THE DEVELOPMENT OF A STRATEGIC INDUSTRIAL ENGINEERING PHILOSOPHY

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ABSTRACT

The proposed expansion of the Industrial Engineering discipline, termed *Strategic Industrial Engineering*, holds that scientific industrial engineering knowledge may be applied to capitalistic systems with the strategic goal of maximising wealth for the corporate shareholders. This paper provides an overview of the development of such a *Strategic Industrial Engineering Philosophy* and discusses the possible application of this philosophy in improving the capital productivity of an organisation.

OPSOMMING

Die voorgestelde uitbreiding van die Bedryfsingenieurswesedissipline, genaamd *Strategiese Bedryfsingenieurswese*, beweer dat wetenskaplike bedryfsingenieurswesekennis toegepas mag word op kapitalistiese stelsels met die maksimisering van welvaart vir die korporatiewe aandeelhouers as die strategiese doelwit. Hierdie artikel verskaf 'n oorsig van die ontwikkeling van so 'n *Strategiese Bedryfsingenieurswesefilosofie* en bespreek die moontlike toepassing van hierdie filosofie in die verbetering van die kapitaalproduktiwiteit van 'n onderneming.

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1. INTRODUCTION

Organisational behaviour is driven by aspirations, similar to human beings that pursue their hierarchy of basic needs [Maslow: 3; Moll: 4]. The process of achieving these organisational aspirations, as illustrated in Figure 1, is a function of attaining the following fundamental organisational goals [Moll: 4]:

- Effectiveness (the ability of organisations to improve themselves);
- efficiency (the ability of organisations to improve the way in which they satisfy their basic needs); and
- equilibrium (the ability of organisations to remain congruent with their environments).

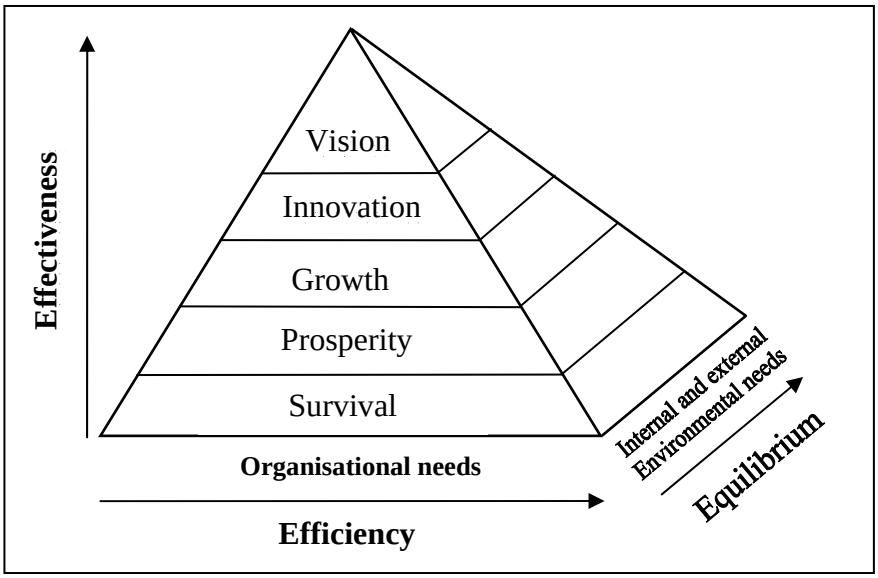

Figure 1: Hierarchy of basic needs of an organisation

The fundamental organisational goals of effectiveness and efficiency, supported by the competitive nature of capitalism, are the motivating forces behind maintaining high levels of productivity of the organisational systems. A proposed expansion of the Industrial Engineering field, termed *Strategic Industrial Engineering*, holds that scientific industrial engineering knowledge can be applied to capitalistic systems with the strategic goal of accumulating capital for the corporate shareholders [Leonard: 2]. Capitalistic corporate shareholders pursue their own self-interests in seeking *maximum gain* from the use of their *capital* and therefore their strategic goal is *wealth maximisation*. Expanding the field of Industrial Engineering by including organisations and industries (capitalistic systems) as resources enables corporations to scientifically improve the productive utilisation of capital investments by improving the rate of wealth maximisation [Leonard: 2]. This paper discusses the possible application of a Strategic Industrial Engineering Philosophy, as defined by Leonard [2], to demonstrate the improvement in capital productivity and thus achieving the capitalistic corporate goal of accumulating capital.

2. DISCUSSION

The expanded field of Industrial Engineering, according to the Strategic Industrial Engineering Philosophy, is aimed at accumulating capital for the benefit of the capitalistic organisational shareholders. Thus Strategic Industrial Engineering applies scientific knowledge to capitalistic systems aimed at accumulating capital for the shareholders. Through the Industrial Engineering discipline the productive achievement of these goals is supported by drawing upon specialised scientific knowledge, skills and the analysis and design principles and methods of engineering to specify, predict and evaluate the results to be obtained from such systems.

Productivity, which is a function of effectiveness and efficiency, is defined as: *The relationship between quantities of output from a system and quantities of input into that same system.* [Sink: 5]. Maintaining high levels of productivity is not only applicable to manufacturing systems, but also to the capitalistic organisational system. Therefore the Industrial Engineering principles and skills that support the achievement of high levels of productivity of the means of production of manufacturing related resources is also applicable to the capitalistic organisational system. Based on this reasoning the following adjustments to the productivity definition are made [Leonard: 2]:

- *Quantities of input,* as per the definition of productivity [Sink: 5], can be expanded to include the *capital investment* into the capitalistic organisational system; and
- *quantities of output,* as per the definition of productivity [Sink: 5], can be expanded to include the *capital gain* from the capitalistic organisational system.

These expansions of the productivity definitions lead to defining productivity of capital as illustrated in Equation 1.

$$Productivity = \frac{Output}{Input}$$

$$Capital\ productivity = \frac{Capital\ gain}{Capital\ investment}$$

$$= \frac{Profit}{Investment}$$

Equation 1: Capital productivity

The financial measure of the rate of wealth maximisation that is equal to the organisation's return on equity (ROE), [Leonard: 2] and the measure of capital productivity [Equation 1] measures the same outcome. Setting ROE equal to capital productivity is illustrated in Equation 2.

Engineering is the application of scientific knowledge to purposefully utilise resources for the benefit of mankind [Blanchard: 1]. If considering the organisational entity as a resource and applying the scientific method of expansionism to it, it can

be derived that the capitalistic corporation is a purposeful system with capital as input and accumulated capital as output. The capital productivity measure of this system is equal to the wealth maximisation measure defined as return on equity [Equation 2]. Thus improving the capital productivity of the capitalistic system will improve the corporation's ROE and subsequently improve the corporation's ability to achieve its capitalistic goal. Corporations can thus purposefully apply Industrial Engineering principles as a strategic tool to influence the rate of wealth maximisation [Leonard: 2].

$$\text{Capital productivity} = \frac{\text{Profit}}{\text{Investment}}$$

And:

$$ROE = \frac{\text{Profit}}{\text{Investment}}$$

$\therefore$ $\text{Capital productivity} = ROE$

And: $ROE = \text{Capital accumulation}$

$\therefore$ $\text{Capital accumulation} = ROE = \text{Capital productivity}$

Equation 2: Capital productivity measures wealth maximisation (ROE)

This reasoning is further strengthened by the relationship between the fundamental principles of the strategy process and the classical engineering approach applied to achieve these improvements [Leonard: 2]. This relationship leads to defining the Strategic Industrial Engineering Process as having the following steps:

- Current position analysis – obtaining an understanding of the specific requirements or needs;
- action plan design – creation of an innovative solutions to satisfy the specific requirement / need; and
- implementation of the action plan through the allocation of resources – applying the solution in order to satisfy the requirement / need.

Wealth maximisation, defined as the goal of a capitalistic corporation, is based on controlling the relationship between the following corporate strategy fundamentals [Leonard: 2]:

- *Organisational competitiveness,* defined as the ability of a corporation's independent organisations to accumulate capital within their specific industries;
- *industry exposure,* defined as the combination of independent organisations and thus the exposure to multiple industries;
- *strategic fit benefits,* defined as the ability of the corporation to capture the strategic fit benefits of its portfolio of organisations; and
- *industry profitability,* defined as the competitive differences between individual industries.

The *Strategic Industrial Engineering Process*, aimed at achieving the capitalistic goal, is defined as illustrated in Figure 2.

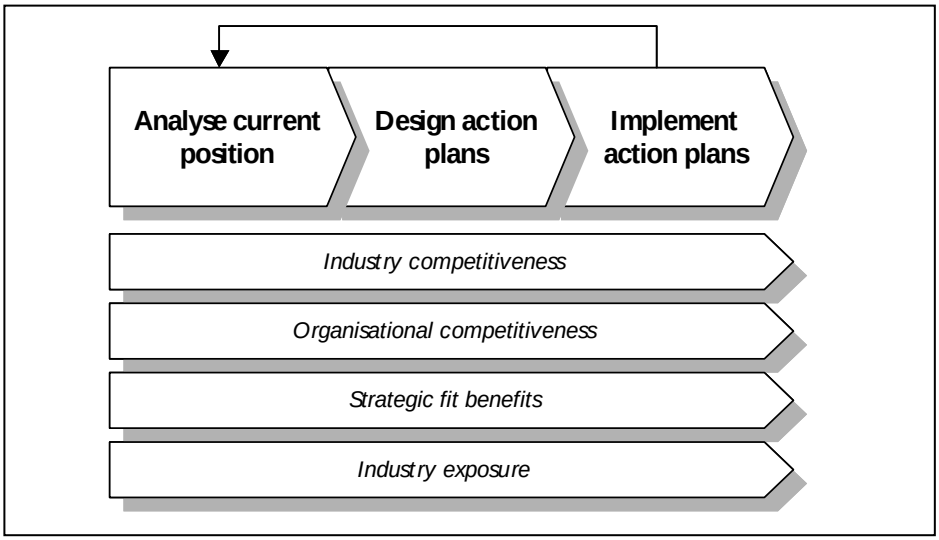

Figure 2: Strategic industrial engineering process

Figure 3 illustrates that the following performance-regulating principles influence a corporation's goal achievement:

- The competitiveness of its individual organisations;
- the individual organisation's wealth maximisation in relation to the corporation's cost of equity;
- the competitiveness of the industries, industry structure, that the corporation is exposed to; and
- strategic fit benefits that improve the corporate performance to more than the average performance of its individual organisations.

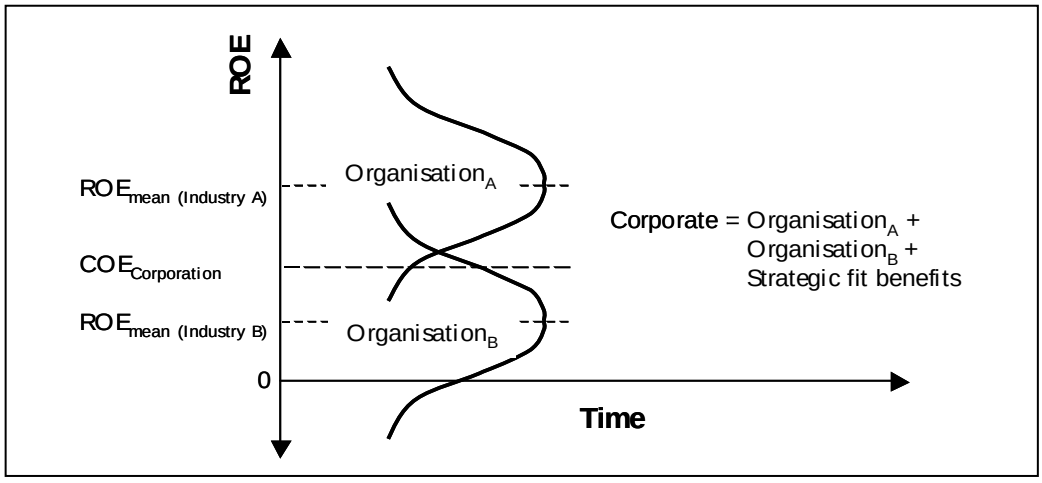

Figure 3: Corporate wealth maximisation

In Strategic Industrial Engineering it is proposed that different corporate strategies are required to control these performance-regulating principles in different phases of the industry ROE life cycle. The industry ROE life cycle, as proposed by Leonard [2], is illustrated in Figure 4.

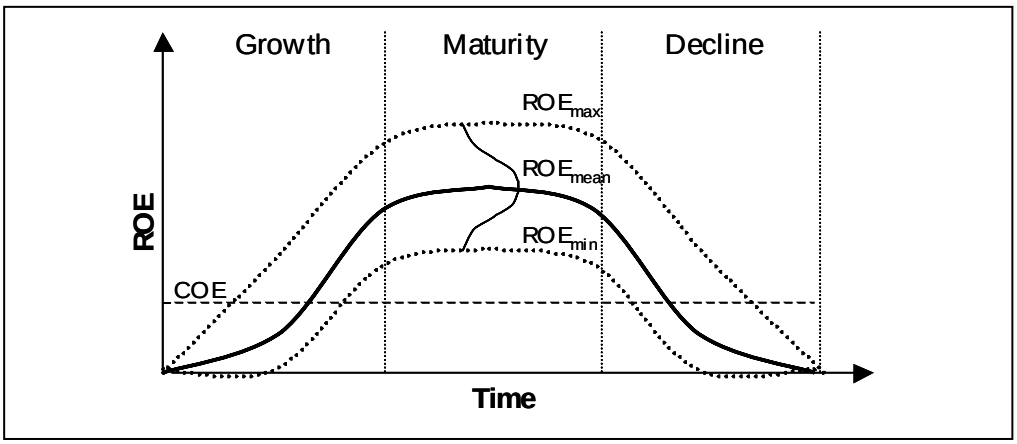

Figure 4: Industry ROE life cycle

The industry ROE life cycle curve [Figure 4] depicts the following:

- The organisational competitiveness distribution that includes:
    - The industry's mean wealth maximisation (ROE_{mean});
    - the lowest organisational ROE in the industry (ROE_{min}); and
    - the highest organisational ROE in the industry (ROE_{max}).
- the cost of equity is included as a reference point to indicate whether wealth maximisation is higher or lower than the cost of equity (COE), thus to determine the positive or negative wealth maximisation contribution, based on the risk profile of the organisation; and
- the industry ROE life cycle that is a function of the industry structure. Changes in the industry structure, including discontinuities, will influence an organisation's ability to accumulate capital. The three fundamental phases of a life cycle are also shown:
    - The growth phase;
    - the maturity phase; and
    - the decline phase.

2.1 Analyse the current position

A corporation's current position is determined by aggregating the results from analysing the performance of each individual organisation and relating industry in

achieving the capitalistic goal. The performance of these individual organisations and industries are analysed according to the four performance-regulating principles. The results of these analyses are plotted on the *current position matrix*, based on:

- *Industry competitiveness* (ROE_{mean}) as independent variable;
- *organisational competitiveness* (*ROE*) as dependent variable; and
- the organisation's *cost of equity* (*COE*) as a threshold on both the independent and dependent variables, to determine the positive or negative wealth maximisation contribution, based on the risk profile of the organisation.

The results are aggregated, by applying the *industry exposure* equation, to determine the corporation's overall wealth maximisation performance. The corporation's wealth maximisation (*ROE*) is benchmarked against its cost of equity (*COE*). Performance above the cost of equity indicates that the corporation's wealth maximisation is above shareholders expectations. The inverse is also true, as a corporate ROE below the cost of equity indicates a performance below the shareholders expectations. Therefore a positive or negative ROE contribution to the corporation, based on the risk profile of the corporation.

The current position matrix is illustrated in Figure 5.

2.2 Design the action plans

Corporate strategies are proposed by Leonard [2] based on applying the *Strategic Industrial Engineering Process* as a strategic tool. Corporate strategies are defined from the relationship between a corporation's individual organisations with the performance regulating principles. These strategies are based on the position of the individual organisations and relating industries performances as plotted on the matrix illustrated in Figure 5.

Leonard [2] proposes that strategic actions for each organisation be defined, based on the following generic capital allocation strategies as defined for each quadrant of the required position matrix.

2.2.1 Quadrant A strategies

For organisations within this quadrant, both the organisation's competitiveness and the industry competitiveness exceed the cost of equity or shareholders' expectations. From this it is derived that:

- Additional capital investments in this industry will potentially generate returns that exceed the *cost of equity*; but
- care should be taken, since the quadrant can be misleading. Although the industry's competitiveness is higher than *COE* it can be that the corporation's exposure is in the worst performing organisation in the industry. In this case the organisation would also require improvement.

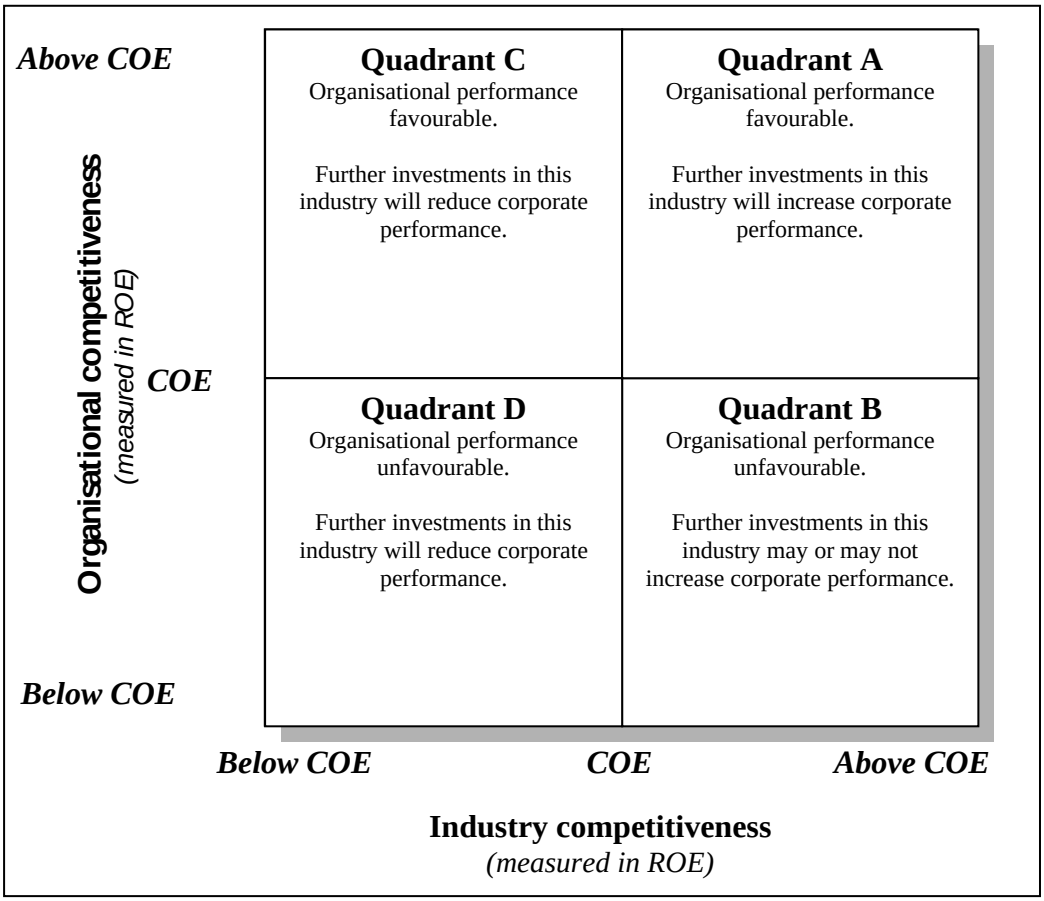

Figure 5: Current position matrix

An organisation within this quadrant can be rated as:

- A+ if the organisational competitiveness is higher than the industry's competitiveness; and
- A– if the organisational competitiveness is lower than the industry's competitiveness.

Proposed capital investment strategies in this quadrant are based on:

- Increase capital investments in A+ rated organisations, as potential industry competitiveness and organisational competitiveness are favourable; and
- two strategies are required for A– rated organisations:
- Improve organisational competitiveness; and
- increase capital allocation in this industry, since it is a profitable industry.

2.2.2 Quadrant B strategies

Industry competitiveness exceeds the *cost of equity* or shareholders expectations and the *organisational competitiveness* is lower than the *cost of equity*. From this it can be derived that:

- On average, additional investments in this industry will have returns that exceed the cost of equity; however
- the current organisation is this quadrant is under performing in this industry and would therefore require improvement before further investments are to be made.

Proposed capital investment strategies in this quadrant are based on:

- Improving organisational competitiveness to obtain wealth maximisation that exceeds cost of equity. This is potentially possible in this industry as its competitiveness exceeds the cost of equity; and
- if this is not possible divestment should be considered.

2.2.3 Quadrant C strategies

Organisational competitiveness exceeds the cost of equity or shareholders expectations, although the industry competitiveness is lower than the cost of equity. From this it can be derived that:

- On average, additional investments in this industry will have returns that are lower than the cost of equity; however
- the organisation's competitiveness in this industry are above average and above the cost of equity. It is therefore important to identify the success factors within the organisation, therefore the competitive advantage, so as to determine if further investments will be successful; and
- the standard deviation of the industry's competitiveness is important as a high standard deviation combined with above average organisational competitiveness indicates a higher probability of success.

Proposed capital investment strategies in this quadrant are based on:

- Whether the superior organisational competitiveness is due to identifiable competitive advantages that can be reproduced, then cautious capital allocation can be attempted; however
- if no competitive advantages can be identified and therefore not reproduced, then wealth maximisation should be captured without additional capital investments.

2.2.4 Quadrant D strategies

Both the *industry competitiveness* and the *organisational competitiveness* are lower than the *cost of equity* or shareholders expectation. From this it can be derived that:

- On average, additional investments in this industry will have returns that are lower than the cost of equity;
- improvement of the organisational competitiveness is required to above the cost of capital before further capital investments are to be made; and
- if no competitiveness improvements can be made to exceed the cost of equity, then this organisation should be divested.

An organisation within this quadrant can therefore be rated as:

- D+ if the organisational competitiveness is higher than the industry's competitiveness; and
- D– if the organisational competitiveness is lower than the industry's competitiveness.

Proposed capital investment strategies in this quadrant is based on:

- Divestment should be considered in D+ rated organisations, as improvement efforts to increase the organisational competitiveness would potentially be difficult and end in failure; and
- a D–rated organisation can improve its competitiveness to a C rate, if the positive standard deviation of the industry's competitiveness exceeds the cost of equity. This would potentially be difficult and could end in failure.

The analysis results are aggregated, by applying the *industry exposure* equation [Equation 3], to determine the corporation's required wealth maximisation performance. The corporation's wealth maximisation (ROE) is benchmarked against the cost of equity. Performance above the cost of equity indicates that the corporation's wealth maximisation is above shareholders expectations. The inverse is also true, as a corporate ROE below the cost of equity indicates a performance below the shareholders expectations.

$$ROE_{corporation} = = \frac{(ROE * Equity)_{industry\,A} + (ROE * Equity)_{industry\,B}}{Equity_{industry\,A} + Equity_{industry\,B}}$$

Equation 3: Industry exposure

The *strategic fit benefit* tests should be applied to all potential diversification strategies. The results from this analysis should be considered in combination with the proposed capital investment strategies.

2.3 Implementing the action plans

In implementation, the administrative activities of continuously measuring and controlling organisational performance against set targets and the timely allocation of resources to support the achievement of the set targets are required. This includes adapting the strategies by making modifications, as action plans can turn out to be incorrect and others, relating to details, cannot be made in advance.

Putting strategies into effect and getting the organisation moving in the chosen direction calls for a different set of managerial tasks and skills. Whereas crafting strategy is largely an entrepreneurial activity, implementing strategy is largely an internal administrative activity. Where successful strategy formulation depends on

vision, market analysis and entrepreneurial judgement, successful implementation depends on working through others, organising, motivating, culture building and creating a strong fit between strategy and how the organisation does things. Ingrained behaviour does not change simply because a new strategy has been announced.

A performance management process aimed at the successful implementation of the desired strategies requires addressing the following main aspects:

- Defining an implementation plan supported by target setting;
- tracking performance against the plan;
- positive and negative rewarding for performance against targets; and
- creating a series of strategic supportive fits.

The proposed implementation cycle or performance management process is illustrated in figure 6.

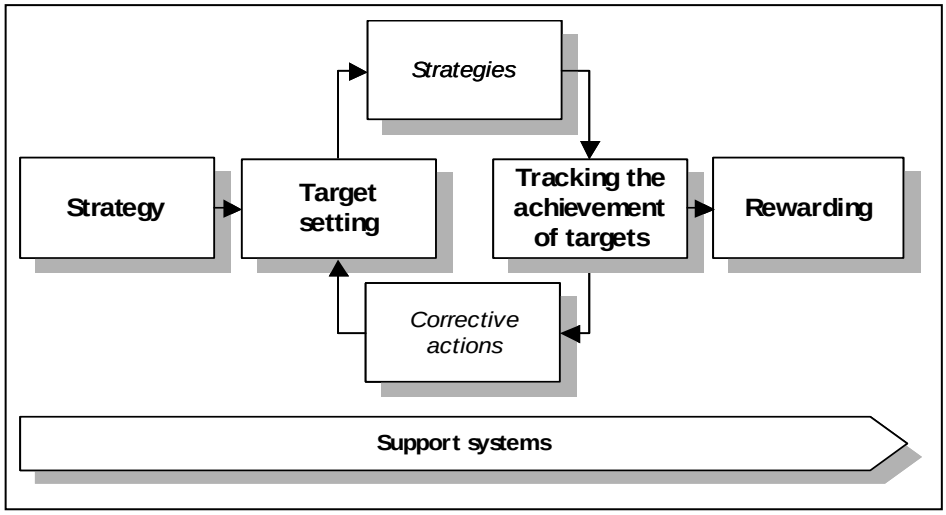

Figure 6: Implementation cycle

3. CONCLUSION

Applying a Strategic Industrial Engineering Philosophy, as a strategic tool, will lead to an improved capital productivity. *Strategic Industrial Engineering Philosophy* is therefore a purposeful expansion of the Industrial Engineering discipline aimed at realising the capitalistic organisational goal by improving the rate of wealth maximisation.

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