

## 5

# Management statistics

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## 5.1 Introduction

Management statistics is the basis for informed decision-making processes in every organization. It provides a systematic approach to measuring organizational performance. As such, it is fundamental to the pursuit of business excellence which, in turn, enables businesses to achieve their overriding goal of staying in business (Dransfield *et al.*, 1999).

Measurement of organizational performance relates to the impact of products and/or services produced by an organization on the environment in which the organization operates. The environment provides the organization with essential inputs that allow it to function, and absorbs its outputs. The extent to which an organization's inputs, processes, and outputs are in harmony with the environment determines its sustainability. For long-term sustainability, an organization needs to achieve two simultaneous outcomes: *satisfied stakeholders* (owners, employees, customers, and community) on the one hand, and its *own economic health* on the other. Organizational performance can be measured at three levels: strategic, tactical, and operational. In the framework of this chapter, we will have a detailed look at each of these.

In order to manage organizational performance successfully, managers should have at least an elementary knowledge of the following four fields in line with Deming's *Concept of Profound Knowledge* (Swift, 1995): systems and optimization theory; statistical theory; managerial techniques and procedures; and psychology. However, given the specific nature of their work and the level at which the organization's performance is measured, managers should strive to deepen their

understanding of individual fields in order to improve their own performance and the performance of their employees.

## 5.2 Types of indicators

Three different types of measures are needed in order to devise an approach to measurement of organizational performance which can be used at strategic, tactical, and operational levels within an organization:

- indicators of past performance (lag indicators);
- indicators of current performance (real-time indicators);
- indicators of future performance (lead indicators).

Typical *lag indicators* of business success are profitability, sales, shareholder value, customer satisfaction, product portfolio, product and/or service quality, brand associations, and employee performance. Most frequently used lag indicators are traditional accounting indicators. Unfortunately they do not allow the confident prediction of future success, but tend to be suitable only for control after the event (troubleshooting instead of managing improvement). Using the quarterly financial statement indicators to manage improvement is, for Dransfield *et al.* (1999), like steering a car along the road by looking in the rear-view mirror.

Significant *lead indicators* are the result of:

- customer analysis (segments, motivations, unmet needs);
- competitor analysis (identity, strategic groups, performance, image, objectives, strategies, culture, cost, structure, strengths and weaknesses);
- market analysis (size, projected growth, entry barriers, cost structure, distribution systems, trends, key success factors);
- environmental analysis (technological, governmental, economic, cultural, demographic, technological, etc.).

As pointed out by Aaker (2001), these are all elements external to organization. Their analysis should be purposeful, focusing on the identification of opportunities, threats, trends, uncertainties, and choices. The danger of becoming excessively descriptive should be recognized and avoided. Readily available industry measures (such as production, sales and stock indices, as well as employment indicators) regularly published by national statistical offices and other government bodies should also be included and interpreted in this framework.

Monitoring of lag and lead indicators is crucial at the strategic and tactical level, while *real-time* (process) *indicators* are important at the operational level.

## 5.3 Measurement of organizational performance at the strategic level

### 5.3.1 Key concerns

At the strategic level, typical concerns boil down to the direction the organization, facing the challenges and problems presented by the outside world, should take. Examples can be verbalized in questions such as:

- How should we respond to the terrorist threat to business?
- How should we respond to EU enlargement?
- Should we penetrate the Asian market?
- Should we review our employment policy?

Decision-makers at this level deal with typical ‘what if’-type problems which are generally of a qualitative nature. These are best dealt with in the framework of the PEST and the SWOT analysis.

### 5.3.2 PEST analysis

Political, economic, social, and technological (PEST) analysis is concerned with a framework of macro-environmental factors used when scanning the environment of a given organization. In combination with SWOT analysis, it is applied to gain an understanding of business and environmental factors such as market growth or decline, market potential, business position, and direction of operations.

*Political* factors under scrutiny are tax policy, employment laws, environmental regulations, trade restrictions and tariffs, and political stability. Prominent among the *economic* factors are economic growth, interest rates, exchange rates, and inflation rate. *Social* factors usually include population growth rate, age distribution, career attitudes, and perceptions of safety. *Technological* factors include ecological and environmental aspects and are used to determine entry barriers, minimum efficient production levels, and outcomes of outsourcing decisions. The PEST factors can be classified as opportunities or threats in the framework of SWOT analysis, which is discussed next.

### 5.3.3 SWOT analysis

SWOT analysis is a strategic planning tool used to evaluate organizational strengths, weaknesses, opportunities, and threats from the viewpoint of a business venture, project, or any other situation that demands decision-making. The technique is credited to Albert Humphrey, who led a research project at Stanford University in the 1960s and 1970s using data from Fortune 500 companies.

*Strengths* are defined as internal attributes that can help the organization to achieve the set objectives (e.g. a well-educated workforce). *Weaknesses* are internal attributes which are harmful to achieving the set objectives (e.g. obsolete machinery). *Opportunities* are external conditions helping the organization to achieve the set objectives (e.g. a low fuel price, development of a new market niche). *Threats*, on the other hand, are external conditions which are harmful to achieving the set objectives (for example the persistent terrorist threat in air traffic).

SWOT analysis is best performed in matrix form, combining external opportunities and threats with internal strengths and weaknesses to form the appropriate strategy as shown in Figure 5.1. In practice, SWOT analysis is usually applied in combination with techniques of creative thinking such as brainstorming, mind-mapping, and/or Delphi technique. These help identify the organization's strengths, weaknesses, opportunities and threats.

SWOT analysis		Internal perspective	
		Strengths	Weaknesses
External perspective	Opportunities	<i>SO strategies:</i> Build on organization's strengths to make use of opportunities.	<i>WO strategies:</i> Eliminate weaknesses to enable new opportunities.
	Threats	<i>ST strategies:</i> Use organization's strengths to divert threats.	<i>WT strategies:</i> Develop strategies to avoid weaknesses that could be exploited by threats.

Figure 5.1 The SWOT matrix.

### 5.3.4 Statistical skills required by management

Ograjenšek (2002) defines *quantitative literacy* in terms of three components:

- *statistical literacy* (ability to select, use, and interpret results of the proper statistical method to solve a given problem);
- *computer literacy* (ability to use the proper statistical software to solve a given problem); and
- *web (on-line) literacy* (ability to find and access data and metadata on-line).

At the strategic level, it is web literacy, rather than the statistical literacy, of managers that is the most important component of quantitative literacy, since dealing

with ‘what if’-type problems often calls for thorough research based on secondary statistical data (e.g. demographic and economic projections prepared by national statistical offices or central banks), and a growing number of secondary statistical resources are accessible on-line.

## 5.4 Measurement of organizational performance at the tactical level

### 5.4.1 Key performance indicators

The key concern of tactical management is the proper implementation of strategic goals. Typical problems encountered in the process include definition of desired leadership characteristics and employee competences, preparation of short-term plans, and establishment of an efficient performance management system based on the so-called *key performance indicators* (KPIs).

Examples of KPIs include (Dransfield *et al.*, 1999):

- *owner-related measures* – profitability, revenue, costs, market share, relevant efficiency measures (for example cycle time);
- *customer-related measures* – on-time delivery, complaints, response time;
- *employee-related measures* – indicators of absenteeism, safety, labour turnover, competencies;
- *community-related measures* – safety, outcomes of environmental audits.

There are three complementary approaches to setting up a system of evidence-based KPIs in an organization. We initially present the integrated model used to map out cause-and-effect relationships, go on to discuss the balanced scorecard that provides management with a navigation panel, and conclude with a brief introduction to economic value added (EVA), an economic model measuring the creation of wealth.

### 5.4.2 The integrated model

The *integrated model* is designed to map out cause-and-effect relationships to help improve management decisions (Kenett, 2004; Godfrey and Kenett, 2007).

Sears, Roebuck and Co. implemented the first example of an integrated model with what was called the employee-customer-profit model (Rucci *et al.*, 1998). The cause-and-effect chain links three strategic initiatives of Sears – that is, to be:

- a compelling place to work;
- a compelling place to shop; and
- a compelling place to invest.

To push forward these initiatives Sears' management looked for answers to three basic questions:

- how employees felt about working at Sears;
- how employee behaviour affected the customer shopping experience; and
- how the customer shopping experience affected profits.

The model presented in Figure 5.2 reflects detailed answers to these questions and identifies the drivers to employee retention, customer retention, customer recommendation, and profits. Sears have been able to map out these variables and determine that, for them, a 0.5 increase in employee attitude causes a 1.3 unit increase in customer satisfaction, which creates a 0.5 % increase in revenue growth.

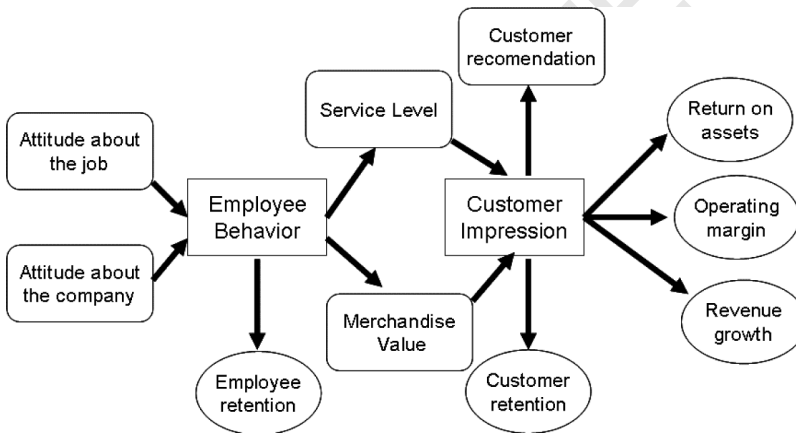


Figure 5.2 The integrated model (Rucci *et al.*, 1998).

As another example, we show data from a company specializing in home office delivery (HOD) of water bottles in Figure 5.3. We established that increase in employees' satisfaction with their immediate supervisor, by branch, is directly related to customer satisfaction at that branch. In the six branches investigated, higher employee satisfaction correlates well with higher customer satisfaction. We can almost exactly predict customer satisfaction on the basis of employee satisfaction level.

Yet another example of an integrated model is the national customer satisfaction barometer, which is a measure for evaluating and comparing customer satisfaction across products, companies, and industries. Sweden was the first to successfully implement the barometer in 1989 (Fornell, 1992). Following the Swedish prototype, the American Customer Satisfaction Index (ACSI) was developed in a joint project of the American Quality Foundation and the University of Michigan Business School (Fornell *et al.*, 1996; Anderson and Fornell, 2000).

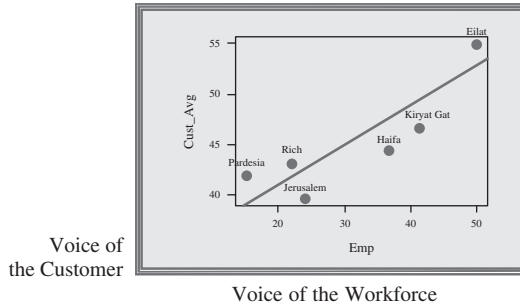


Figure 5.3 The relationship between employee and customer satisfaction (Kenett, 2004).

The ACSI is a structural equation model with six endogenous variables measuring perceived and expected quality, perceived value, satisfaction level, customer complaints, and customer retention (see Figure 5.4). In order to assess the customer satisfaction level a partial least squares (PLS) analysis is conducted of exogenous data gathered through telephone surveys. Similar projects have also been developed and implemented in Asia, Europe, and South America (among them the European Customer Satisfaction Index, introduced in 1999).

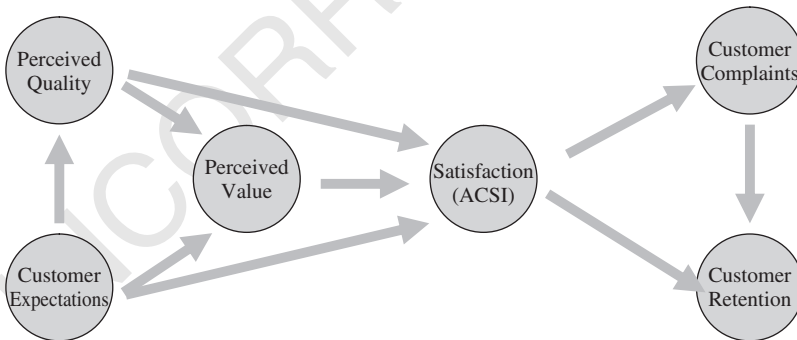


Figure 5.4 The relationship between employee and customer satisfaction.

### 5.4.3 Balanced scorecard

To translate vision and strategy into objectives, Kaplan and Norton (1992) created the *balanced scorecard*. This is meant to help managers keep their finger on the pulse of the business. Each organization will emphasize different measures, depending on their strategy. Management is, in effect, translating its strategy into objectives that can be measured.

The balanced scorecard helps organizations identify and track a number of financial and non-financial measures to provide a broader view of the business. Data analysis is not limited to accounting data. A company may decide to use

indicators of process efficiency, safety, customer satisfaction or employee morale. These may capture information about current performance and indicate future success. The aim is to produce a set of measures matched to the business so that performance can be monitored and evaluated.

Leading variables are future performance indicators, and lagging variables are historic results. We already know that financial measurements are typically lagging variables, telling managers how well they have done. On the other hand, an example of a leading indicator is training cost, which influences customer satisfaction and repeat business. Some variables exhibit both lagging and leading characteristics – for example, on-time deliveries are a lagging measure of operational performance and a leading indicator of customer satisfaction.

The balanced scorecard usually has four broad categories, such as financial performance, customers, internal processes, and learning and growth. Typically, each category will include two to five measures. If the business strategy is to increase market share and reduce operating costs, the measures may include market share and cost per unit.

Another business may choose financial indicators that focus on price and margin, willingly forgoing market share for a higher-priced niche product. These measures should be set after the strategy is in place. A list of objectives, targets, measurements and initiatives comes with each variable. The saying ‘we manage what we measure’ holds true. One reason why the balance scorecard works is that it raises awareness. A sample balanced scorecard is presented in Figure 5.5.

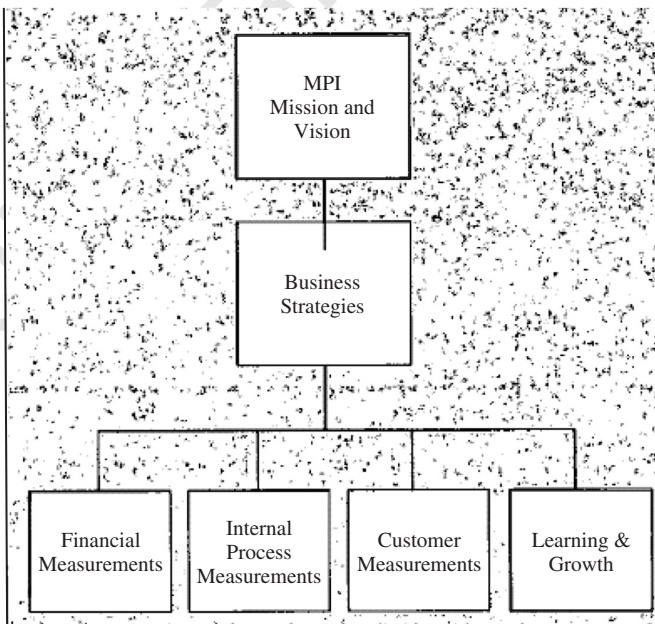


Figure 5.5 A sample balanced scorecard (Gordon and Gordon, 1998).

Although the balanced scorecard is typically used in the private sector, examples of its application in the public sector are also known. The public sector management of Charlotte (North Carolina) has been using this framework to manage the city. Their scorecard includes performance indicators that track improvements in community safety, quality of transportation, economic development, and effectiveness of government restructuring. Other more local measures of fire prevention, garbage collection, and sidewalk maintenance are used for individual departmental scorecards. This illustrates the flexibility of the scorecard and re-emphasizes the point that the scorecard measures can be determined only after the overall strategy is accepted and understood.

The balanced scorecard, if properly implemented, is an excellent management framework that can help managers to track different factors which influence performance. But it lacks a single focus for accountability. Management needs one overriding goal to summarize the interaction between the variables and, ultimately, determine success. Shareholders entrust management with the implementation of strategy but their primary concern is earning an adequate return on their investment. EVA, a measure discussed in the next subchapter, tells us whether managers have correctly balanced the scorecard measures.

#### 5.4.4 Economic value added

*Economic value added* is the one measure used to monitor the overall value creation in a business. There are many value drivers that need to be managed, but there can only be one measure that demonstrates success. A single measure is needed as the ultimate reference of performance to help managers balance conflicting objectives – and that measure is EVA.

The EVA measure was created by Stern Stewart & Co. (Stewart, 1991) to address the challenges companies faced in the area of financial performance measurement. By measuring profits after subtracting the expected return to shareholders, EVA indicates economic profitability. As shown in empirical studies (Boulos *et al.*, 2001), EVA tracks share prices much more accurately than earnings, earnings per share, return on equity or other accounting metrics. Creating sustainable improvements in EVA is the same as increasing shareholder wealth.

EVA is not a new concept. Economists have known about the residual income framework for years, but businesses have only recently begun to make the switch from managing for earnings to managing for value. EVA has facilitated this process by providing practical applications that operating managers can use. One of the great benefits of the balanced scorecard is that it illuminates the objectives which drive the strategy. In the same manner, EVA provides a common language across the organization. Typically, different metrics are used for different processes. For example, sales growth and market share are discussed when strategy is formulated, net present value or internal rate of return (IRR) are calculated when capital investments are considered, earnings and earnings per share are considered when an acquisition is contemplated, yet trading profit is used when bonuses are determined. Which do you manage? Managers who use IRR to get a project approved

do not need to worry about their actual performance because IRR cannot be used to measure performance in the middle of a project. Managers who are rewarded against a budget know that budget negotiation skills can be more lucrative than actually delivering results.

EVA can be the single metric used in all of these management processes. When decisions are made, performance is measured and compensation is determined. By using the same measurement you get accountability. EVA thus simplifies the lives not only of tactical but also of operating managers, who barely understand the interaction between the multiple existing measures.

#### 5.4.5 Managerial commitment as the basis of an efficient performance management system

At the tactical level, managers' statistical and computer literacy are the most important components of quantitative literacy. This is similar to the operational level, yet with a different focus.

All three complementary approaches to setting up evidence-based KPIs in an organization begin with new measurement techniques. At the outset, it is important to understand the barriers that can prevent a project from becoming successful. Creating more or better information is not necessarily going to lead to better decisions. In fact, adding another measurement to the existing pile of measurements will actually complicate matters. Managers must be motivated to act upon their new information. When managers are not rewarded for making the right decision, the right decision will rarely be made.

Another critical factor is achieving a balance between simplicity and accuracy. An overly complex model may be more accurate, but the project could collapse under the weight of mountains of data that hide the relevant facts. And, as an overly complex model may be too difficult for managers to understand, an excessively simplistic model might lead to the wrong decisions.

Senior management commitment is imperative for the project team to receive the support necessary to deliver results. Without this commitment, the project will be viewed as another 'flavour of the month' or, worse, another 'bean-counter' initiative. The desired result is not to get better information, but to increase the value of the organization. The only way these frameworks will help achieve this goal is by using the new information to make the right decisions. People, not information, add value to the organization, so the project must positively affect management behaviour to be successful.

Long-term, sustainable increases in performance will come when an organization's culture is transformed from one focused on doing one's job to one centred on value creation. The implementation of a measurement system alone will not create sustainable changes. Freedom to act upon the information can only be delegated when there is accountability for the results. A compensation plan that properly rewards the desired actions is needed to expect true 'owner-like' behaviour.

The integrated model, the balanced scorecard and EVA are complementary tools that can help a company achieve greater success in the current dynamic and

competitive business environment. The integrated model can help managers understand the cause-and-effect relationships of their decisions. The balanced scorecard broadens the view of performance to include financial and non-financial indicators of both a leading and lagging nature. EVA provides a link between decisions, performance measures, and rewards, which focuses managers on creating value.

These frameworks help managers focus on performing better. Regardless of whether one of these tools has already been implemented, the other two should be considered for implementation. Managers perform best when they have the information, decision frameworks, performance measures, and rewards that motivate them to behave like owners. It is important to have a good strategy, but it is just as important to have managers who are motivated to execute the strategy and achieve results.

## 5.5 Measurement of organizational performance at the operational level

### 5.5.1 Key concerns and prerequisites

Operational management is directly concerned with processes in which people within an organization interact to create value-added products and services (Dransfield *et al.*, 1999). Examples of dilemmas at this level are illustrated in the following list:

- How could we improve the capacity of this product line?
- How many temporary workers should be hired during the summer?
- Should this batch be reworked?
- Why is this process suddenly out of control?

An understanding of variation is the key prerequisite for measurement of organizational performance at the operational level. All processes in the company are functions of five elements: materials, people, machines or equipment, methods or procedures, and environment (Beauregard *et al.*, 1992: 15). There is variation in each element; each element thus contributes to variation in the process output as shown in the following formula (which should be understood as a simple illustration, not a statement about linear nature of links among the elements):

$$V_{\text{mat}} + V_{\text{p}} + V_{\text{mach}} + V_{\text{met}} + V_{\text{env}} = V_{\text{po}}.$$

Here  $V_{\text{mat}}$  denotes variation in materials,  $V_{\text{p}}$  variation in people (e.g. their knowledge, abilities, willingness to work),  $V_{\text{mach}}$  variation in machines (equipment),  $V_{\text{met}}$  variation in methods (procedures),  $V_{\text{env}}$  variation in environment, and  $V_{\text{po}}$  variation in process output. Interaction among process inputs yields the process output. Since the variation of process inputs inevitably contributes to variation in the process

output, analysis is necessary to determine whether process adjustments have to be made or not.

The roots of variation are either in common or special causes. *Common* causes of variation are reflected in the so-called chronic or historic variation, which seems to be an inherent part of the process. It can only change if the process itself is changed. This type of variation can be reduced in the process of continuous quality improvement based on the Deming (PDCA) cycle which is designed as a continuous four-step problem-solving approach.

*Special* causes of variation are due to acute or short-term influences that are not normally part of the process as it was designed or intended to operate. Statistical process control (SPC) is the tool to use in order to reduce the influence of special causes. For Juran (1989: 28) finding and eliminating them is similar to fire fighting, since there is no permanence in achieved solutions.

Historically, quality management was concerned with finding and eliminating the special causes of variation. Juran (1989: 29) talks about the *original zone of quality control* as opposed to the *new zone of quality control*, in which finding and eliminating the common causes of variation presents an opportunity for continuous quality improvement.

### 5.5.2 Key tools at the operational level

Measurement of organizational performance at the operational level follows the essence of the Deming cycle: it is a continuous revision and improvement of existing standard operating procedures, as well as replacement of existing standards with new, improved ones. Its continuity is viewed as the best warranty against bureaucratization of processes and their components. The cycle has four steps, as shown in Figure 5.6, and described briefly as follows:

- *Plan*. An area for improvement is chosen. Data are collected, the current state of affairs is analysed, and problems are identified. Action plans for change are prepared with the goal of process improvement in a pre-specified time framework.
- *Do*. The action plan is executed and changes are implemented. Detailed records of executed steps, gaps between goals, and actual outcomes of planned activities, as well as possible changes of goals, are usually prepared in order to be reviewed in the next step of the cycle.
- *Check*. The results of the previous step are studied in detail. Gaps between planned goals and actual outcomes are given special attention.
- *Act*. A proper reaction to both wanted and unwanted results of the previous steps is the essence of this phase. If the results are satisfactory, companies are prompted to standardize and institutionalize the procedures in which they were achieved, thus making them known and available to all employees. Where the results unsatisfactory are, procedures have to be revised and either improved or discarded.

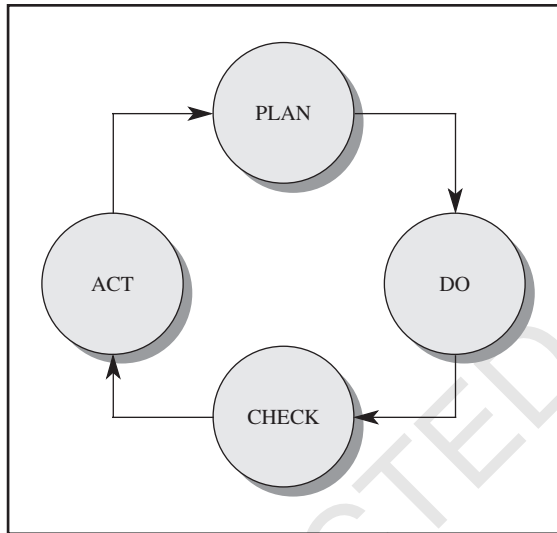


Figure 5.6 Deming (PDCA) cycle.

The use of statistical methods plays a very important role in all four steps of the Deming cycle, be it in the analysis of factors influencing the current state of affairs, forecasts of future developments, or comparisons of planned goals and actual outcomes.

In the framework of the Deming cycle, Ishikawa (1985) popularized a set of seven simple tools for employees to use (usually without any in-depth statistical training):

- *Check sheets* are the simplest and easiest-to-use data collection sheets which often serve as memory joggers to make an operation or a process mistake-proof. Maintenance personnel use them when performing preventive maintenance to ensure they do not overlook a step. Interviewers use them to determine whether a candidate meets all requirements for a job.
- *Pareto charts* help graphically separate the few most important causes of a problem from the many trivial ones. In the analysis of order errors or invoice errors Pareto diagrams can be made by type of error, by cause, or by employee.
- *Histograms* display attribute and variable data in order to discover data patterns. In a truck rental company, for example, accidents can be analysed by cause, by truck type, by truck age, by time of the day, by length of rental, and so on.
- *Scatter plots* depict a relationship between two variables. They are useful for determining if one variable is dependent on another, for showing how

a dependent variable responds to change in an independent variable (cause-and-effect analysis) as well as for predicting the response of a dependent variable to a setting of the independent variable that has not previously been measured.

- *Control charts* help evaluate whether a process is within the preset statistical limits. They are useful when assessing material quality, on-time delivery performance, the supplier or employee response to inquiries and similar.
- *Flowcharts* – also called *service maps* or *service blueprints* – show how steps in any process (e.g. invoicing process or work order process) are linked together.
- *SPC* combines the use of control charts and flowcharts with the goal of reduced process variability.

The simplicity of their use is the reason why these tools are applied in production and service facilities around the world on a daily basis.

### 5.5.3 Key skills at the operational level

According to Fortuna (1992: 20–21) unfamiliarity with the concept of variation can have serious consequences:

- management failing to understand past performance and embarking on a fruitless search for a definitive cause of a single observed occurrence;
- management accepting wrong conclusions about past performance and trends, which can lead to flawed plans for the future;
- management acting or reacting to trends that are perceived but do not actually exist, or management failing to act when the data signal a systematic shift;
- management rewarding and punishing people for system faults – things over which they have no control because the inherent variation in the system is independent of individual performance.

For all these reasons, Snee (1999: 143) argues that an understanding of variation should be regarded as the core competence of statisticians, one giving them competitive advantage over other experts. Thyregod and Conradsen (1999: 145) add that, apart from statistical thinking, statisticians also need to understand business and management issues so that they can address problems in their proper context and prioritize the necessary efforts in accordance with the order of effectiveness and the principle of diminishing returns.

It would seem that at this level a knot should be tied between managerial competences and statistical as well as computational skills – the way it is done in the framework of the Six Sigma approach where the proactive manager with profound statistical skills strives to anticipate and avoid problems in the never-ending quest to improve operations, and, ultimately, the bottom line.

## 5.6 The future of management statistics

What future for management statistics? The need for evidence-based management has never been greater. The institutional framework for consistent use of management statistics – a quality management system – seems to be in place in most organizations. Where, then, lies the problem?

Although Czarnecki (1999) claims that the quality movement represents an impetus for measurement, it could be ascertained that even ISO-certified companies focus primarily on the philosophy inherent in total quality management, without really embracing the statistical methodology. In other words, concepts such as quality circles, or Deming's fourteen points, have been widely accepted and used. Statistical aspects of quality management, on the other hand, have usually remained the neglected component of certified quality management systems, due to measurement problems and the quantitative illiteracy of employees. Of the two problems, quantitative illiteracy is doubtless the more problematic to overcome. According to Gunter (1998),

ISO-mania is symptomatic of an ever more pervasive decline in the quality profession . . . the retreat from quantitative methodology to soft quality . . . [which] emphasises human relations, personnel organisation, communications procedures, meeting conduct, and the like. I do not wish to dismiss this stuff as useless; some is both necessary and important. However, without the core quantitative disciplines that actually measure and effect real improvement, it ends up being mere fluff and distraction – all form and no substance. . . . I believe that the flight from quantitative methodology in general – and statistical methodology in particular – is basically a capitulation. . . . It is a lot easier to send everyone through a class on how to hold better meetings or improve interdepartment communication than it is to learn SPC or experimental design. So by dismissing quantitative methods as inadequate and ineffective, one avoids having to expend that effort.

The fact is that most MBA courses on quality management do not incorporate statistical aspects, which probably makes them easier to sell. The negative attitude of (business) students towards statistics is well documented (Gordon, 1995; Sowe, 1998; Francis, 2002; Martin, 2003; Ograjenšek and Bavdaz Kveder, 2003) and countless discussions on how to overcome it have not yet managed to produce any long-term satisfactory results.

Because older versions of the ISO 9001 standard address the issue of statistical analysis in two very general, very brief paragraphs (see Box 5.1 for the 1994 version), and the necessary links to International Statistical Standards were first published in 1999 (ISO/TR 10017:1999), such setting of priorities comes as no surprise.

In the 2000 version of the standard (ISO 9001: 2000) a more process-based structure was introduced together with an increased focus on continuous quality improvement and customer orientation. This version emphasizes an evidence-based

**Box 5.1** Clause 4.20 of ISO 9001: 1994.

## **4.20 STATISTICAL TECHNIQUES**

### **4.20.1 Identification of Need**

The supplier shall identify the need for statistical techniques required for establishing, controlling and verifying process capability and product characteristics.

### **4.20.2 Procedures**

The supplier shall establish and maintain documented procedures to implement and control the application of the statistical techniques identified in 4.20.1.

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approach to decision-making, and accordingly deals with issues of measurement, analysis and improvement in much more detail in its clause 8 (see Box 5.2 for the general requirements in clause 8.1).

**Box 5.2** Clause 8.1 of ISO 9001: 2000.

## **8 MEASUREMENT, ANALYSIS AND IMPROVEMENT**

### **8.1 General**

The organisation shall plan and implement the monitoring, measurement, analysis and improvement processes needed

- a)** to demonstrate conformity of the product,
- b)** to ensure conformity of the quality management system,
- c)** to continually improve the effectiveness of the quality management system.

This shall include the determination of applicable methods, including statistical techniques, and the extent of their use.

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Standardization, ISO. These standards can be obtained from any ISO member and from the Website of ISO Central Secretariat at the following address: [www.iso.org](http://www.iso.org). Copyright remains with ISO. Reproduced with permission from ISO.

Apart from the general requirements provided in clause 8.1, clause 8 also includes guidelines on measurement of customer satisfaction, internal audits, monitoring and measurement of processes, as well as monitoring and measurement of products. Furthermore, the clause addresses the control of measurement systems, non-conforming products, and the issue of data analysis. Despite the heroic effort in the update of the guidance document ISO/TR 10017: 2003 to present a list of ISO 9001: 2000 clauses, clause by clause, and an identification of need for quantitative data and appropriate statistical techniques associated with the implementation of the clauses, it is, however, questionable whether this important revision of the standard and the guidance document can result in rapid positive changes of attitude towards the use of the statistical toolbox in companies with ISO-certified quality management systems.

This doubt is further reinforced by awareness that statistical methods have always been used more frequently in those companies whose production vitally depends on statistical trials (e.g. in chemical, pharmaceutical or food industries). Overall, however, during the whole total quality management and ISO certification boom, the promotion of the use of statistical methods was systematically neglected both at the company level and at the level of economy as a whole – and has been to this day, although solutions are proposed from time to time.

European statisticians carry their share of responsibility for such a state of affairs. It is therefore of the utmost importance that they recognize the need to establish a professional network. Such a network, which should connect theoretical and applied statisticians and statistical practitioners who, in their professional environments, have lacked interaction with and stimulation from the like-minded professionals, was founded in December 2000 as the European Network for Business and Industrial Statistics (ENBIS). Its mission and goals are presented in Box 5.3.

**Box 5.3** ENBIS mission and goals.

The mission of ENBIS is [to]:

- Foster and facilitate the application and understanding of statistical methods to the benefit of European business and industry,
- Provide a forum for the dynamic exchange of ideas and facilitate networking among statistical practitioners (a statistical practitioner is any person using statistical methods whether formally trained or not),
- Nurture interactions and professional development of statistical practitioners regionally and internationally.

Additionally, ENBIS also strives:

- To promote the widespread use of sound science driven, applied statistical methods in European business and industry, . . .
- To emphasize multidisciplinary problemsolving involving statistics,
- To facilitate the rapid transfer of statistical methods and related technologies to and from business and industry,
- To link academic teaching and research in statistics with industrial and business practice,
- To facilitate and sponsor continuing professional development,
- To keep its membership up to date in the field of statistics and related technologies,
- To seek collaborative agreements with related organizations.

Source: <http://www.enbis.org/index.php?id=9> (accessed September 2007).

Functioning as a web-based society, ENBIS connects members who feel that statistics is vital for economic and technical development, and, consequently, improved competitiveness of European companies. Therefore, the ENBIS initiative has to be hailed as an important step in giving the quantitative aspects of management – and consequently management statistics – the attention they deserve.

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