about here

Insert Table 6 about here

In addition, there is some evidence that the conventional portfolio in the Atlantis selling territory also did not perform up to expectations during this same time period. Figure 4 displays actual versus projected conventional sales, and indicates that after the diversification move conventional sales fell well below 1998 projected sales after having met or exceeded expectations the previous several years. Figure 5 provides actual operating profit for this same period.

Insert Figure 4 about here

Insert Figure 5 about here

The next section discusses the system dynamics model developed to explore the impact of sharing S&N's sales force between the existing conventional wound management product portfolio and the newly acquired actives portfolio in the Atlantis territory.

§4. Sales Force Sharing Simulation Model

The simulation model operationalizes a theory explaining why the related diversification move into the actives portfolio has not resulted in S&N's expected resource sharing synergy in the Atlantis sales territory. To the extent possible, the model replicates the two years of actual historical data for the Atlantis sales territory after the related diversification. However, numerous operating details have been omitted that would be required for an exhaustive dynamic analysis of the Wound Management GBU. For example, product prices are assumed to remain constant during the time horizon explored, an assumption that is mostly justified given that prices are indeed almost fixed once on the medical reimbursement list. The wound management supply chain has also been omitted in the model under the assumption that all products have been available. Also, within portfolio cross product cannibalization has not been explicitly represented through any estimated cannibalization rates. However, changes in product sales could certainly occur through cannibalization in the model.

A series of interviews indicated that the sales force was seen as an important resource that could be leveraged to drive value out of the actives portfolio, and the model was developed to see if the managerial policies of sales force expansion and allocation were coordinated across the combined wound management portfolio to achieve management's objectives. The time horizon explored is 60 months (September 1997 – September 2001), with the acquisition occurring in December 1997. This time horizon was chosen to cover the period just prior to the related diversification move to establish a performance benchmark, plus an additional 4-5 years to observe the resulting performance of the coupled wound management portfolio.

At the heart of the model is a stock of shared sales force representatives which increases or decreases over time depending upon the hiring and leaving rates. The sales force is divided into Novice and Experienced Representatives. New hires are considered novices and are only 50% as productive as experienced representatives, and it takes an average of six months for a novice to develop into a fully productive experienced sales representative. Experienced Representatives depart the company at an annual turnover fraction of 12%. The existing Atlantis sales network has historically sold conventional portfolio products to district nurses and doctors in their sales territory, and the cost structure for this established sales network includes fixed and variable components. To the extent that the existing sales network can be leveraged to sell the new actives products, resource utilization increases and the firm captures

economies of scope benefits which improve financial performance. This is the ideal scenario for the Wound Management division as it embarks on the related diversification strategy into the actives portfolio and fully captures the potential synergy benefits.

However, there are also potential costs of sharing resources unless management co-ordinates resource expansion and allocation across both product portfolios perfectly. The partial model diagram in Figure 6 focuses on these potential co-ordination costs for sales force sharing within S&N Wound Management. As the total number of products increases with the diversification into actives, the firm may hire additional sales force representatives in order to maintain adequate sales details across all products. This is a negative or balancing feedback loop, labeled B1, in which management attempts to expand the shared stock of sales force representatives to meet increasing product demands.

Insert Figure 6 about here

In fact, the diversification plan indicated the Atlantis sales force would be increased by five extra salespeople and one sales manager in order to maintain adequate resourcing on existing brands. However, cost pressure constraints imposed soon after the diversification move froze all planned sales force expansion hiring. Given the hiring and training delays and cost pressure constraints to expand the stock of sales force representatives, as the firm absorbs the actives portfolio the number of total products increases and results in overstretching the sales force. With more total products to sell, the average number of sales details per product decreases which results in lower product Sales Effectiveness. This intangible erodes for some products as sales representatives are forced to choose which of the 2-3 products they will inform the district nurse or doctor about on each customer sales call. Each sales call results in, on average, 2.5 product details where the sales representative describes the benefits of a specific S&N product to ensure the nurse or doctor is aware of the product and then attempts to persuade them to prescribe or use the product for their wound care patients.

As Sales Effectiveness falls over time, this leads to rising opportunity costs of lost sales for those products which receive fewer details. The impact of low sales effectiveness takes

several months to affect product sales, as there is some inertia built into customers buying habits. Therefore, the rising opportunity cost of lost sales remain invisible to the firm for some time while sales effectiveness erodes. Meanwhile, there are behavioral and cognitive processes at work within the organization which ensure the underlying sales force adequacy problems remain hidden. As the number of product details decreases for each product portfolio, the operating details goal for each portfolio also declines as per an anchor and adjustment goal setting process (Tversky & Kahneman, 1974). The operating details goal is a blend of management's fixed details goal and the traditional product details for each portfolio. With the traditional portfolio details anchor adjusting downwards, a positive reinforcing feedback process is activated, P1 as shown in Figure 6, which reduces the desired sales force such that the signal to hire additional sales representatives remains very weak. This process has been documented in both the insurance (Oliva, 1996; Senge and Sterman, 1992) and banking sectors (Oliva, 1996) for single business service quality erosion.

These feedback loops demonstrate how sales force sharing in S&N's Wound Management GBU resulted in overstretching the sales force to undermine the significant and real economies of scope gains in performance. The next section formalizes the model and explains the key equations in detail.

4.1 Sales Force Sharing Model Formalization

The stock of shared sales force representatives is a two stage stock and flow chain composed of novice sales representatives and experienced sales representatives. Resource relatedness is operationalized through cost savings achieved by spreading the Fixed Sales Network Costs (f) over both conventional and actives product portfolios. There is an assumption that leveraging the sales force into the actives business will not require any additional fixed sales network infrastructure cost investments, thereby guaranteeing economies of scope cost savings for the diversification move. Sales Expenses (e) are composed of variable sales force Salary expenses (w) multiplied by the sum of Experienced Sales Force representatives (R) and the Novice Sales Force (N), and then added to the Fixed Sales Network Costs (f) as indicated in Equation 1. All time subscripts have been omitted for clarity.

$$e = f + (R + N)w \qquad (1)$$

In addition to economies of scope, there are also potential economies of scale benefits operationalized for each product portfolio. Cost of Goods Sold for Conventional and Actives portfolios (c_n), as shown in Equation 2, consists of variable production costs (v_n) multiplied by portfolio sales (s_n), and added to the fixed manufacturing costs (m_n). As sales increase, the firm benefits from economies of scale by spreading out the fixed manufacturing costs over more units. It should also be obvious that if total sales decrease, there are diseconomies of scale and scope since the fixed costs remain unchanged over the course of the simulation.

$$c_n = m_n + (s_n \times v_n) \qquad (2)$$

There are also numerous behavioral components within the Sales Force Sharing model. The underlying assumption is one of bounded rationality (Cyert and March, 1963; Morecroft, 1983 and 1985; Simon, 1982; Sterman, 1985a and 1987), where managers exercise control through heuristics which are locally rational. The following managerial policies are captured explicitly in the model: sales force hiring, sales effort allocation, product portfolio details goal, and sales pressure.

As shown in Equation 3, the Sales Force Hiring Rate (h) is equal to the Sales Force Gap (g) plus an adjustment for the difference between the desired Novice Sales Force (N^*) and the actual Novice Sales Force (N), plus replacement of any leaving experienced sales force (l). The first two terms are divided by the Sales Hiring Delay (τ_h). Sales Force Gap (g), as shown in Equation 4, represents an adjustment for the difference between Desired Net Sales Capacity (K^*) and actual Net Sales Capacity (K), multiplied by a Cost Pressure parameter (χ) which represents management's bias for expansion hiring. As shown in Equation 5, Net Sales Capacity (K) is composed of three components: Experienced Sales Force representatives (R), plus Novice Sales Force (N) multiplied by the fraction of Novice Productivity (ϕ) relative to experienced sales representatives, minus Novice Sales Force (N) multiplied by the required training ratio (ρ) of experienced sales representatives to train novices. Desired Novice Sales Force (N^*) is equal to the Departure or leaving Rate (l) multiplied by the Training Delay (τ_t), as shown in Equation 6. These formulations are supported by the stock management investment decision rule identified and empirically tested through behavioral experiments in

previous studies (Diehl & Sterman, 1995; Sterman 1987, 1989a, 1989b). The multipliers α_1 and α_2 are parameters which define how aggressively management invests to close the gaps between desired and actual sales force levels. These two parameters have been set equal to one in this model, but can take on values between 0 and 1 in general. Evidence from behavioral experiments suggests α_2 is typically less than 1, but for simplicity we will assume α_2 is equal to 1 for the remainder of this discussion.

$$h = \frac{(g + \alpha_2(N^* - N))}{\tau_h} + l \tag{3}$$

$$g = \alpha_1(K^* - K) \times \chi \qquad \alpha_1, \alpha_2 \geq 0 \tag{4}$$

$$K = R + (N \times \phi) - (N \times \rho) \tag{5}$$

$$N^* = l \times \tau_t \tag{6}$$

Desired Net Sales Capacity (K^*) is defined as a weighted average formulation of two managerial components: the desired number of sales representatives given a constant customer base of district nurses and doctors (β) and a standard ratio of customers per sales force representatives (σ), and the Details based Desired Net Sales Force (F^*), as shown in Equation 7. The weighting parameter (ψ) represents management's propensity to rely on the customers per sales representative component; as ψ approaches 1, K^* is determined primarily from customers per sales representative. Details based Desired Net Sales Force (F^*), as shown in Equation 8, is equal to the sum of the Operating Desired Details Goal (d_n^*), across all product portfolios N, divided by the Average Details per sales force Representative per month (δ). Productivity improvements in terms of increasing the average number of details per experienced sales force representative per month have been omitted from the model. There is a minimum required travel time for a sales representative to visit each customer for a sales call, and this travel time cannot be significantly compressed. In addition, each sales call lasts a finite number of minutes and within this time only 2.5 product details on average can be covered by the sales representative, and this also cannot be significantly improved.

$$K^* = \frac{\beta}{\sigma} \times \psi + F^* \times (1 - \psi) \tag{7}$$

$$F^* = \frac{\sum_N d_n^*}{\delta} \quad (8)$$

The Operating Desired Details Goal for each product portfolio (d_n^*), as shown in Equation 9, is a weighted average formulation of Management's fixed Details Target goal for each product portfolio (ξ_n) and the Traditional Details for each product portfolio (T_n) based on historical values of actual product details for each portfolio. The weighting parameter (γ) represents management's goal pliancy; as pliancy approaches 1, d_n^* is determined primarily from tradition. These terms are also multiplied by a Sales Pressure factor (π_n) to adjust desired details upward when perceived Sales Effectiveness has fallen below management's objective. The Traditional Details for each product portfolio (T_n) is a stock which adjusts over time to reflect the actual Details per product portfolio (d_n) given any shared sales force constraints. The stock adjustment rate is formulated as a first order exponential smoothing process. This is an anchor and adjustment goal setting process (Lant, 1992; Levinthal and March, 1981; Lewin et al., 1944; Tversky & Kahneman, 1974) with the anchor (T_n) adjusting over time to reflect historical values. The actual Details per product portfolio (d_n) is equal to the actual fraction of the sales force allocated to each product portfolio (RF_n) multiplied by the total product details (pd), as shown in Equation 11.

$$d_n^* = (T_n \times \gamma + \xi_n \times (1 - \gamma)) \times \pi_n \qquad 0 \le \gamma \le 1 \quad (10)$$

$$d_n = RF_n \times pd \quad (11)$$

The total product details (pd) is determined by the Net Sales Capacity (K) multiplied by Average Details per sales Representative per month (δ), as shown in Equation 12. The actual Fraction of the Sales Force allocated to each product portfolio (RF_n), as shown in Equation 13, is a stock which adjusts over time (τ_{rf}) to reflect the Indicated Fraction of Sales Force allocated to each product portfolio (irf_n) in a first order exponential smoothing formulation. The Indicated Fraction of Sales Force allocated to each product portfolio (irf_n), as shown in Equation 14, is a weighted average formulation based on two managerial components: the proportional product portfolio Sales Targets (s_n^*) and the proportional Operating Desired Details Goal for each product portfolio (d_n^*). This sales force allocation policy is specified by

computing the 'attractiveness' of each product portfolio determined by weighting desired sales details (d_n^*) and each portfolio's target sales (s_n^*) by averaging parameter θ. Product portfolio Sales Target (s_n^*) is defined as a first order exponential smoothing formulation which adjusts over time (τ_s) to reflect portfolio Sales (s_n) as a historical sales level, which is then multiplied by a Sales Improvement Stretch parameter (μ). When the averaging parameter θ is close to one, sales force effort is allocated based entirely on the projected portfolio sales. In contrast, when the averaging parameter θ is close to zero, sales force effort is allocated based entirely on desired sales details.

$$pd = K \times \delta \tag{12}$$

$$\frac{dRf}{dt} = \frac{irf_n - Rf}{\tau_{rf}} \tag{13}$$

$$irf_n = \frac{s_n^*}{\sum_N s_n^*} \times \theta + \frac{d_n^*}{\sum_N d_n^*} \times (1-\theta) \tag{14}$$

Each product portfolio consists of i different product types, and in the Sales Force Sharing model there are only two product types within the Conventional and Actives portfolio: growth products and mature products. The actual Details per product portfolio (d_n) is further allocated into each product type within each portfolio to yield Details per portfolio per product type (d_{ni}). As shown in Equation 15, Details per portfolio per product type (d_{ni}) are equal to Details per product portfolio (d_n) multiplied by the Fraction of Details parameter within each portfolio for each product type (fd_{ni}). Detail Adequacy for each product type within each portfolio (da_{ni}) is determined by the ratio of actual Details per portfolio per product type (d_{ni}) and the normal required details (nrd_{ni}) as shown in Equation 16. The normal required details can be defined in terms of industry best practice in order to establish a comparative basis with rivals. Sales Effectiveness (se_{ni}) is equal to Detail Adequacy (da_{ni}) as shown in Equation 17.

$$d_{ni} = d_n \times fd_{ni} \tag{15}$$

$$da_{ni} = \frac{d_{ni}}{nrd_{ni}} \tag{16}$$

$$da_{ni} = se_{ni} \tag{17}$$

Advertising and Promotion (A&P) product spend has not been explicitly operationalized in the model, and clearly A&P budgets have an impact on sales effectiveness as well. However, for the purposes of this model A&P spend has been assumed to remain constant at 5% of product sales, and the sales effectiveness function represents the level of sales effectiveness given this 5% A&P budget for each product portfolio.

The Indicated Sales Impact of sales effectiveness (isi_{ni}) is a function of Sales Effectiveness (se_{ni}), as shown in Equation 18, which represents the opportunity cost of lost sales in the case of low sales effectiveness. There are two different opportunity cost functions used to compute the Indicated Sales Impact of sales effectiveness (isi_{ni}) for growth and mature product types (i=1 and i=2 respectively. Actual Sales Impact (SI_{ni}) is represented as a first order exponential smoothing delay of Indicated Sales Impact with a time to realize the opportunity costs of low sales effectiveness (τ_{si}), as shown in Equation 19. These opportunity costs manifest themselves by impacting product sales. Mature product sales (MS_n) is a stock which represents the established base of sales for all mature products within each portfolio, and this established base of sales decreases with the Mature Product Sales Decline Rate (mdr_n), as shown in Equation 20. The Mature Product Sales Decline Rate (mdr_n), as shown in Equation 21, is equal to the Average Sales Decline (η) multiplied by the Actual Sales Impact (SI_{n2}) for mature products (i = 2).

$$i\text{si}_{n\,i} = f_i(se_{ni}) \qquad f_1(1)=1,\ f'_1 \le 0 \quad ;\ f_2(1)=1,\ f'_2 \ge 0 \qquad (18)$$

$$\frac{dSI_{ni}}{dt} = \frac{i\text{si}_{n\,i} - SI_{ni}}{\tau_{rsi}} \qquad (19)$$

$$\frac{dMS_n}{dt} = mdr_n \qquad (20)$$

$$mdr_n = \eta \times SI_{n2} \times MS_n \qquad \eta < 0 \quad i = 2 \qquad (21)$$

Growth product sales (GS_n) is a stock which represents the level of sales for all growth products within each portfolio, and these sales increase with the sales Growth Rate (gr_n) as

shown in Equation 22. The Growth Rate (gr_n), as shown in Equation 23, is equal to the Actual Sales Impact (SI_{n1}) for growth products (i = 1) multiplied by the Growth Fraction (gf_n).

$$\frac{dGS_n}{dt} = gr_n \tag{22}$$

$$gr_n = gf_n \times SI_{n1} \times GS_n \qquad i = 1 \tag{23}$$

The Growth Fraction (gf_n) is a function of the growth product Portfolio Average Age (a_n), as shown in Equation 24. The Portfolio Average Age (a_n), as shown in Equation 25, is equal to the Cumulative Portfolio Age (PA_n) divided by the number of growth products in each portfolio (gp_n). The Cumulative Portfolio Age (PA_n) is a stock which increases with the Portfolio Aging Rate (par_n) as shown in Equation 26. The Portfolio Aging Rate (par_n), as shown in Equation 27, is equal to the number of growth products in each portfolio (gp_n) multiplied by a Product Months parameter (λ). The average age of the conventional product portfolio includes an assumption for product development or regeneration of the portfolio to slow aging of the portfolio. In addition, in month 8 a step change in the average conventional portfolio age represents the introduction of several new focus product formulations onto the drug tariff in the Atlantis selling territory, thereby decreasing the average portfolio age since these products replace older formulations. These assumptions were included to conform with the actual case history.

$$gf_n = f(a_n) \qquad f(100) = 0,\ f' \le 0 \tag{24}$$

$$a_n = \frac{PA_n}{gp_n} \tag{25}$$

$$\frac{dPA_n}{dt} = par_n \tag{26}$$

$$par_n = gp_n \times \lambda \tag{27}$$

There is very rapid monthly sales growth during the first few months of a product's life cycle, and then the growth slows considerably. The monthly growth fraction determined by the average age of the growth portfolio can be considered the base expected growth rate if adequate sales effort is given to support the growth portfolio. However, low sales

effectiveness results in a substantially diminished sales growth rate, and the opportunity costs of low sales effectiveness may well undermine any resource sharing economies of scope benefits for a related diversification move.

Management's perception of Sales Effectiveness for each product portfolio (PE_n) is a stock which adjusts over time (τ_{sep}) to reflect the actual Sales Effectiveness for each portfolio (se_n), in an exponential smoothing delay formulation, as shown in Equation 28. Sales Pressure (π_n) is a function of the difference between Management's Sales Effectiveness Goal (ζ) and Management's Perceived Sales Effectiveness (PE_n), as shown in Equation 29. As discussed previously, Sales Pressure (π_n) impacts the Desired Details Goal for each product portfolio (d_n^*) defined in Equation 10.

$$\frac{dPE_n}{dt} = \frac{se_n - PE_n}{\tau_{sep}} \tag{28}$$

$$\pi_n = f(\zeta - PE_n) \qquad f(0) = 1,\ f' \geq 0 \tag{29}$$

This sales pressure policy and the associated sales pressure function has been operationalized to enable policy testing through simulation experiments. Neither the policy nor the function were derived from the Smith & Nephew case, but were included to test the systemic impact of such a policy to see if it might be effective.

Equations 1-29 specify the heart of the model, and the following section discusses some of the simulation experiment results. The financial sector has not been discussed in detail in this section but the calculation of total sales, operating costs, operating profit, and profit margin are very straight forward.

§5. Simulation Experiment Results

This section presents the simulation results for the Sales Force Sharing model of the Wound Management Division's related diversification move into the actives product portfolio. Six different simulation experiments are discussed: 1) Conventional Product Focus, 2) Related Diversification Ideal, 3) Related Diversification with Opportunity Costs, 4) Details Based Expansion, 5) Sales Pressure, and 6) Fixed Goals. The experiments cover a time period of 60

months and all financial values are in constant £'s reported on a monthly basis. Model parameters are based on the Atlantis selling territory for S&N's Wound Management GBU.

The benchmark or base case simulation includes only the conventional product portfolio, without the diversification move, over the entire time horizon. Figure 7 shows the results for total group sales with line 1, labeled Conventional Product Focus, at a beginning value just below £8.5 million per month and an ending value of just over £15.6 million per month by the end of the simulation. This base case simulation shows a dramatic growth in the conventional portfolio in month 8 which is driven by the introduction of several new conventional products onto the drug tariff in the Atlantis selling territory. This corresponds to the actual case history with the growth after month 8 based on the assumptions for focus product growth given the, now significantly lower, average portfolio age. All simulations include this growth for the conventional portfolio.

Insert Figure 7 about here

The Related Diversification Ideal simulation, line 2, shows the results of coupling the related actives portfolio with the existing conventional product portfolio in month three. The acquired actives portfolio immediately increases sales in the Atlantis territory since it has been an established portfolio prior to the acquisition, and results in an additional £1.3 million per month in group sales over the Conventional Product Focus simulation by the end of the five year time horizon. The Related Diversification Ideal simulation represents the ideal diversification move without any opportunity costs. The Related Diversification with Opportunity Costs, line 3, exploits the exact same potential synergy benefits of the Related Diversification Ideal experiment, but now also includes the opportunity costs of eroding sales effectiveness. For the first several months after the diversification move, there is no distinguishable difference between the Related Diversification Ideal and Related Diversification with Opportunity Costs experiments. However, by month 12 of the simulation, total group sales for the Related Diversification with Opportunity Costs experiment fall short of the ideal scenario. By month 20, total group sales for the Related Diversification with Opportunity Costs simulation fall below the Conventional Product Focus base case, down to a

value of just under £13.3 million per month. This simulation experiment replicates, reasonably well, the diversification case history within S&N's Atlantis sales territory for the first 24 months after acquiring the actives portfolio.

The first three simulation experiments were performed under a managerial policy for sales force expansion which was based entirely on a customers per sales force representative ratio (ψ = 1), which resulted in no sales force expansion since the number of customers, district nurses and doctors within the Atlantis territory, remains fixed over the time horizon. A similar outcome would be obtained with an assumption of rising Cost Pressure after the diversification move, resulting in an expansion hiring freeze for a period of 12-18 months. The Details Based Expansion experiment, line 4, investigates a policy change scenario in which Cost Pressure is zero throughout the time horizon and the desired sales force is based on the desired details across the combined portfolios (ψ = 0). This scenario also assumes sales force allocation is driven by the proportional desired details for each portfolio (θ = 0), instead of being based exclusively on the portfolio target sales (θ = 1). Finally, the Details Based Expansion scenario assumes the time delay in adjusting sales force effort to the actives portfolio (τ_{rf}) is reduced from 12 months to 3 months. A critical issue, which emerged within the S&N case history for the Atlantis sales territory, is that it took quite a long time to reallocate substantial sales force effort to the actives portfolio. The Details Based Expansion exploits the exact same potential synergy benefits of the Related Diversification Ideal experiment, and also includes the opportunity costs of eroding sales effectiveness as in the Related Diversification with Opportunity Costs experiment. The Details Based Expansion simulation results in higher total group sales than the Related Diversification with Opportunity Costs experiment, but still falls below the group sales achieved in the Conventional Product Focus base case.

Figures 8 and 9 show the two components of group sales- actives and conventional portfolio sales- to uncover where the opportunity costs emerged in these simulation experiments. Figure 8 shows the Actives Sales for the Related Diversification Ideal, Related Diversification with Opportunity Costs and Details Based Expansion experiments, where all simulations begin at the pre-acquisition sales value for the actives portfolio within the Atlantis sales territory. The latter two simulations result in growing actives sales for the first few months after the diversification move, but then suffer from low sales effectiveness leading to opportunity cost

of lost sales. The result is that actives sales fall well below the pre-acquisition level of sales on a steady and continuing decline. This behavior is qualitatively very similar to the observed historical sales, for the first 24 months after the diversification move, in the Atlantis territory discussed previously and shown in Figure 5.

Insert Figure 8 about here

As shown in Figure 9, Conventional Portfolio Sales for the Conventional Product Focus and the Related Diversification Ideal experiments are equal. No positive sales synergy is assumed within the model and, in the ideal simulation, there are no opportunity costs to reduce sales from the level that would be achieved without the diversification move into actives. However, the Related Diversification with Opportunity Costs and Details Based Expansion experiments result in lower sales after the first few months subsequent to the diversification move. These latter two simulations suffer from low sales effectiveness leading to opportunity cost of lost sales as shown in Figure 10 (lines 2 and 3).

Insert Figure 9 about here

The Sales Pressure and Fixed Goals Simulations, lines 4 and 5 in Figure 10, shows the results for experiments in which management realizes over time that low sales effectiveness is due to inadequate sales force resources. As awareness of the root of the problem grows, management expands the sales force in order to meet sales effectiveness targets. Also, in the Fixed Goals experiment management's details per product operating goal cannot erode.

Insert Figure 10 about here

Figure 11 displays the results for Group Profit Margin for the first four simulations. The profitability metric tells the tale in determining the success of the firm's related diversification move into the actives portfolio. Once again, line 1 represents a focused conventional portfolio which will constitute our benchmark for value creation. This Profit Margin benchmark for the Conventional Product Focus simulation begins at roughly 16% and increases over the 60 month period to just over 24%. This is a very optimistic outlook for the Conventional Product Focus business, since it does not include substantial Capital Expenditures for upgrading manufacturing facilities or any loss of market share to rivals' advanced medical devices and equipment. The Related Diversification Ideal simulation, shown in line 2, presents the ideal related scenario in which the full potential value of synergy between the conventional and actives portfolios is extracted without incurring any costs. The Related Diversification with Opportunity Costs simulation, line 3, shows profitability for the combined portfolios increases for the first few months after the diversification move, but ultimately results in lower profitability than the benchmark as rising opportunity costs of low sales effectiveness undermine firm performance. After appearing to create value for the first 27 months, the related diversification move results in value destruction of over two Profit Margin percentage points compared to the focused conventional product simulation, and more than three Profit Margin percentage points less than the Related Diversification Ideal simulation. The Details Based Expansion simulation, line 4, results in better performance than the Related Diversification with Opportunity Costs simulation, but still falls below the performance of the benchmark Conventional Product Focus experiment.

Insert Figure 11 about here

In the midst of these last two simulations, which seem to destroy value in a related diversification move which has economies of scope by definition, management has an important role to play in coordinating sales force resource sharing to avoid undermining synergy benefits. Figure 12 shows two additional simulations which demonstrate how management can successfully tap the benefits of resource sharing. Lines 1 and 2 are the Conventional Product Focus and Related Diversification Ideal simulations, already shown in Figure 11, and included here as performance benchmarks.

Insert Figure 11 about here

The Sales Pressure simulation, line 3, shows the impact management has on performance when sales effectiveness is measured and managed. In this simulation, management becomes aware of a sales effectiveness problem over time and takes action by hiring additional sales force resources to relieve overstretching. Group Profit Margin still falls below the Related Diversification Ideal, but the related strategy is value creating compared with the focused strategy (line 1). The last simulation, line 4, displays the results when the management team maintains fixed goals regarding operating details goal. In the Fixed Goals simulation, Profit Margin is a bit closer to the ideal value achieved in the Related Diversification Ideal without costs scenario, and results in value creation of nearly one Profit Margin percentage point compared with the focused strategy (line 1).

§6. Discussion and Conclusions

The mathematical simulation model was operationalized to test the proposition of whether the rising opportunity costs due to overstretched shared sales force resources explain S&N's poor performance subsequent to the related diversification move into the actives portfolio. Simulation results indicate that the rising co-ordination costs of sales force resource sharing can indeed explain the poor performance of the diversification move and supports the feedback structure of the model. It is obvious from these simulation experiments the crucial role management can play in determining the success or failure of a related diversification move. The model demonstrates that the rising opportunity cost of lost sales is a specific type of co-ordination cost. Only through identifying the various ways that invisible costs may manifest themselves as a consequence of resource sharing can we truly provide specific insights regarding robust managerial policies which avoid these hidden traps.

S&N's diversification move into the actives portfolio leveraged a set of core business existing resources including a shared medical sales force. Absorbing the new actives portfolio into the existing business resulted in resource overstretching, which gave rise to increasing resource

co-ordination costs. In this case, those costs manifest themselves as opportunity costs from lost sales due to eroding sales effectiveness. The results suggest there is a crucial role for resource expansion and allocation managerial policies in determining the success or failure of a related diversification move. Simulation experiments demonstrate how boundedly rational managerial behavior can unintentionally undermine the gains in performance even when the economies of scope benefits are significant.

Explicit in this approach is a shift to a 'systems view' or activity system view (Porter, 1996) of strategy, emphasizing inter-relationships instead of laundry lists and isolated actions, where coordinating the interconnected resource system is a primary function of senior managers. In previous research, it has proven difficult to adequately incorporate the interactions between strategy, organization and environment in large sample studies, and yet understanding these complex interdependencies is required to advance our knowledge on this issue. Accomplishing this task requires us to embrace new approaches such as the feedback simulation modeling approach adopted in this thesis. The model supported case studies presented in this thesis go well beyond descriptive case analyses. Typically, in-depth descriptive cases are characterized as primarily useful for generating propositions which can then be empirically tested. In contrast, modeling extends into the theory testing phase through an explicit test of the internal consistency of the theory which is proposed to explain the behavior of key case variables over time.

The process of identifying propositions and building theory through inductive reasoning by relying on observations gathered in case field work is riddled with difficulty. Operationalizing the theory explicitly in a mathematical model enables the researcher to determine whether the proposed relationships, which make up the theory, are capable of producing the observed case behavior. Such an internal validity test builds a great deal of confidence that the proposed causal theory is in fact responsible for the issue of focus in the case. Furthermore, testing the theory through simulation helps illuminate other behavioral modes which can arise from the same set of relationships and under what conditions to expect each of the behavioral modes. Assessing external validity is a separate issue which is not addressed in this paper, but would involve a larger sample size.

The managerial implications which emerge emphasize developing and monitoring performance metrics which track 'soft' indicators of strategic health, and taking care to analyze the interdependencies within the multi-business resource system. Management must proactively invest to expand shared resources when attempting to extract synergy in a related diversification move, and must actively manage resource stretching throughout the portfolio. The benefits of leveraging existing resources may be quite large, but it is very likely that realizing the potential benefits will require investment to expand the set of shared resources. Ideally, management should invest in shared resources and capabilities in advance of increasing work loads in a new business, or run the risk of activating locally rational responses which will undermine performance in the long run. Alternatively, building or developing completely new resources to support a firm's diversification strategy, rather than sharing existing resources, may lead to higher long term financial performance in many cases. There must be persuasive reasons to legitimize increasing dynamic complexity through resource sharing.

Another interesting implication concerns the highly touted strategy whereby firms refocus on their core business by divesting 'non-core' activities. This refocusing strategy may be successful in improving profitability largely because it simplifies the dynamic complexity of managerial decision-making. If there really are substantial potential synergy benefits, aligning managerial policies to unleash those benefits may create more value for shareholders than divesting businesses. There should be no illusions that there are numerous organizational impediments to adopting these policies. In particular, investing in excess shared resources in advance of increasing demands is quite difficult in practice because of the negative impact on short term financial performance. Similarly, investing in shared resources to unleash untapped relatedness benefits is also very difficult because it might well require investment at a time when financial performance is suffering from opportunity costs of lost sales. Cost pressure may well rule out any additional resource expansion given the short term objectives for financial performance. Nevertheless, these policies can be feasibly implemented by organizations that take a long term perspective regarding financial performance.

There is a great deal more research needed in order to continue to push forward our understanding about how multi-business firms are managed to reach performance objectives, and about the degree of fit between strategy and these management control policies. There are undoubtedly numerous other types of co-ordination costs which crop up time and again as

unintended consequences of resource sharing. Only by identifying and specifying the nature of these costs can we inform managers how to avoid the hidden pitfalls of increasing dynamic complexity within organizations and recommend specific policy changes. This paper begins that process.

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	1999	% Sales	CAG%
Orthopaedics	£ 276	26%	16%
Endoscopy	£ 193	18%	11%
Wound Management	£ 231	21%	9%
Casting, Support and ENT	£ 190	18%	2%
Consumer Healthcare	£ 186	17%	11%
Total	£ 1,076	100%	8%

Table 1: Smith & Nephew Sales by product group (£ million).

	1997	1998	1999	2000	2001	2002
Sales (£000)	17,940	19,380	24,060	26,310	28,530	30,930
Cost of Goods	8,628	10,053	10,956	11,421	12,117	12,861
Gross Profits	9,312	9,327	13,104	14,889	16,413	18,069
GP %	52%	48%	54%	57%	58%	58%
Operating Expenses	17124	4983	5616	5745	6243	6459
Operating Profit	-7,812	4,344	7,488	9,144	10,170	11,610
Profit Margin	-44%	22%	31%	35%	36%	38%

Table 2: S&N five year projected P&L for actives portfolio (£000).

	1998	1999	2000	2001	2002
Acquisition Cost	35,889				
Operating Profit	4,344	7,488	9,144	10,170	11,610
Working Capital	3,876	936	450	444	480
Annual Cash Flow	-35,421	6,552	8,694	9,726	11,130
Cumulative Cash Flow	-35,421	-28,869	-20,175	-10,449	681

Table 3: S&N projected cash flow payback for actives portfolio (£000).

	1997	1998	1999	2000	2001	2002
Operating Expenses						
Sales	10,800	1,890	2,250	2,250	2,550	2,550
A&P	-	969	1,203	1,317	1,428	1,548
R&D	2,922	600	600	600	600	600
Regulatory/Clinical	-	750	600	525	525	525
Depreciation	1,026	-	-	-	-	-
SG&A	2,376	774	963	1,053	1,140	1,236
Total Expenses	17,124	4,983	5,616	5,745	6,243	6,459

Table 4: S&N five year projected operating expenses for actives portfolio (£000).

Desired Additional Resources	Estimated Annual Cost (£000)
12 Extra Salespeople	£480
3 Product Managers	£150
A&P Budget	5% of turnover
2 Regulatory Affairs Managers	£70
1 R&D Scientist	£50
1 Clinical Research Analyst	£40

Table 5: Additional required resources and associated cost for actives.

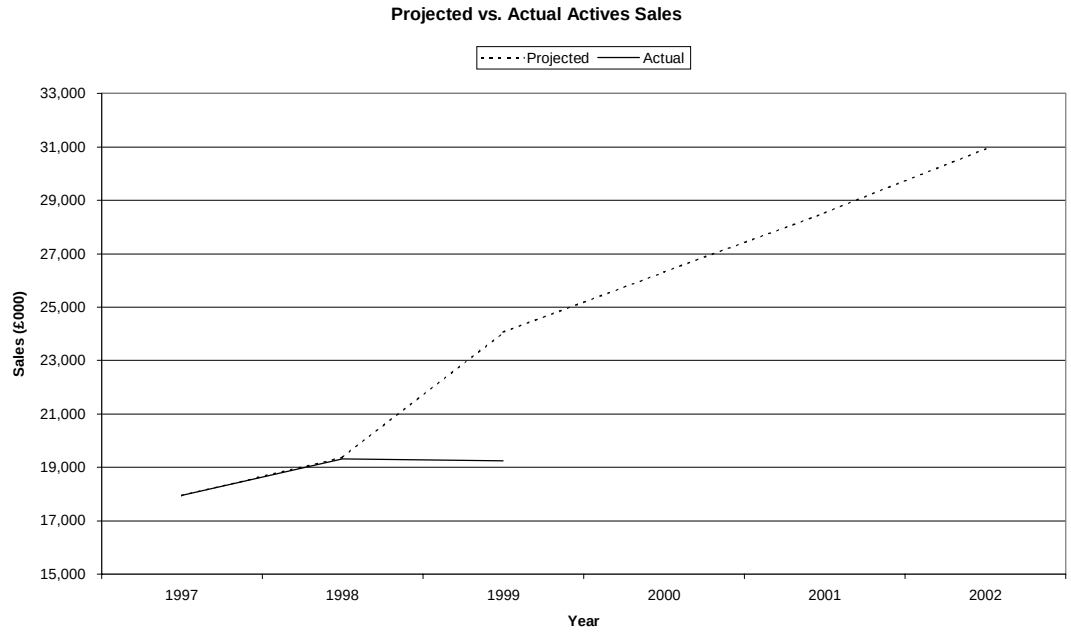

Figure 1: S&N projected versus actual actives global sales.

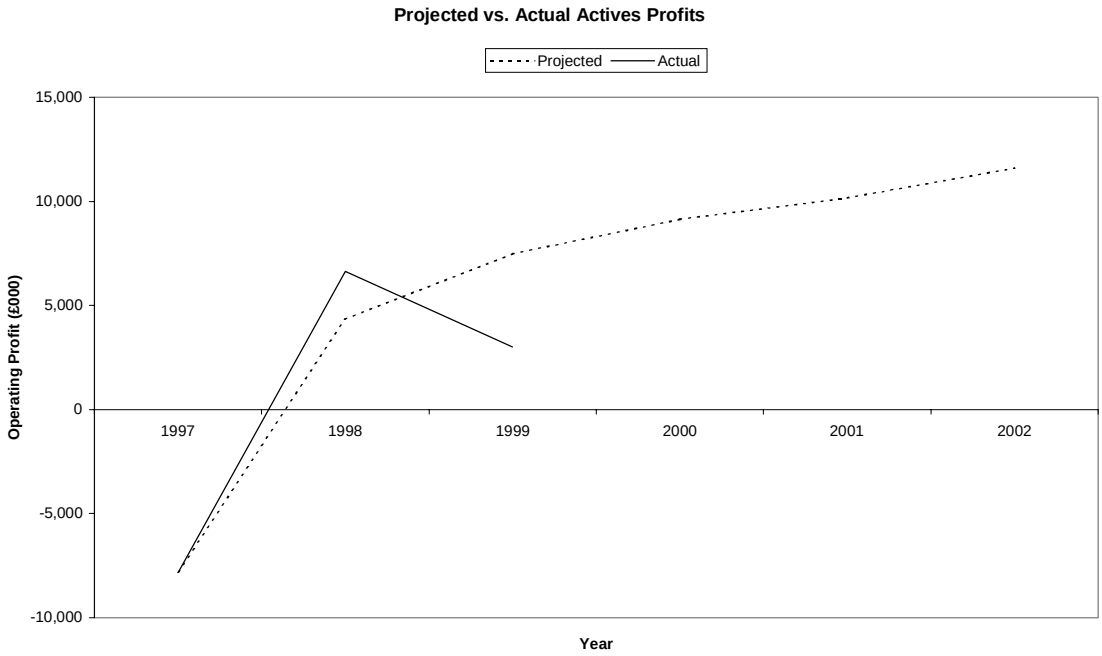

Figure 2: S&N projected versus actual global actives portfolio operating profit.

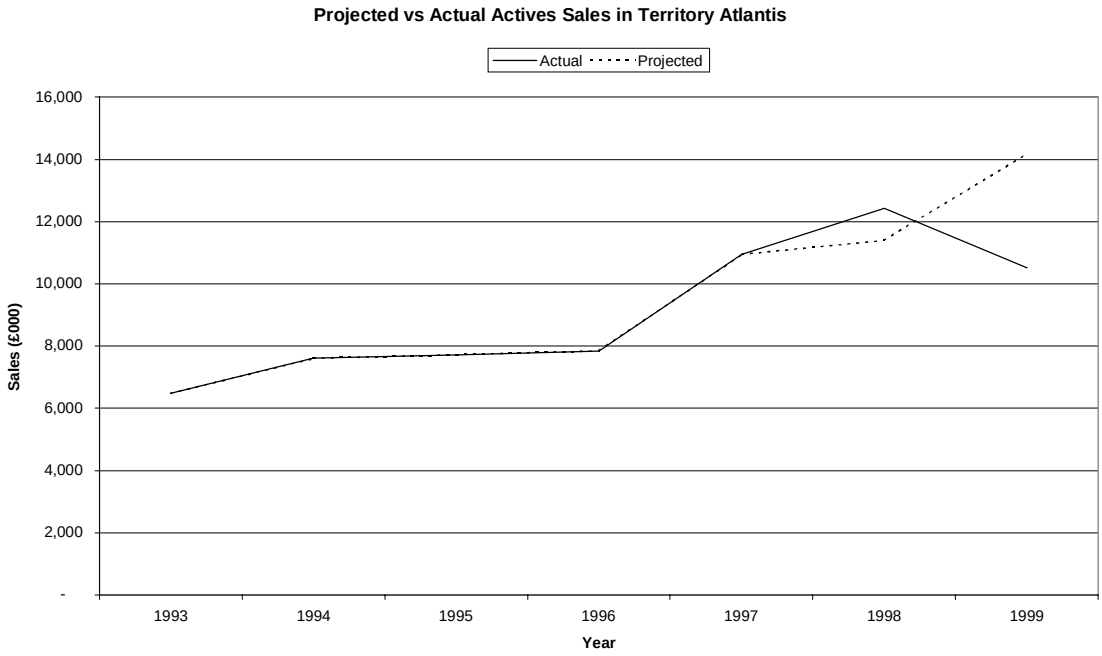

Figure 3: Actual versus projected actives portfolio sales in territory Atlantis.

	1997	1998	1999
Sales (£000)	10,944	12,437	10,502
Product Profit		4,207	1,515
Profit Margin		34%	14%

Table 6: Summary actives portfolio financial performance in territory Atlantis.

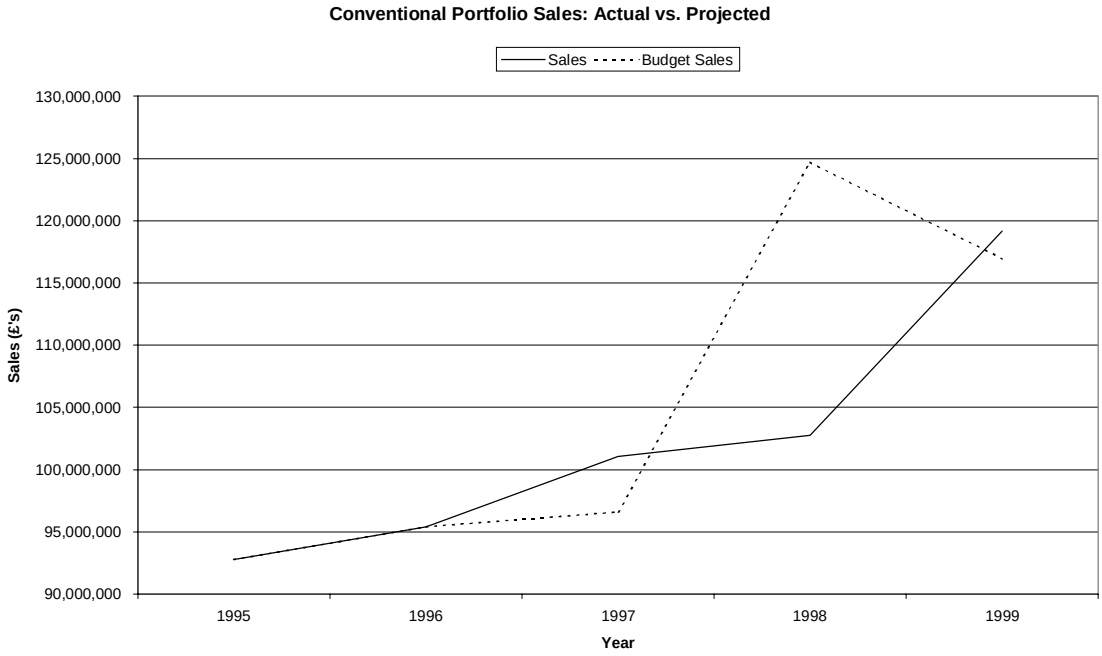

Figure 4: S&N projected versus actual Atlantis conventional portfolio sales.

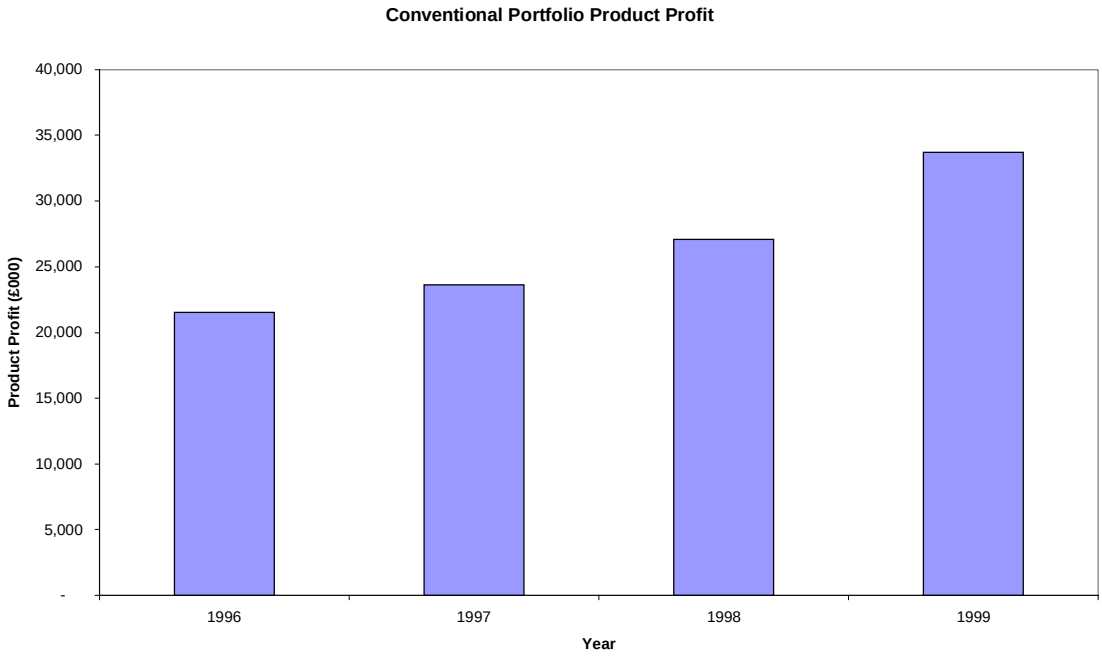

Figure 5: S&N historical conventional portfolio operating profit

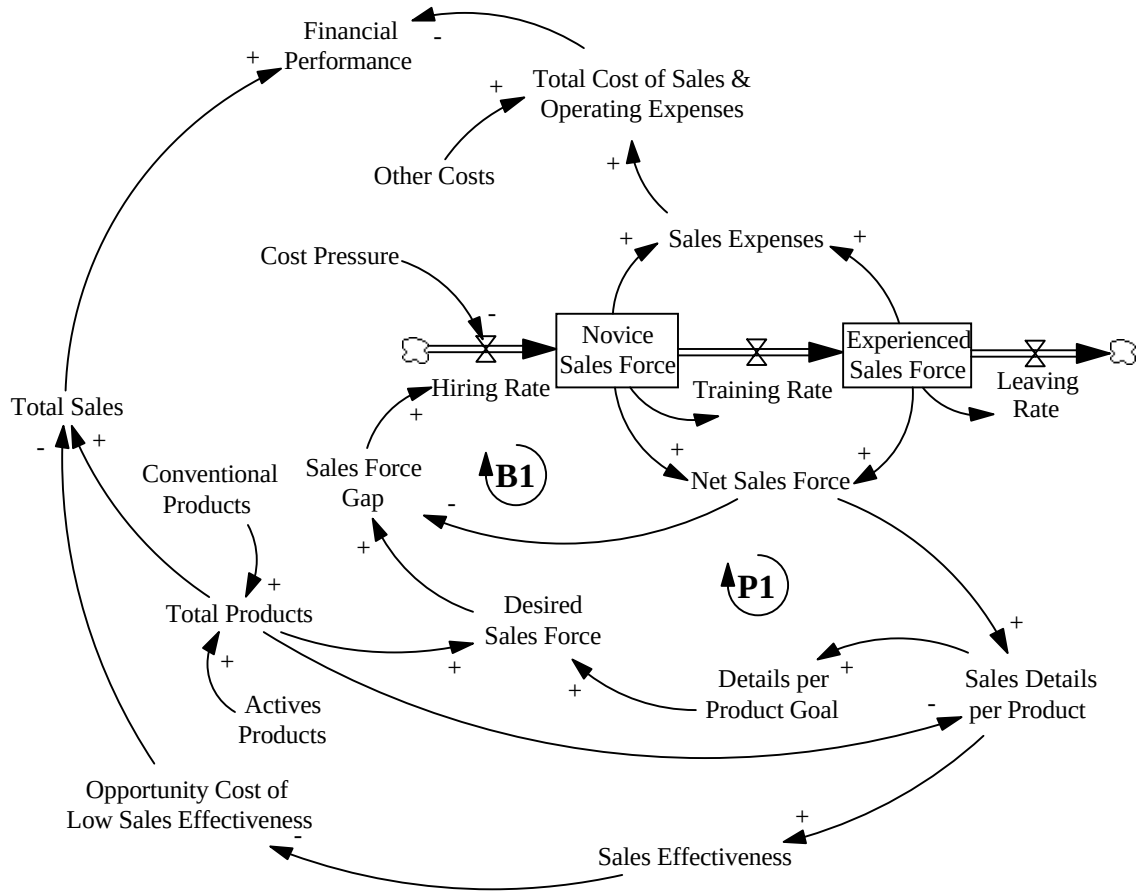

Figure 6: Erosion of Sales Effectiveness feedback loop diagram.

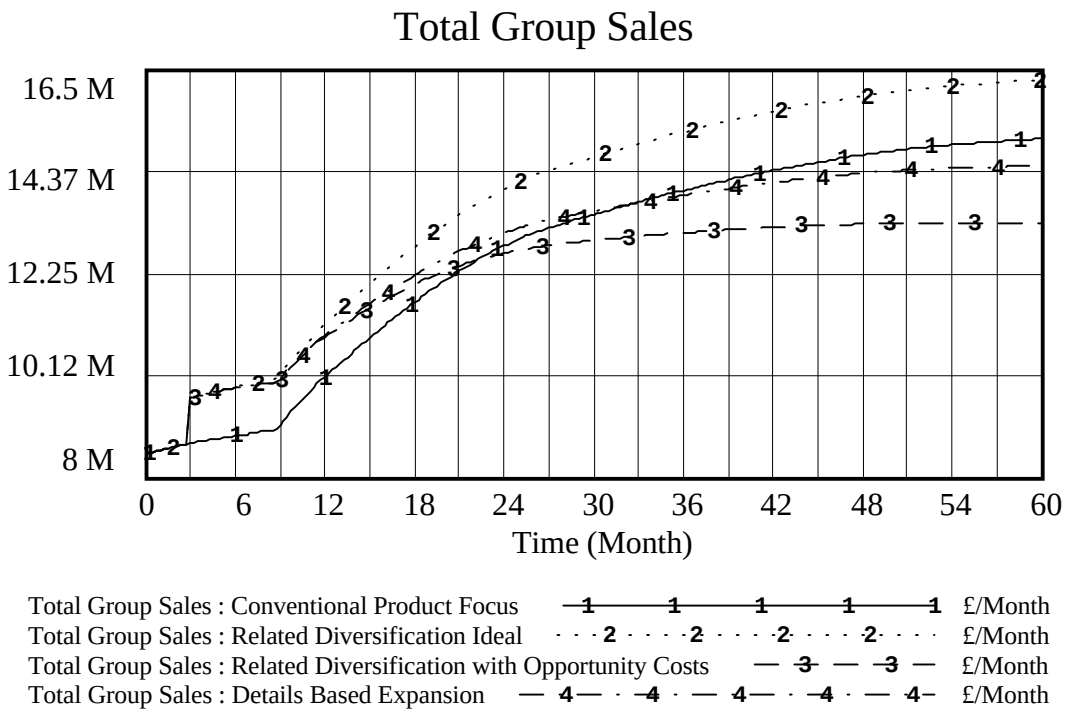

Figure 7: Simulation results for Total Group Sales.

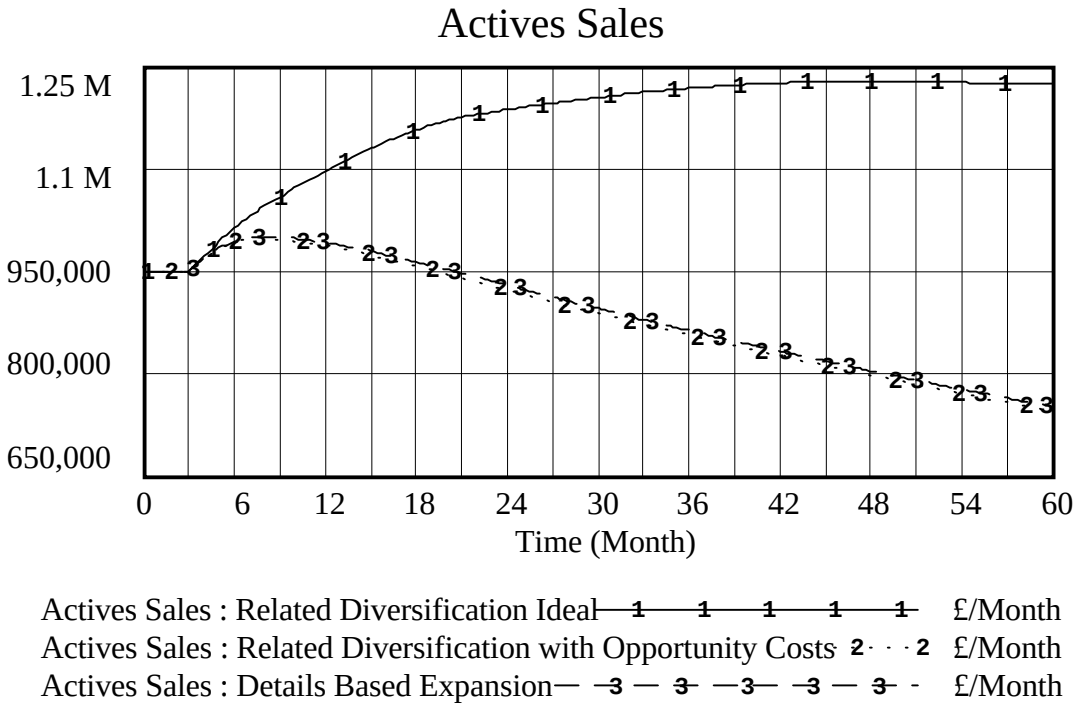

Figure 8: Simulation results for Actives Portfolio Sales.

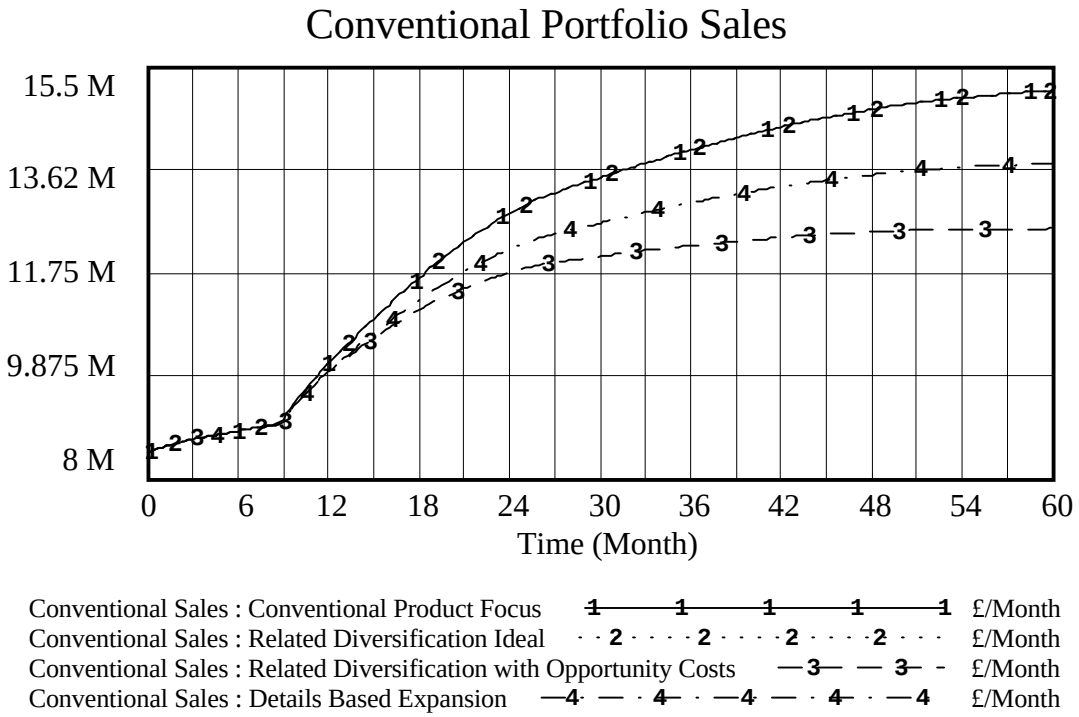

Figure 9: Simulation results for Conventional Portfolio Sales.

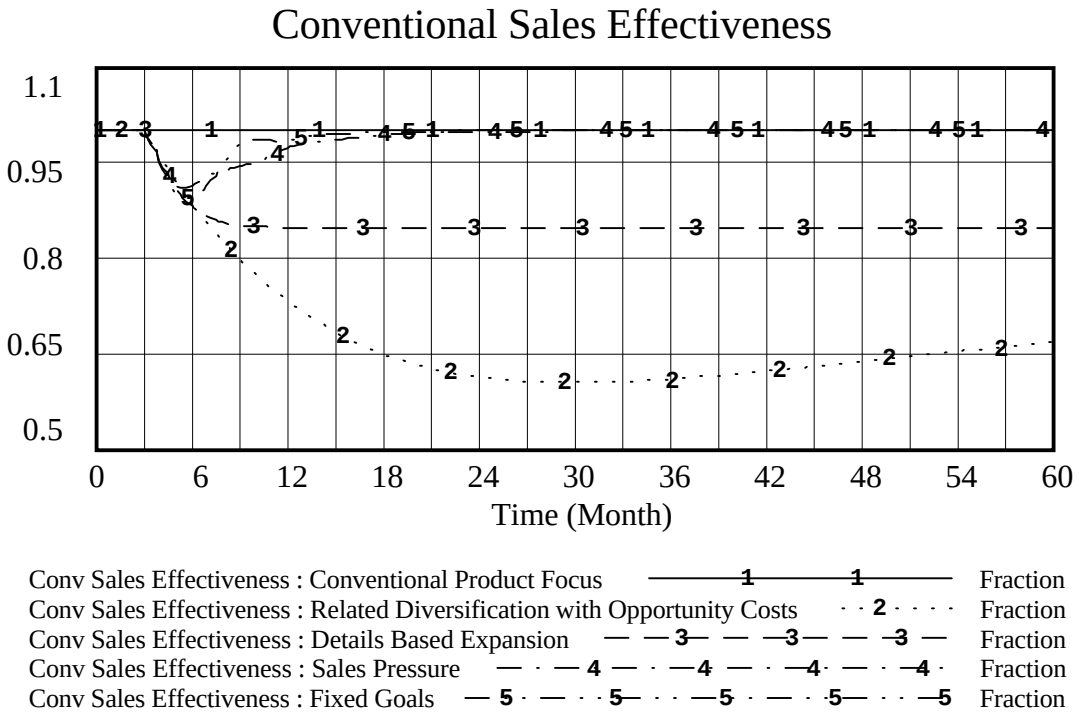

Figure 10: Simulation results for Conventional Sales Effectiveness.

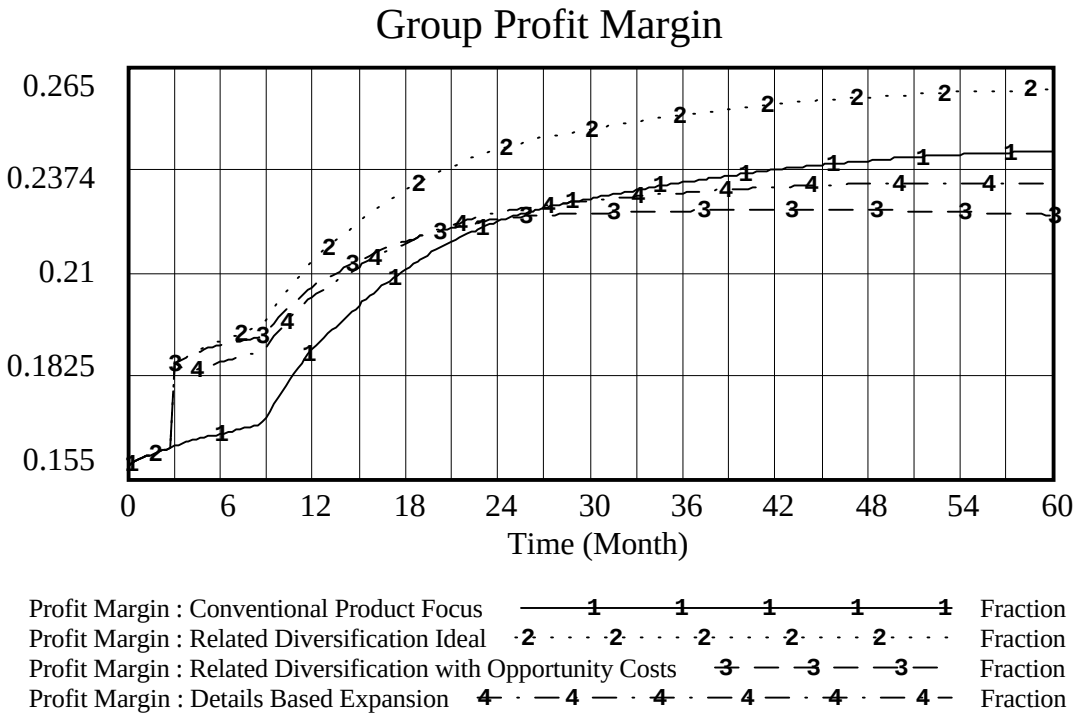

Figure 11: Simulation results for Group Profit Margin.

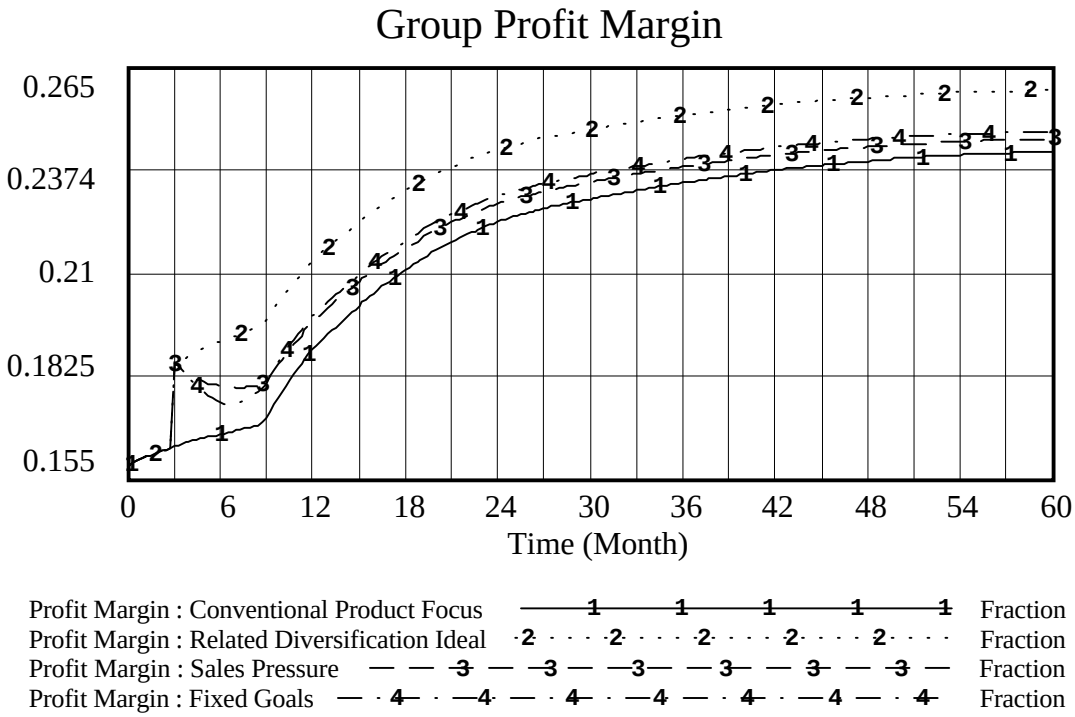

Figure 12: Simulation results for Group Profit Margin continued.