

Evolution of the “OS Wheel” Model of Operations Strategy in Continuous Manufacturing Industry

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Abstract

Malcolm Baldrige National Quality Award-BNQA-SA was introduced in 1987 in US companies to create overall excellence in all parts of an organisation, leading to “integrated companies” as the ultimate goal for sustained performance by using the Baldrige Excellence Framework (BEF). The “Balanced Score Cards” (BSC) methodology, as an instrument of designing, cascading and communicating strategy, was introduced in 1992. Operations excellence is an outcome of a well-designed, monitored and implemented operations strategy (OS). This paper traces the evolution of an “OS Wheel” model of operations strategy, for continuous manufacturing industries (CMI), deployed using the BEF, using BSC’s, to achieve performance excellence and sustained competitive advantage. The model was applied in a large scale, CMI company in India, over a period of fifteen years (a longitudinal study), the description of which will demonstrate its utility.

Keywords

MBNQA, BE, OS, QOS, OS Wheel, BSC, Total Quality Management (TQM), Plan-Do-Check-Act (PDCA), CMI, Standardise-Do-Check-Act (SDCA), Longitudinal Study

1. Introduction

The scoring band descriptors of the BEF [1] provide a roadmap to create a world class integrated organisation. Such an organisation is scored at or more than 600 in the MBNQA, out of a maximum of 1000. Beginning at that score, an organisation can move further up, say, to over 700, by improving the maturity of the integration [1]. Business strategy and operations strategy are two major compo-

nents of this framework.

In CMI, the operations value chain is a series of interconnected activities, in a unidirectional flow, with value addition increasing continuously in the direction of the finished product. The upstream activities, like, issue of raw materials, the manufacture and packaging, are followed by downstream activities, like, finished goods storage, logistics, distribution, and, finally, customer returns and customer complaints handling. Industries such as iron and steel, aluminium, pharmaceutical, production of industrial gases like ammonia, oxygen, hydrogen, oil and gas refineries, typify CMI. CMI is characterised by high volumes of production, and a high degree of processing at each stage of value-add. These activities are summarised in **Figure 1** and called the Operations Value Chain (OVC) diagram in a CMI.

The operations strategy (OS), in the case of CMI, is done over the medium and long term of 3 to 10 years. This is largely because of the capital-intensive nature of such industries, as well as the long gestation periods. For example, it takes about five years to put up a 2 mtpa integrated iron and steel plant, which could cost about Rs 10,000 crores (or about 1.5 billion USD). Similarly, it takes the same time to put up a large oil refinery, with a similar capital outlay. CMI becomes profitable only over the medium to long term. Typically, such businesses earn low margin, with PAT/Sales percentages varying from 2 to 7.

This paper describes the development of the “OS Wheel” model for OS in CMI. The model is so named because it is a dynamic combination of five principal

Materials procurement	Inward materials receipt	Production Planning and Control	Systems certification	Distribution	HR for Operations
Vendors and suppliers management	Inward inspection	Inspection, Quality Control	TQM and Business Excellence, continuous improvement	Customer returns	Administration for Operations
Inward logistics	Unloading and storage	Process Control	Maintenance	Customer Complaints Handling	Operations strategy group
Inventory control	Store keeping	Technology scanning, selection, planning	Manufacturing	Project Management	COO's Office
Strategic sourcing	Issue to manufacturing	Engineering and Development	Research and Development	Packaging and FG stores	

Figure 1. Operations value chain diagram in a CMI (typical).

activities, viz., top management commitment/leadership, teams, culture, training/education, and process efficiency [2] [3], which make OS in a CMI a continuously rotating “wheel” in an upward spiral. The wheel symbolises dynamism and a continuously evolving process (PDCA), while the upward spiral symbolises the continuous upward movement of the outcomes (SDCA-Standardise, Do, Check and Act). The sequence of steps in which this paper is written and the logic is shown is as below:

Step 1:

Since the OS Wheel is embedded in BEF/EFQM type of business excellence models which promote development of “integrated organizations”, it can be practised only by companies using the BEF (or equivalent, like EFQM). Therefore, this paper gives a brief overview of MBNQA/BEF.

Step 2:

Organizational transformation is a pre-requisite to practice BEF and create the “integrated organization”. Kotter and others have developed a substantive literature on the practices of such transformations. Hence, we describe the close link between such transformational mechanisms and the BEF.

Step 3:

Competitiveness is a pre-requisite for sustainability, which characterizes “integrated organizations” created through the “Kotter enabled” transformation. Well evolved business and operations strategies are needed to make an organization competitive through performance excellence. We describe the literature about sustainability and competitiveness and show that competitiveness and sustainability go hand in hand.

Step 4:

Competitiveness can be sustained only through operations strategy (OS). OS practiced under the BEF and organizational transformation framework is termed as Quality Operations Strategy (QOS). Hence, we describe the OS and QOS.

Step 5:

SDCA (Standardize, Do, Check, Act) is the practice of PDCA with “holding the gains” through standardization, thereby providing a continuous, upward direction for improvements. This is the “Upwardly Moving Spiral”. Development of the “OS Wheel”, for use in CMI (Continuous Manufacturing Industry), to achieve competitiveness and sustainability using SDCA, will lead to sustained competitive advantage and performance excellence. This paper introduces the term “OS Wheel”, and provides a detailed explanation of the OS Wheel process.

Step 6:

Finally, we describe the development and benefits achieved by using the OS Wheel in a large integrated steel company in India, which is a part of CMI, using a longitudinal study method.

1.1. Purpose of Research

The purpose of this research is to respond to the question: is there an operations

strategy (OS) model for CMI to enable creation of a sustainable competitive advantage in the marketplace? What are the components of this model? What are its key building blocks? How will it be designed and implemented?

1.2. Methodology

Barnes [4], codified the various methods, their rationale and usefulness to the community of operations strategists to design and implement OS. He proposed three requirements of an OS: should be a combination of the intended and the emergent, should take the organisational context into account and should contain adequate level of details to meet the purpose of the research. He also showed that a “strategy charting case study” methodology, preferably a longitudinal study, as also “documentation”, are acceptable ways to study and develop OS constructs.

The study by Rytter *et al.* [5] (using the case of a Danish company) and Smith [6] (using the case of Unilever company), are examples of the approaches advocated by Barnes [4]. Both are longitudinal studies.

This paper is a longitudinal study between the years 1987 and 2003, when, beginning with OS, the process evolved to QOS and, finally, to the OS Wheel, in one of India’s largest integrated iron and steel producer in the private sector, The Tata Iron and Steel Company Limited, (Tata Steel, for short). Amongst the many distinctions that this company has achieved, the one most coveted is perhaps the “world’s lowest cost steel producer” tag.

The qualitative and action research methodology [7] [8], using a longitudinal case study, and following the guidelines established by Barnes, have been adopted for this research. A foundation to establish the need for the OS Wheel model is laid, in three parts, viz., adoption of BEF, practice of organisational transformation leading to sustainability, and development of long-term competitiveness through OS/QOS. The OS Wheel model is then described, as a continuum of the QOS. Its usage in a large CMI company, and the results obtained, using a longitudinal study methodology, are then presented, to establish the efficacy of the OS Wheel.

2. Describing the Evolution of the OS Wheel: BEF, Sustainability, Competitiveness, OS and QOS

2.1. BEF and Sustainability

The 2010 United Nations Global Compact-Accenture CEO study [9] found that 93 per cent of CEOs believe sustainability will be critical to the future success of their companies. A critical mass of business leaders, 80 per cent, believes a tipping point will be reached within the next 15 years when sustainability will be automatically embedded in the core business and strategies of most companies, and 54 per cent believe this tipping point could be reached within the next ten years [10]. The BEF, which anticipated this trend in 1987, is shown in **Figure 2** below:

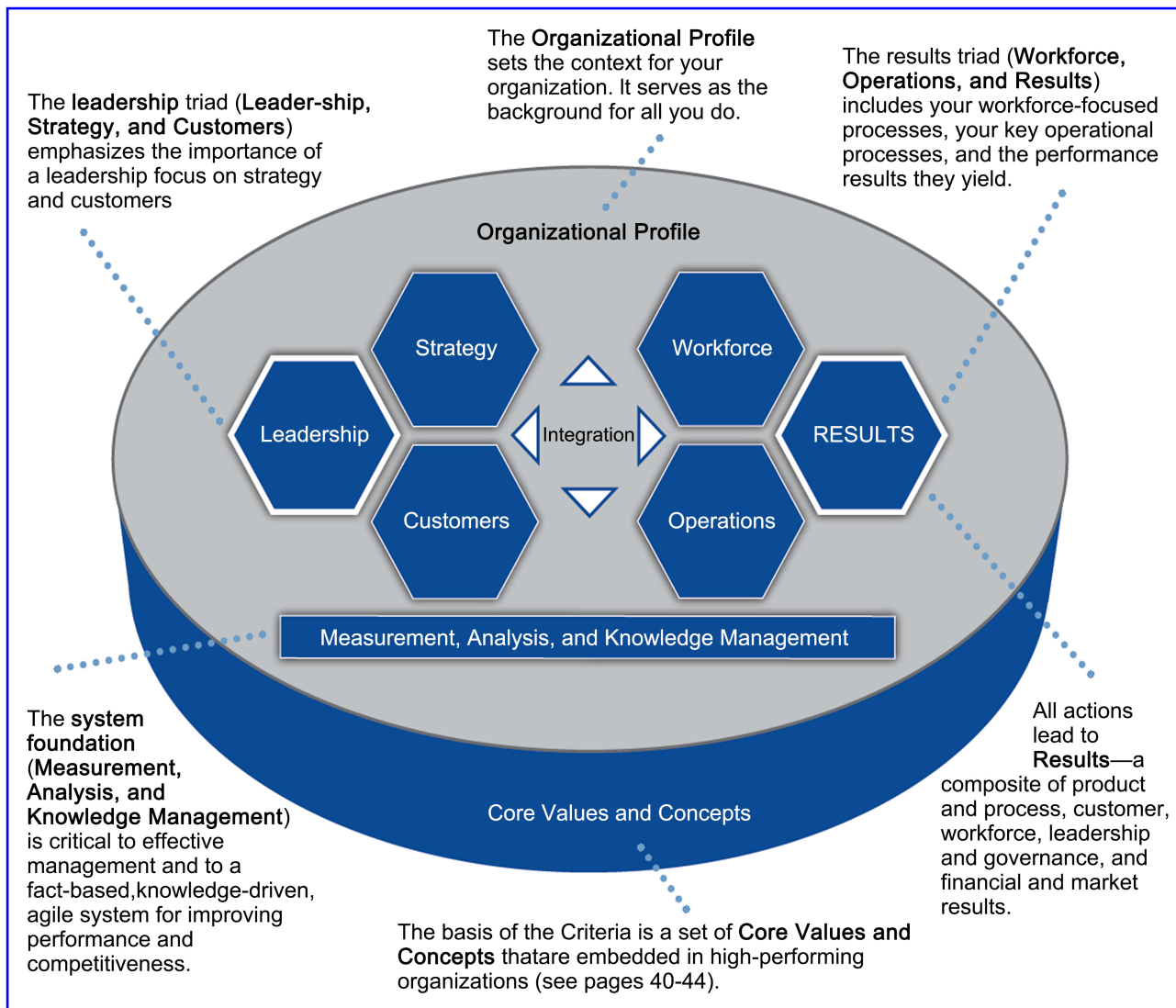


Figure 2. The framework of the Baldrige Performance Excellence Model 2017-2018 (source: <https://www.nist.gov/baldrige>).

For each element of the framework, of which there are seven, a complete set of questions to be responded to have been provided [1]. A company, which wants to adopt the BEF, should identify actions that need to be taken to address the requirements of the questions. The status of the actions is assessed by a team of Baldrige experts, assessors who are trained in evaluating the status against a set of criteria, which contains “band descriptors” and the associated scoring ranges and indicate scores against each of the seven chapters, viz., leadership, strategy, customers, measurements, analysis and knowledge management, workforce, operations and organisational results - totalling up to a maximum of 1000 points. Any company whose aggregate score is above 600 is rated as “excellent” and becomes an MBNQA winner. Other gradations are also defined, such as, “early stage” (for a score of up to 250), and so on. For more details, the reader is referred to [1].

The objective is to score 600, to win the award. In the process, the company

becomes a practitioner of performance excellence. Such a company can, if it continues to score progressively above 600, become an integrated company and a sustainable leader.

An integrated company is characterised by the following: key processes are linked in the predecessor-successor way (for example, marketing and production) and in a parallel, supportive way (for example, HR, finance, administration) [1]. Strong, well-designed and frequently tested and improved process linkages, using cross functional teams, establish synergistic connectivity between functions and departments, enabling them to function in harmony and synchronicity. Integration enables companies to respond speedily to market stimuli, to innovate, to anticipate and prepare for the future, to design and run effective processes. Integrated companies are created as a result of addressing the BEF methodology continuously, using the PDCA, TQM and other tools of management excellence. Integrated companies react and pro-act as one composite unit, similar to the human body. Such companies are able to save on energy consumption, reduce waste, which ingest sustainability. Sustainability is the result of reducing consumption, producing more using less, using eco-friendly products and services as well as processes. Sustainability is achieved progressively by reducing carbon footprint by innovating new work methods to stay environmentally friendly.

The BEF is designed around a set of eleven “core values”. These are considered essential for the practice of performance excellence. That a set of “core values” is essential for practising excellence has been established by Dahlgard *et al.*, [11]. Emphasis on sustainability is evident throughout in the BEF.

For example, under the “Leadership” category is a query on the practices pertaining to sustainability:

Legal and Regulatory Compliance [1]

1.2.(b).1 How do you address and anticipate legal, regulatory, and community concerns with your products and operations? How do you

- address any adverse societal impacts of your products and operations;
- anticipate public concerns with your future products and operations; and
- prepare for these impacts and concerns proactively, including through conservation of natural resources and effective supply-chain management processes, as appropriate?

Apart from the above, the core values of the BEF, which include societal responsibility, systems perspective, ethics and transparency and managing innovation, taken together and individually, address the sustainability aspect of businesses completely. Other core values, like, visionary leadership, management by fact, delivering value and results indicate that the organisation must strategize and move ahead as a well-knit whole. Strategic themes, goals, targets are of primary importance if these core values have to be practised. The objective of the BEF is to create world class companies, which can be competitive, sustain their leadership position and act as responsible corporate citizens, to maintain the

sustainability of their businesses.

Competitiveness is driven through a results orientation, adoption of world class, best practices, which are developed in the organisation over a period of time, through a well implemented system of PDCA. By continuous improvement, organisations increase the maturity of their processes continuously. In its report to the US Congress [12], the General Accounting Office, which studied the 20 companies which scored the highest in the MBNQA in 1988 to 1989, reported that, total quality management practices achieved better employee relations, higher productivity, greater customer satisfaction, increased market share, and improved profitability. The MBNQA philosophy emphasizes a holistic approach to managing companies, and brought into the continuous improvement movement areas which were not fully or comprehensively addressed by TQM, such as, leadership, corporate governance, ethics, environmental friendliness and sustainability [13]. In that sense, MBNQA is TQM+. Founded on, and built on TQM, it enables a holistic approach.

Asif, *et al.*, [14], provide another link to the BEF and sustainability. They showed that the BEF, in general, addresses all three areas of the Triple Bottom Line (TBL), as proposed by the United Nations. The “performance results” category of the BEF is particularly strong in this area. It explicitly requires that the organisation’s financial and marketplace performance is assessed. Other contributors to the economic bottom line, including customer satisfaction, are emphasised throughout the model. Social considerations are also explicitly required to be addressed. The model stresses the need to practice good corporate citizenship, to not only meet but also exceed regulatory requirements, and to promote enhanced relationships with all stakeholders.

The BEF provides a systems approach to address corporate sustainability. This means that sustainability is not addressed in isolation, but rather is viewed as an essential aspect of the business. Park *et al.*, [15], in their comparison of the Peters and Austin model (1985), the Xerox model, the EFQM, BEF and the 4P of Toyota, found that only the EFQM and BEF provide for specific and serious inclusion of societal concerns as a corporate management agenda item. Both these models explicitly solicit information from companies about the way they address societal issues, especially with respect to sustainability. Similarly, Stata [16] has concluded that organisational learning through cross functional efforts, continuous quality improvement, the creation of an integrated organisation are all essential for sustainability.

Finally, in the strategic planning category, the Baldrige criteria have consistently focused on two key elements of the strategy development process “areas to address” 1) the process by which an organisation conducts strategic planning and 2) the collection and analysis of relevant data and information that are used in the strategic planning process [17]. Thus, there is adequate literature available to show that the BEF supports sustainability, competitive performance and the primacy of strategic thinking to make organisations sustainable global leaders.

2.2. Organisational Transformation Is a Pre-Requisite for Adopting BEF

Any company that wants to adopt the BEF needs to do so using organisational transformation mechanisms. This is true also of TQM, as both TQM and MBNQA affect all areas of working in any organisation. To get the benefits from the “Total” in the TQM, and the “integrated company” concept in MBNQA, it is necessary to transform the entire organisation. Typically, this could be done through the eight-step process devised by Kotter [18] [19], Kotter *et al.*, [20]. Kotter defines eight steps which provide the basis for sustainable transformational change in organisations: create a sense of urgency, create a guiding coalition, create clear vision and strategies, communicate across the organisation, empower people, obtain short term wins (low hanging fruits), don’t let up and make change stick (holding the gains). Such an approach suits large scale change making, which is what the BEF is all about. To address the seven chapters of the BEF, a company needs to take up initiatives, convert them to actions, followed by continuous, systematic, relentless follow-up to ensure the change “sticks” [1]. And since the BEF is founded on TQM/PDCA, all departments of the company need to get involved, as well as practice continuous improvement across the board, which leads to organisational transformation. The connectivity and usefulness of TQM to BEF has been demonstrated in the works of McAdam and Leonard [21], Ojha [22] and Petersen [23].

Sullivan *et al.* [24], Ragsdell [25] and Franklin [26] describe the main ingredients which need to be addressed in making large scale changes. Vora [27] has provided the results of several organisations, such as, Harvard Business School (HBS), IBM, American Society for Quality (ASQ), and has shown how BEF deploying organisations have successfully created sustainability due to their all-round abilities developed over many years. Harshak *et al.*, [2] emphasise, amongst other things, the crucial role played by the mental and physical engagement of personnel in change efforts. Graetz [28] emphasises the need to adopt BEF type of initiatives, mechanisms, strategic (instrumental) and charismatic (personal involvement of leaders who walk the talk) in the transformation of companies. In her study of three Australian companies, she has highlighted the role played by continuous improvement, and other systematic actions, needed to bring about large cultural changes.

Companies need to involve top management and a group of corporate executives as well as departmental and divisional heads to make excellence happen [28]. Distributed, decentralised authority, responsibility, execution and monitoring are the basic building blocks. In the words of Harshak *et al.*, [2], who have developed a five-step transformation process similar to Kotter’s, sustainable change can be achieved by using a step-wise transformational framework. And this aligns well with the BEF methodology.

Overall, by merging the concepts proposed by Kotter and others for large scale transformations with the BEF, one can create integrated organisations. How

such organisations address the issues of sustainability is explained in the next part of this paper.

2.3. Sustainability and Competitiveness

According to Sigalas [29], who surveyed 268 Greek firms, “competitive advantage is the above industry average manifested exploitation of market opportunities and neutralization of competitive threats, whereas superior performance is the above industry average financial and operational performance. For managers, the challenge should be to ex ante identify, develop, protect and deploy idiosyncratic firm resources and capabilities, and/or market positions, and/or mobility barriers (which are all sources of competitive advantage), as grounds for establishing competitive advantage (*i.e.* above average exploitation of market opportunities and neutralization of competitive threats) and, thereby, generate superior performance (*i.e.* above average financial and operational performance)” [29]. Using a meta-analysis of all TQM studies done, Eman *et al.* [3], show that competitiveness can be achieved through the application of TQM. Ferdousi *et al.*, [30], also support this view. However, Ibrahim *et al.*, [31], and others do not agree fully. They have concluded that quality management alone may not be able to provide a competitive advantage. This could be the reason why many Japanese companies, which practised TQM, could not compete with US companies, which included TQM in the BEF, and proved that a strategic orientation is very much needed to make TQM efforts fruitful. Strategy formulation, implementation, using TQM, under the BEF, leads to sustainability and competitiveness [13] [32] [33] [34] [35].

There are different dimensions of sustainability. Product sustainability is reflected in its qualities of durability and dependability [36]. Organizational sustainability is concerned with the ability to meet the current needs of both the organization and its stakeholders while being able to meet the future needs of stakeholders [37].

The consensus view, especially in Europe, is that sustainability strategies ensure long term competitiveness. One example is the Henkel company’s sustainability strategy that kicked off in 2011 under the “Factor 3” initiative. By 2016, many of the sustainability goals that were set were achieved, and competitiveness was enhanced [38].

Resources sustainability is reflected in aspects like yield, consumption norms, etc. Elements which build sustainability also lead to competitive advantage, through their beneficial effects on cost reduction, speedy new product introductions, better product launches. Competitive advantage is a dynamic, changing, and evolving concept and companies must address it constantly. In this endeavour, continuous improvement, PDCA and six sigma help by aligning practices, processes and costs to the market. For example, in companies using the BEF, inputs from customers collected through QFD, customer surveys, focus group discussions are all fed into the measurement, analysis and knowledge manage-

ment (M, A & KM) systems, which, then, are used by the leadership triad, to design strategy. Through goal and target setting, such inputs are converted into a company's strategic actions agenda. Thus, since the BEF incorporates TQM within itself, it not only provides a company with a sustainability construct, it addresses the competitiveness position, too. Integration with the society through CSR initiatives gives such companies a perspective on conservation of non-renewable resources and other societal concerns.

2.4. Operations Strategy (OS)

Wernerfelt [39] introduced the concept of resource based and product-based OS. Using this approach largely, Datta and Roy [40] have studied and reported on the OS followed by two defence industry companies in the UK. Khalili *et al.*, [41], using a study of 160 companies in Iran, have provided five models of deciding on the OS to be adopted. They have also described the linkage between OS and business strategy, which is critical from the alignment point of view. Lewis and Slack [42] describe the allocation of resources and decisions to be made on location of facilities, capacity etc., as a central concern of OS.

Sting *et al.*, [43], have reported on the results of a study of how OS was designed and implemented in six German manufacturing companies, using data for the years 2006 to 2010. They have studied the balance between horizontal (or top down) and the vertical (or bottom up) methods of implementing the OS in these companies. In a study of 655 companies in the US, Ahmed *et al.*, [44] found that those companies which adopted an OS performed better on several dimensions than those which did not, with a large proportion of those using OS performing well above the average. Almost 60% of the studied companies used TQM as the OS. In a study of 307 listed companies in Pakistan, Anwar and Hasnu [45] found that those companies which used an OS performed better than those which did not. Burnes [46] has examined the “emergent approach to organisational model” by Pettigrew and Whipp, a model of strategic and operational change, which involves five interrelated activities: environmental assessment, leading change, coherence, linking strategic and operational change, and developing human resources. By undertaking these activities, organizations can cope with uncertainty by becoming open learning systems, with strategy development and change emerging from the way the company, as a whole, acquires, interprets and processes information about its environment. Bamford and Forrester [47] support this view, with some additions, from their research. Berman *et al.* [48] have proposed an updation of the strategy development process to suit the various disruptions caused by the newly emerging technologies, viz., IOT, AI, big data, data analytics etc.

To become an excellent performer, companies must do many things, to cover all working areas, to continuously improve processes in all departments and divisions to take them up to high levels of maturity. All these must be done in a systematic way, using the PDCA principles. OS is a dynamic process which, in a

BEF adopting company, plays a critical role in establishing sustainability, competitive advantage and performance excellence.

Business strategy and operations strategy (OS) are the two main tools used to drive operating performance. The OS process is shown in **Figure 3** below.

OS forms the link between the leadership triad and the operations triad, in CMI, leading to operational results. The process of OS involves the company leadership to define the OS in alignment with the corporate strategy, after which the decisions regarding resourcing and manpower are made. The PDCA is achieved through the M, A & KM processes. The M, A & KM processes include the many processes that engage in assessments of the “degree of excellence” in the organisation. These assessments include the BEF assessment, the ISO certification assessments (ISO 9000, ISO 14,000, TS 9000, ISO 27,000, ISO 18,000, SA 8000 etc.) and others. The feedback from all these assessments is used as inputs by the two triads as well as the OS processes, to take the Corrective and Preventive Actions (CAPA) needed to deploy PDCA in action. The networked nature of the organisation that is developed as a result of the adoption of the BEF makes the organisation agile, responsive and leads to an “integrated organisation” in the long run [1].

OS is a process by which a company does two things—makes strategic decisions regarding capacity, supply networks, process technology and development of organisation, and assures quality, speed, dependability, flexibility and cost [42]. OS is a process by which inputs from the various departments in a company are sought, and, applying the rule of “alignment with corporate strategy” [41], comes up with options for consideration. Please see Mills *et al.*, [49] for a detailed discussion on the various types of OS.

These are then debated upon, budgets are examined for allocation, ROI/IRR calculations are done to examine the financial consequences of the options, and, finally, a set of outcomes are decided upon. These are then implemented, monitored and examined periodically for adherence. A rolling program of OS is used to make course corrections along the path of execution.

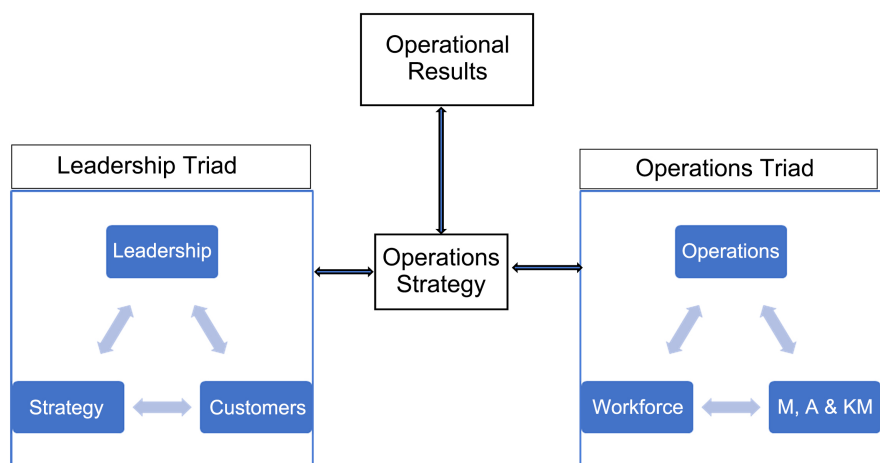


Figure 3. Position of operations strategy in a BF adopting organisation.

2.5. Quality Operations Strategy (QOS): The evolution of OS from 1900 to 1990

Henry Ford highlighted the importance of OS to a company, when he discovered the assembly line. Mass production, since then, became possible, and companies, which, till then, had to produce small volumes through craft production techniques, at high cost, discovered the importance of operations to increasing a company's profit manifold. The sellers' market, which lasted till about 1940's, witnessed large scale production of goods, to be sold in markets, which were growing at a frenetic pace. During this period, OS dominated company fortunes through new technology, new products, high volume production. Productivity was a key variable. If a company could produce goods, it could sell them. However, as foreseen by Shewhart, Dr Deming, Dr Juran and others, the sellers' markets were transforming to buyers' markets, which needed a new approach. OS had now to concentrate on quality and continuous improvements, as competition was fast catching up. Thus, was born the TQM movement in Japan, along with the Toyota TPS, in 1950. In the TQM view of things, corporate strategy had become central, and total quality had to be practiced. However, till the 1985's, most Japanese companies practiced TQM, but did not emphasise strategy as a key instrument of competitiveness. That changed in 1987, with the advent of the BEF, which proposed a central role for strategy, which would address the newly emergent issues like environmental protection, resources sustainability, ethical governance, corporate social responsibility (CSR), using the TQM and other continuous improvement initiatives like lean management and six-sigma. OS assumed a new role of the central repository for all the company's strategizing activities, driving a unified, goals driven framework, providing a long-term direction to a company's competitiveness and sustainability.

David Garvin's paper [36], defined and refined the new role for quality as the key variable for OS. The "eight dimensions of quality" addressed in this paper were used by some of the BEF practitioners, to build up the role of OS. Thus, for the first time, quality concepts were integrated into OS, and quality became a main thrust area. While OS was always concerned with competitiveness, productivity, technology, cost reduction, profitability, new quality concepts like sustainability, continuous improvement, variability reduction through statistical process control (SPC)/statistical quality control (SQC)/six-sigma, lean management, became the new foundations which moved quality from a "specification/compliance/inspection" oriented role to a "strategic/process driving/excellence inducing" role. Quality became an integral part of strategy. This change was a welcome move, especially in CMI, where operating costs were as high as 75% to 90% of the total product costs (for example, see **Figure 10**, for the operating cost percentages in Indian manufacturing industry). When used under the BEF, quality became a powerful tool for addressing sustainability, competitiveness and the triple bottom line.

The OS used in a BEF adopting company can be termed as Quality OS, or, QOS.

The word quality is added to denote the use of concepts like PDCA, BEF, TQM to design, implement and continuously improve the OS. The significant difference between QOS and OS using quality as a thrust area is that QOS has two dimensions of quality. One, it uses quality as a thrust area. Two, the design and implementation of QOS is done under the BEF, which implies a PDCA/TQM based process orientation. The second factor is the key differentiator.

QOS is especially useful in gaining competitive advantage in modern markets, where customers demand high quality at a low price. Garvin [36] defined the eight dimensions of quality which need to be addressed by every organisation. Quoting the Total Quality Control concept introduced by Feigenbaum in 1956, he argues for such an “integrated” approach to quality. As proposed and demonstrated by Deming, such an approach leads to co-operative working, joint decision making, team-based operations and statistically measured results [23].

Our experience in companies which have adopted the BEF leads us to believe that BSC or the hoshin kanri type of tool, to develop, describe, communicate, cascade, implement, monitor and continuously improve OS, is essential. The extensive spread and use of BSC by Kaplan and Norton, following the publication of their 1992 paper [50], has made it a global best practice. A spate of papers [51]-[56], Gumbus, [57]. Shuki Dror [58] and several books, seminars and presentations and consulting have had a pronounced effect on its popularity. Moreover, its suitability for use as a BEF tool is a big factor in driving its usage. Tata Steel started the use of this system in 1999 [59] [60] [61].

A QOS is practised in an environment of business excellence and is different from an OS in significant ways. For one, it is subject to PDCA. Second, it is done systematically. Systematically includes use of BSC, AQUIP (Annual Quality Improvement Plans), feedback loop, a process which defines the inputs and outputs that need to be checked regularly and periodically, a rolling methodology (in time) to be adopted to practice CAPA.

The “rolling methodology” is the same as the “time fencing” concept used in the preparation of an MRP, with the three periods categorised as frozen, moderately firm and flexible [62]. Third, it is derived from the corporate strategy, and cascaded across the organisation using a hoshin-kanri [63] type of methodology. This specific process is a best practice to obtain consensus, through a top and bottom, iterative, catch ball phenomenon, for zeroing in on the final, consensus strategic goals and targets, with a very high degree of commitment across the organisation for achievement (see **Figure 4** below).

Fourth, it is monitored continuously across the organisation by using a hierarchy of BSC's (**Figure 4**). Fifth, the monitoring is done at the departmental, divisional as well as the corporate levels, using the respective BSC's. The complete process of the QOS is shown in **Figure 5** below.

Thus, QOS is an improvement over OS, and the “OS Wheel” model, developed using the QOS, and an improvement over QOS, is a specific initiative to drive performance in CMI, as described in the sections that follow.

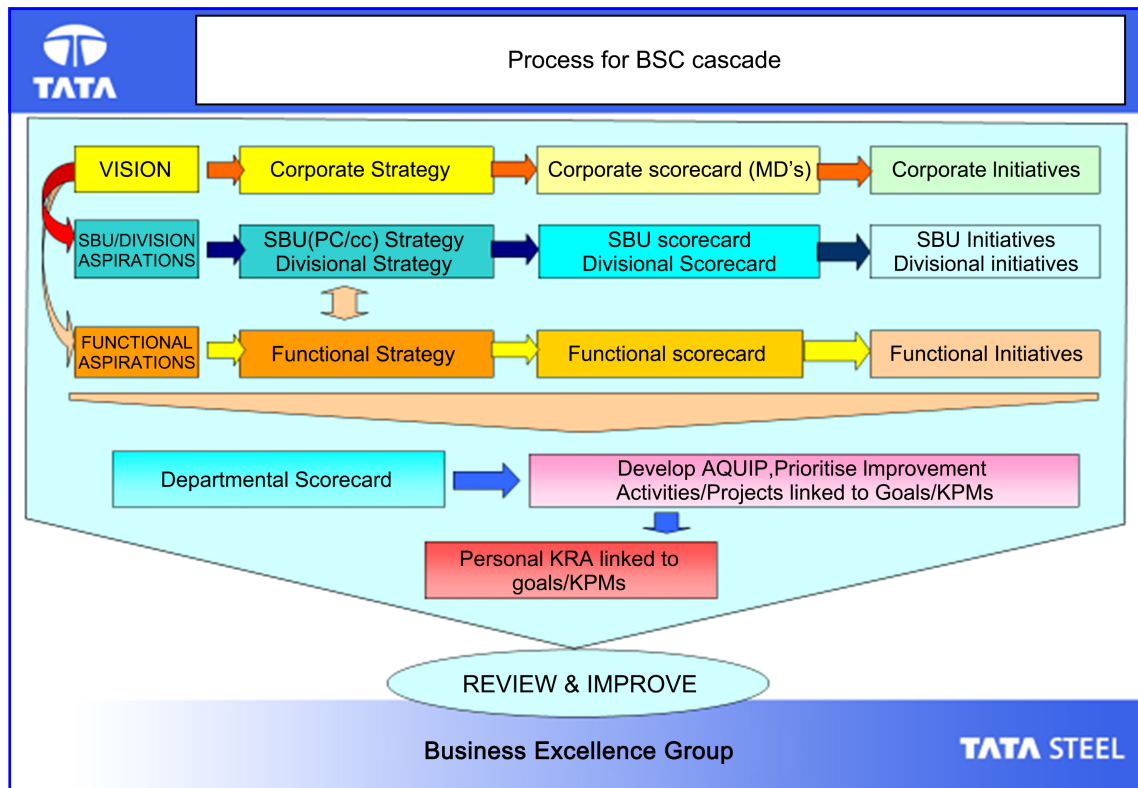


Figure 4. The cascading of company strategy (Source: Author).

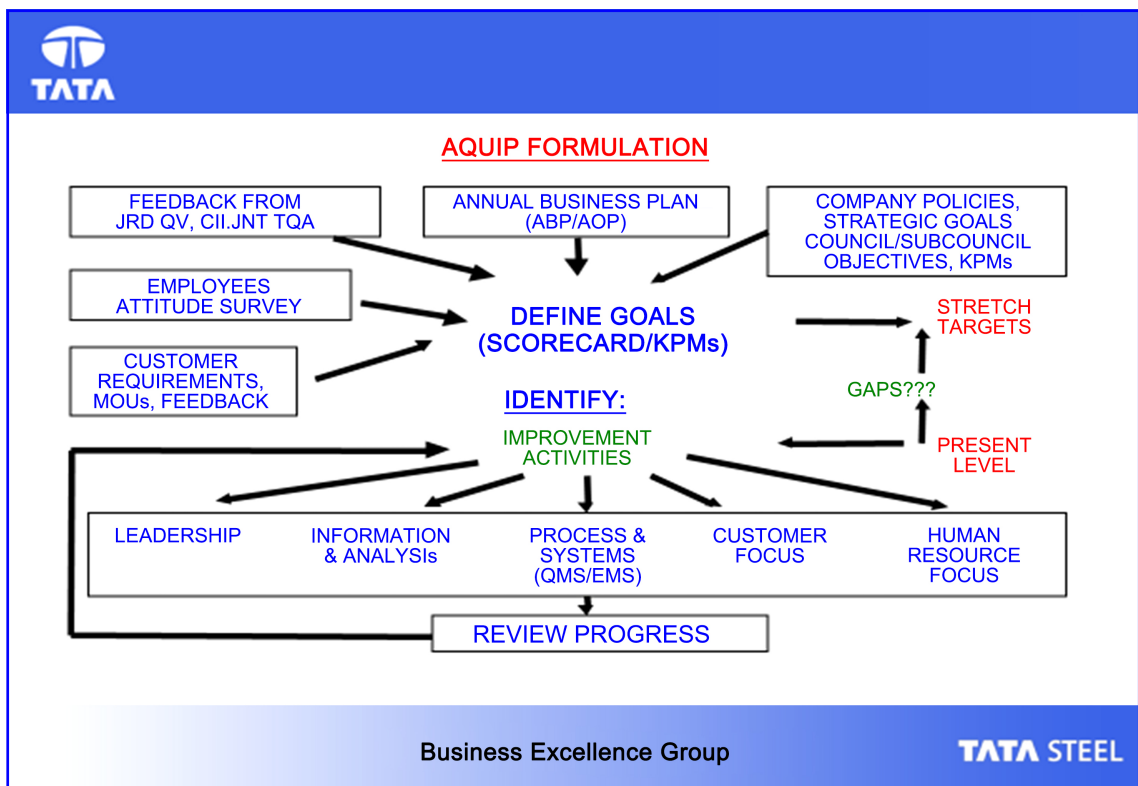


Figure 5. The process of deploying QOS using BSC's and the Annual Quality Improvement Plans (AQUIP) methodology (Source: Author).

3. The OS Wheel

By definition, the QOS is a system to produce superior performance. Practising QOS in a continuously upward moving spiral is the essence of the “OS Wheel” model. The underpinnings of the “OS Wheel” model are: holding the gains, viz., SDCA (Standardise, Do, Check and Act). The OS Wheel is, in short, QOS + SDCA. **Figure 6** and **Figure 7** show the “OS Wheel” schematic.

The upward spiral, shown in **Figure 7**, represents the upwardly mobile “OS Wheel”. Apart from the continuous improvement (PDCA) which drives performance on the horizontal, the practice of SDCA as a part of the OS Wheel elevates the performance to higher levels in an upward direction. Thus, there are two dimensions to the OS Wheel. An annual, superior performance driving,

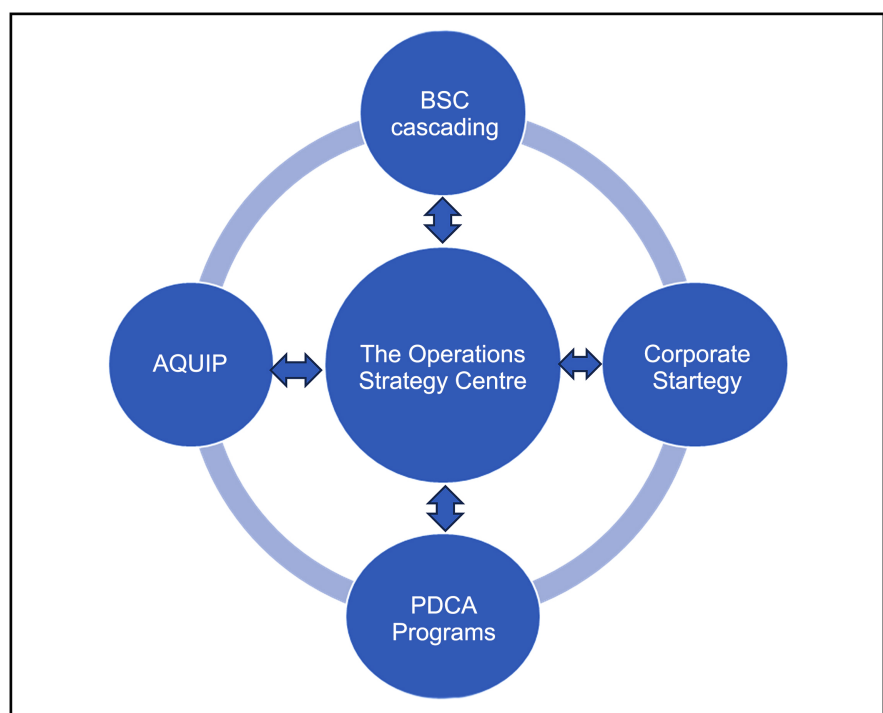


Figure 6. The “QOS” model for continuous manufacturing industries.

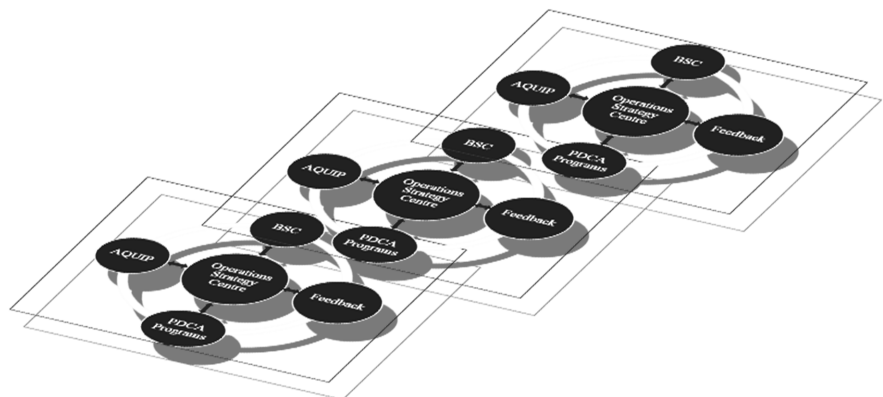


Figure 7. Illustrating the upward spiral effect of OS Wheel.

QOS, and, a holding the gains, SDCA driven, upward spiralling continuous leap. It is the upward spiral that provides the distinct edge to the OS Wheel method, to claim superiority over the QOS. The OS Wheel is built around the QOS, and using this base, reaches higher levels of performance, somewhat similar to periodic “quantum” jumps.

The quantum depends on a few factors, including the “stretch” that is accepted by the company through a mechanism of “stretch targets setting” in the BSC’s, similar to the “BHAG’s described by Collins [64], using the power of innovations to come up with ideas and actions to keep the OS of the company current with the industry leading practices, as well as, moving past the industry frontiers. In the words of the “efficiency frontier” theory [42], it is like occupying the pole positions in the efficiency frontier curve consistently, continuously challenging the industry leaders, and, in the process, becoming the leader.

The “OS Wheel” is a complex process, and needs well-trained teams of people in an organisation, to run successfully. The mechanics are as follows: run QOS using the BEF/BSC/TQM/PDCA systems. Then, concurrently, use select techniques like, stretch targeting, the top box approach (to develop customer centric, value creating activities), cross industry benchmarking, innovations, multi-stakeholder improvement teams, and similar such other activities, to intensify the integration of the organisation through cross functional, cross stakeholders and cross organisational initiatives. Such integration can happen only through continuous practice, and not by merely thinking and debating about it. The “OS Wheel” uses tools like “improvement diagram”, standardisation, consistently addressing the maturity of processes, honing the strength of processes through “improvement cycles”, deepening the interface between the Baldrige core values and company practices. The “OS Wheel” is an evolutionary process. Further details are provided in the next section, in which, we discuss a case study of Tata Steel, a part of the iron and steel CMI of India, to illustrate the practice and results obtained by using the “OS Wheel”.

The concept of the OS Wheel, and how it has been developed using BEF is summarised below:

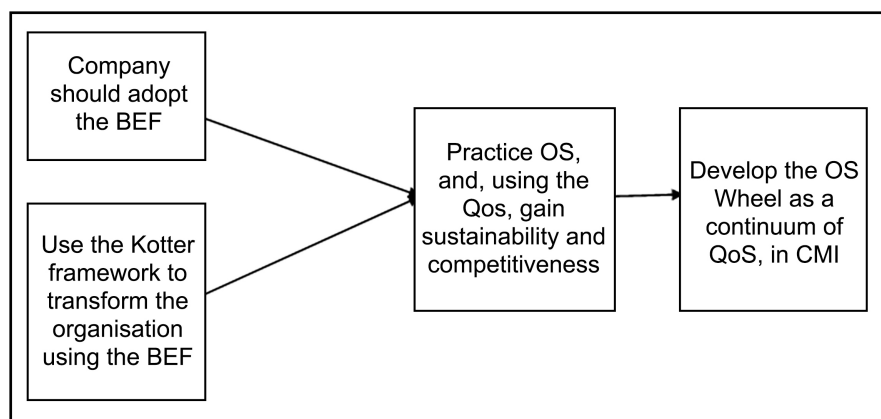


Figure 8. Development of the OS wheel.

4. Case Study: Tata Steel, India

The Tata Iron and Steel Company Limited (Tata Steel or TS, for short) started the TQM movement in 1987. TS was the largest publicly held and traded iron and steel company in India in the private sector at that time, and it was a part of the CMI. It was vertically integrated, with ownership of iron ore and coal mines, with all the facilities of an integrated iron and steel works. Finished products included: bars, rods, plates, ingots, billets, sheets, railway wheel tyres and axles. The company operated the outdated technology of open-hearth furnaces for steel making, the bottom poured casting route for ingot production, an old plate mill, a manually operated sheet mill and an equally old wheel, tyre and axle plant. While the employees' management system was of the highest order, the facilities available for production were primitive and outdated (for more information on Tata Steel, see <https://www.tatasteel.com>).

In the late 1980's, the to-be Managing Director (MD) of the company himself took the lead, and created a small "core team", reporting to him directly, to drive TQM. Subsequently, in 1991, a larger "leadership coalition" was created, of all his direct reports, to drive, oversee, guide and do all that was required to turn around the company, as exemplified by Kotter [18]. A report prepared by consultants Arthur D. Little, which informed that the company was in a "poor shape" in all areas of work, also advised such a move.

The evolution of the "OS Wheel" in Tata Steel can be summarised in **Figure 9**.

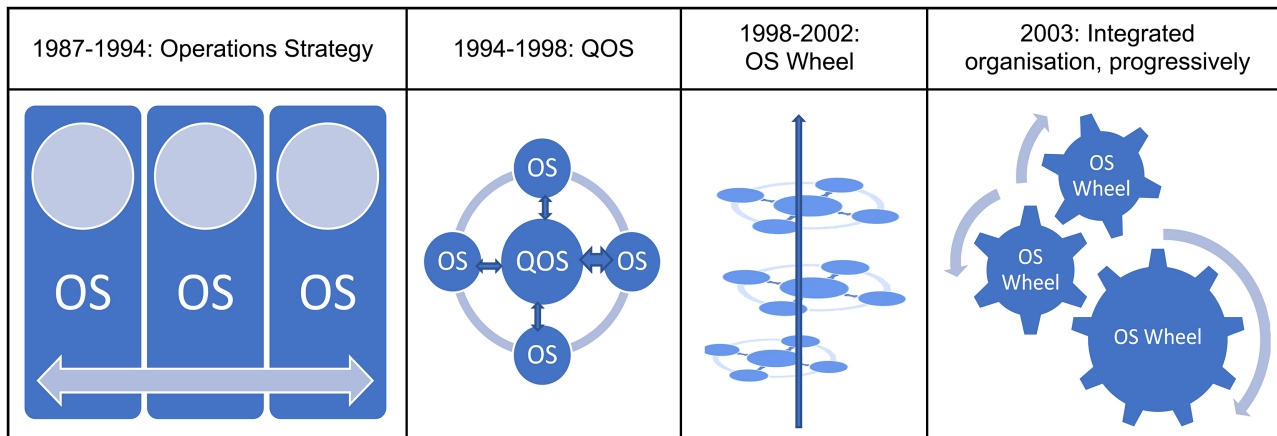


Figure 9. The evolution of the OS Wheel-schematic.

In the period 1987-1994, many initiatives were taken to improve the company's performance, with primary emphasis on creating a most modern steel plant. The OS was put into operation, beginning 1987, with Modernisation Phase III (MP III). The MP III was executed successfully between 1990 and 1994. After completion of MP III, Tata Steel had closed down all its old technology facilities, like the open hearths, the bottom poured ingots, etc., replacing them with the most modern technologies like continuous casting, basic oxygen LD furnaces, hot strip mill, etc. The OS was put to good use, in creating a company ready for its

journey in excellence. During the period 1992-1994, several initiatives, such as, quality circles, quality improvement projects, value engineering, methods improvement projects, were all initiated, to create awareness, engagement and a flavour for quality working in all areas of company working.

4.1. QOS during 1994-2000

After initiating TQM/PDCA for about two years, the company developed the QOS method to drive OS. In the late 80's/early 90's, OS was the primary driver of turning around the company. The primacy of OS is a singular feature of all CMI's. The volume of production and sales, the product-mix range, the large investments needed to install and mobilise productive assets, the long durations for recovering investments, all of these factors make the operations a central piece of CMI's. Managing these is central to the long-term survival, competitiveness and sustainability. A key feature of manufacturing industry is the high percentage of operating and raw materials cost to the total sales income (**Figure 10**).

Hence, OS becomes the prime-mover. However, to create "performance excellence", the OS needs to morph into the QOS. This can be achieved by adopting the BEF. The process to design the QOS, as shown in **Figure 6**, evolved during these years. There are two dimensions to the successful practice of QOS: the long term and the daily management. The long-term dimension is useful in developing the framework of the OS. This is shown in **Figure 11** below.

The long-term dimension is the formulation of the strategic direction, the evaluation of the performance of current capital assets, determining the needs for creating such assets in the future, using the PDCA process, as shown in **Figure 6**. The other dimension is the daily management, where, using the AQUIP, action plans are developed to achieve the goals and targets set in the relevant score cards, as shown in **Figure 5**. Amongst the many successes achieved due to the practice of QOS, the one that was most significant was the arrest of the galloping CAGR of the cost of producing steel, which was brought down from 13.3% to 3.1% by the year 2000 (see **Figure 12** below).

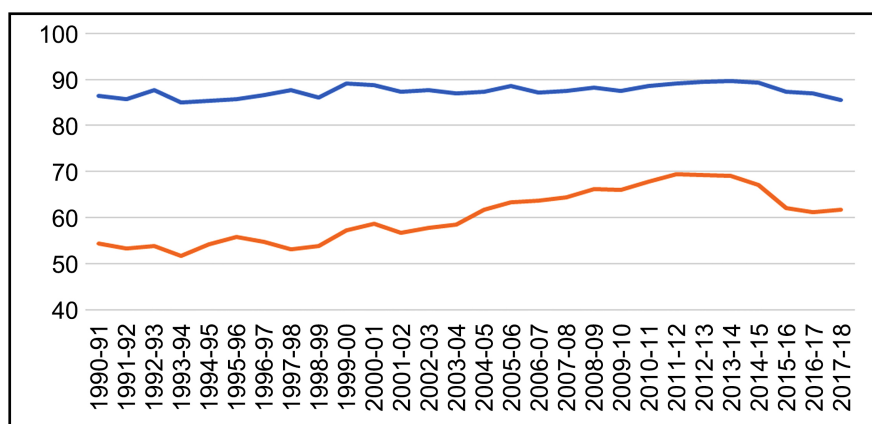


Figure 10. Percentage of operating expenses and RM cost to sales income, Indian manufacturing industry (Source: CMIE).

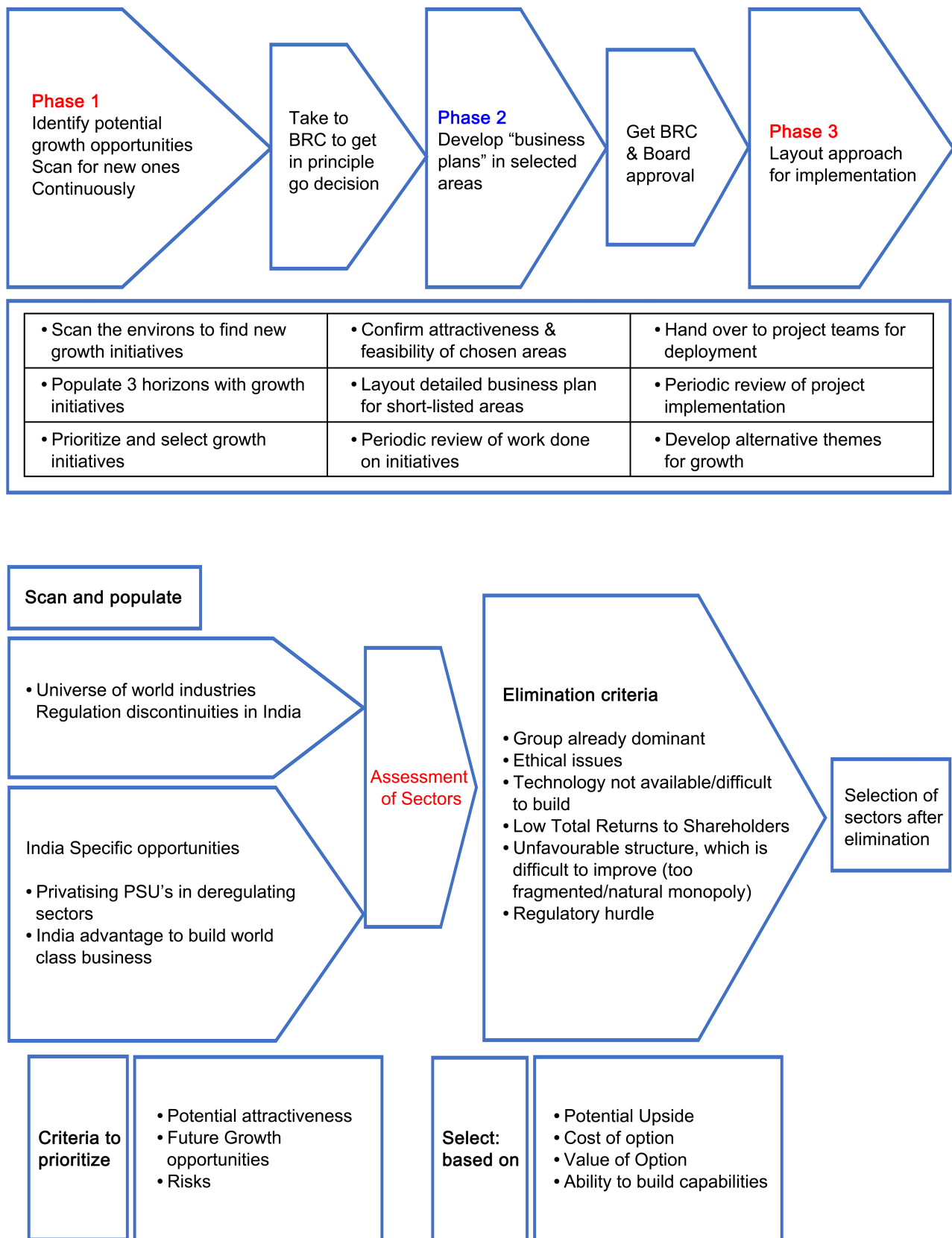


Figure 11. The long term dimensions of OS as practised in Tata steel in the years 1987 to 1994 (Note: BRC—Business Review Committee of the Tata Group, PSU—Public Sector Undertakings).

In 1994, the company started using the BEF, naming it as the “Tata Business Excellence Model”, to become a “world class” company. This was the beginning of the transformation from QOS to the OS Wheel. The first strategic goal was to “become the lowest cost steel producer in the world”. This was a tall order, as, at that time, the company produced only 3.5 mtpa (million tonnes per annum) of steel, out of a total world production of some 875 mtpa. However, using the QOS, it was possible to achieve significant results (**Table 1**).

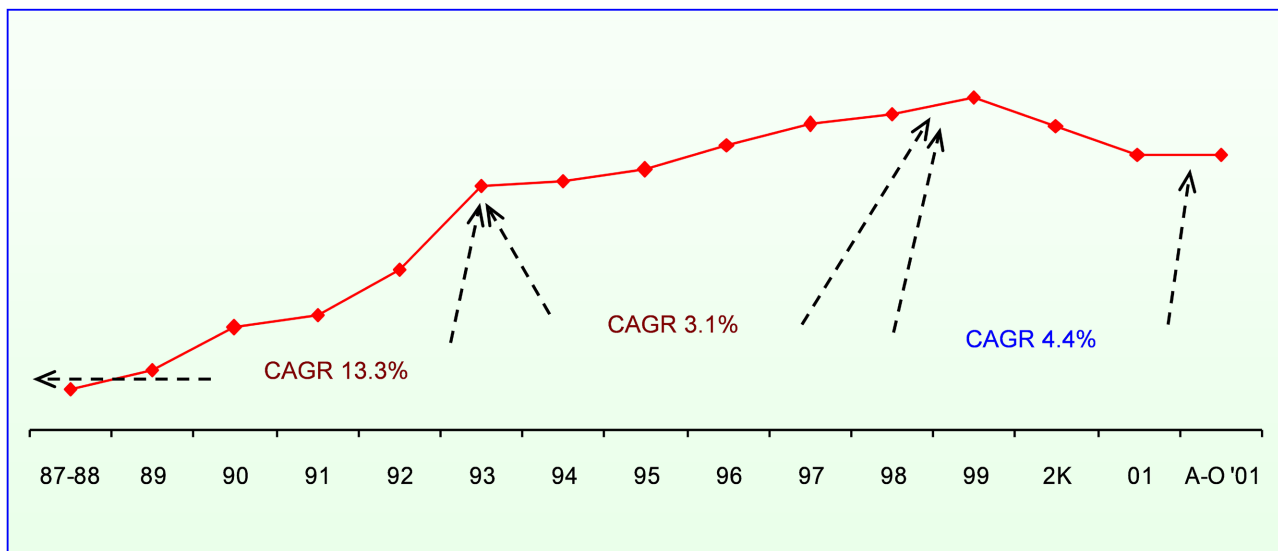


Figure 12. Result of practising QOS between the years 1994 and 2000.

Table 1. Improvement diagram summarising the changes made (or PDCA cycles) in the OS area in tata steel.

Period	Strategy process Themes	Important outcomes
'85-'90	Technology dominated, mergers and acquisitions, synergy group formed, decisions from board, continuous improvement started	Technology upgradation, capacity expansion, joint ventures, TIS group synergy advantages realised
'90-'95	Economies of scale, Flat products, value added, automation, computerisation, PPM, consultants-ADL, restructuring, change management	Hot Strip Mill installed, SAP and PPM practice, new IBM mainframes, automation benchmarked with BHP, MP III completed
'95-'00	Concentrate on core, CRM, divestments, Adopt TBEM for BE, SAP in M&S, strategies for coal, iron ore, other raw materials developed, re-engineering of key business processes	Higher revenue and profit, EVA trend reversed from negative to positive, cement and power units divested, Tata Timken shares sold, new JV with Ryerson Tull, Cold Rolling Mill commissioned in world record time and cost
'00-2002	Portfolio of business, non-steel for making EVA positive identified, strategic thinking spread throughout the organization, branding one of the thrust area for differentiation	Sales of branded products on the rise, titanium and ferro chrome businesses under implementation, Tata SSL acquired, evolution of the four-tier strategy process

The table is a summary of the many improvements done using the AQUIP methodology, as well as other tools. Improvements were done in each and every work area of the OVC shown in **Figure 1**. This was possible due to the cascading of the scorecards, shown in **Figure 5**, and the AQUIP methodology adopted in each and every department of the company, **Figure 6**. The responsibility of designing the scorecards, the AQUIP's and the task of monitoring and following up progress of the scorecard items were done using the Quality Management Structure, shown in **Figure 13**.

4.2. The OS Wheel in Tata Steel (FROM 2000)

The overall management of the AQUIP was done for the office of the MD by the BE team. The OS Wheel was an evolutionary development, which started around 1999/2000. The steps involved in the OS Wheel process are summarised below:

Step 1:

The OS Wheel centre (this is a small group, called the “strategy group”) receives and processes inputs, as shown in **Figure 6**, and arranges for discussions with the top management group, to facilitate themes for adoption in the OS for the next five years, with year-by-year listings. Based on the discussions, every year, the strategy group would facilitate the formulation of the Annual Business Plan, Annual Marketing Plan, Annual Operations Plan and the Annual Capital Budget, as also the five-year plans.

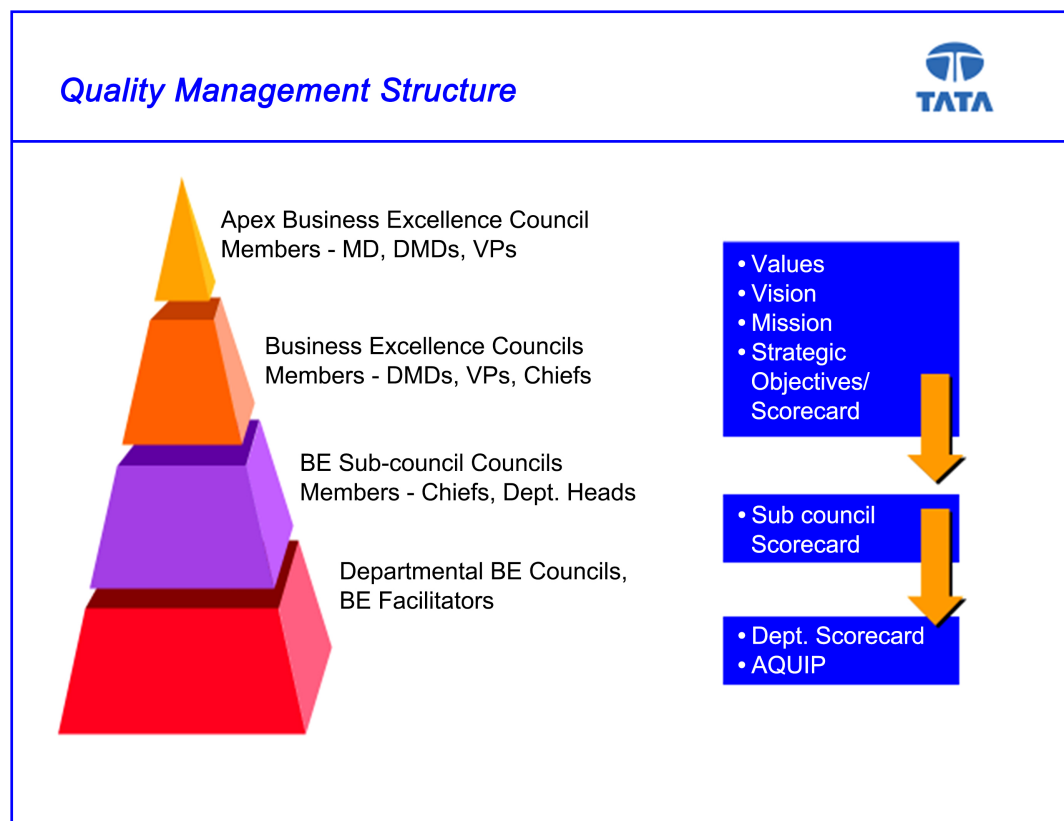


Figure 13. Tata steel quality management structure, the mechanism for implementing the OS wheel.

Step 2:

Finalise the BSC of the MD based on the operations strategy (as detailed in the various annual plans) evolved over a six-month period, using the several inputs shown in **Figure 6**. The BSC should be for five years, with the four perspectives of the Kaplan - Norton BSC design. Goals and targets, along with key initiatives to achieve the targets, should be mentioned in the BSC.

Step 3:

Cascade the BSC to the MD's direct reports, then to the divisional and functional heads, then to departmental heads. In each of the BSC's identify projects that need to be taken up/continued, to achieve the targets. These projects are then assigned to teams at the departmental and other levels as appropriate. Each department prepares its set of projects, which are called the "Annual Quality Improvement Plans" (or AQUIP).

Step 4:

The progress of the AQUIP is measured by each department, and progress reported at various fora, like, departmental, divisional, functional, etc. quality councils. The MD's BSC is monitored at the Apex Quality Council.

Step 5:

CAPA is done by the concerned quality councils.

Step 6:

Innovations, knowledge building through the Knowledge Management website, continuous improvement and PDCA are run through the appropriate quality council. Quantum jumps are identified by the quality councils, discussed, and then taken to the Apex council for decision. Setting stretch targets, new initiatives, like new products introduction, large scale expansion plans, introduction of new technologies, new business opportunities planning etc. are parts of the continuous improvement process. All these are routed through the OS Wheel centre to the top management group, consisting of the MD, his direct reports, functional experts for consensus decisions making.

Step 7:

The upward spiral is caused by SDCA

Based on the above process, which itself was subjected to CAPA annually, the OS Wheel was driven rigorously. Improvements achieved were captured in the form of "improvement diagrams", of which **Table 1** is an example. Other significant examples are shown in **Table 2** and **Table 3**. These are only a selection of many such improvement diagrams which were used across the company to monitor the progress of the journey towards building an integrated organisation.

The culmination of the efforts was the recognition by World Steel Dynamics, an international body tracking performance of all global iron and steel companies, in 2001, that Tata Steel had become the lowest cost steel producer in the world (**Figure 14**).

The OS Wheel was invented and implemented in Tata Steel for more than five years, and the results achieved during the evolution of the OS Wheel are shown in **Figure 15**, **Figure 16** and **Figure 17** below:

Table 2. Improvement diagram showing the changes made in the organisation as a part of the OS Wheel implementation.

Period	Improvements	Reasons/Changing Business Needs
Evaluation Cycle II: (‘96-‘98)	Re-designed customer satisfaction and requirement determination process (partnering Thermax, and with inputs from Ryerson followed up by MODE in 1998-99), including for international markets	To account for segment specific business needs (initiated in customer satisfaction review meeting)
	Customer Complaints Handling Process: Modi Xerox as a benchmarking partner helped us arrive at a comprehensive process	For addressing customer complaints and using the data in prioritization of customer requirements. (Initiated as a feedback from JN Tata), Focus on operational efficiency
	Product Improvement and Development: Vesuvius has been the benchmarking partner	The customer’s changing requirements is captured in this process. (initiated as feedback from Mode survey)
	Customer Week Concept: HTA, our partner in marketing communications brought in this concept from Philips	Customer Week exposes a wider cross section of people to the customers and their changing requirements
Evaluation Cycle III: (‘98/‘99)	Customer visit reports centrally analyzed and action taken through ATR, Technical reports on visits to international customers	More focused and proactive information gathering (initiated from Management Review meeting, Area Sales Managers conference)
	Re-engineering of MD and OG & F process. ADL and IBM provided the consultancy and Best Practices to design world-class processes	Small initiatives were not enough to meet the requirements of a significantly altered market place
Evaluation Cycle IV: (‘99-‘00)	Supply Chain redesign (Hub and Spoke concept) to enhance service levels and improve CSI, Revenue Management to focus on factors affecting customer profitability	Price sensitivity of steel market; focus on cost-competitiveness and service
Evaluation Cycle V: (2000-2001)	IT enablement across the organisation for MDP processes, LP/FP profit centres created Setting up of E-Commerce task force. Web enabling SAP to provide customers 24/7 access to their accounts	Institutionalising the reengineered processes. Knowledge sharing across the organisation. 24/7 accesses to customers. Understand their own info needs

Table 3. Improvement diagram of the “spiral” changes made in the organisation as a part of the implementation of OS Wheel.

Period	Process improvement	Results achieved	Further E & I identified
‘80 = ‘85	Modernisation phase I: LD, Continuous Casting, VAD	Better liquid steel and billet quality, production of lower gas steel	Higher continuous casting ratio, better coke properties, more finishing facilities
‘85-‘90	Stamp charging battery, Wire Rod Mill, Bedding & Blending Yard, ISO 9000, TQM	Better coke quality (CRI/CSR), better sinter quality, better process documentation	Enhance IT support, improve quality of rebars
‘90-‘95	TMT facilities at WRM, FP Complex, coal beneficiation, certification of more units to ISO 9000, VE, QIPs	Better quality of rebars, better quality of coal (lower ash), better process control	Enhance quality of flat products, improve project management process
‘95-‘00	World class project management, TPM, benchmarking, TBEM, ISO 14,000, QS 9000, MDP, Key business processes	World class CRM commissioned at lowest cost and time, process standards improved, new efficient processes introduced	Enhance environmental controls, reduce process variability, process model of Tata Steel
‘01-‘02	Vigorous deployment of TBEM and EFQM, continuous improvement, organisational learning	World’s lowest cost producer of HRC, “Best Steel” plant in the world	Top Box in CSI, Tata Steel Enterprise Process Model, New Vision

Note: E&I—evaluation and improvement, LD—Linz Donawitz process for steel making, VAD—vacuum arc degassing, CRI—coke reactivity index, CSR—coke strength, WRM—wire rod mill, FP—flat products, VE—value engineering, QIP—quality improvement projects, MDP—management development program, CRM—cold rolling mill, CSI—customer satisfaction index.

World Steel Dynamics has identified 12 Companies as World Class Steel Makers and positioned them as follows: (June, 2001)

Company	Ranking	Score
Tata Steel	1	131
Usinor	2	129
Posco	3	127
CSN	4	123
Baosteel	5	121
China Steel	6	119
Gerdau	7	118
Nucor	8	116
Car-Tec	9	112
Nippon Steel	10	111
Severstal	10	111
Dofasco	11	109

#

Figure 14. Ranking of world class steel companies.

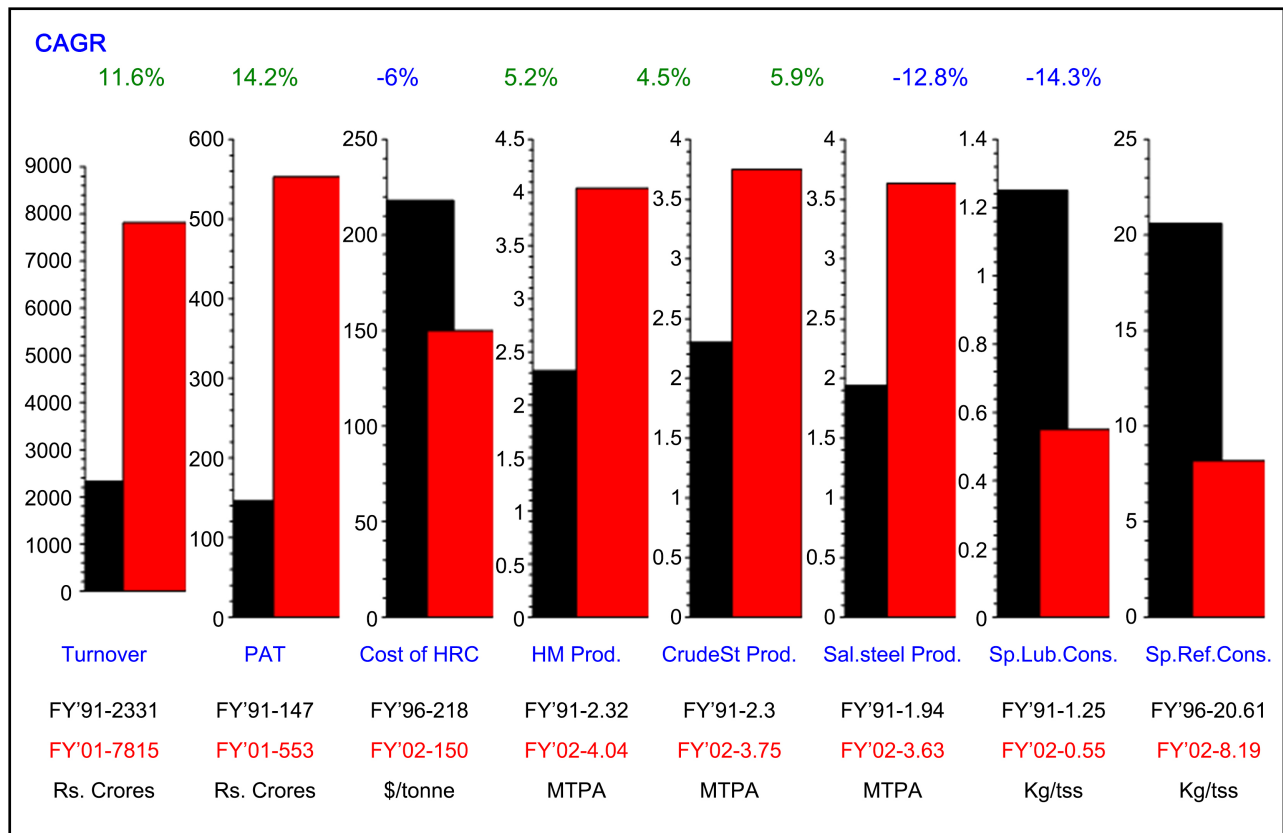


Figure 15. CAGR's of key performance indices illustrating the success of the OS/QoS/os wheel in Tata Steel (Note: PAT—profit after tax, HRC—hot rolled coil, HM—hot metal, Sp.Lub.Cons.—specific lubricant oils consumption, Sp.Ref.Cons—specific re-fractories consumption, MTPA—Million tonnes per annum, tss—tonnes of saleable steel, 1 crore = 10 million).

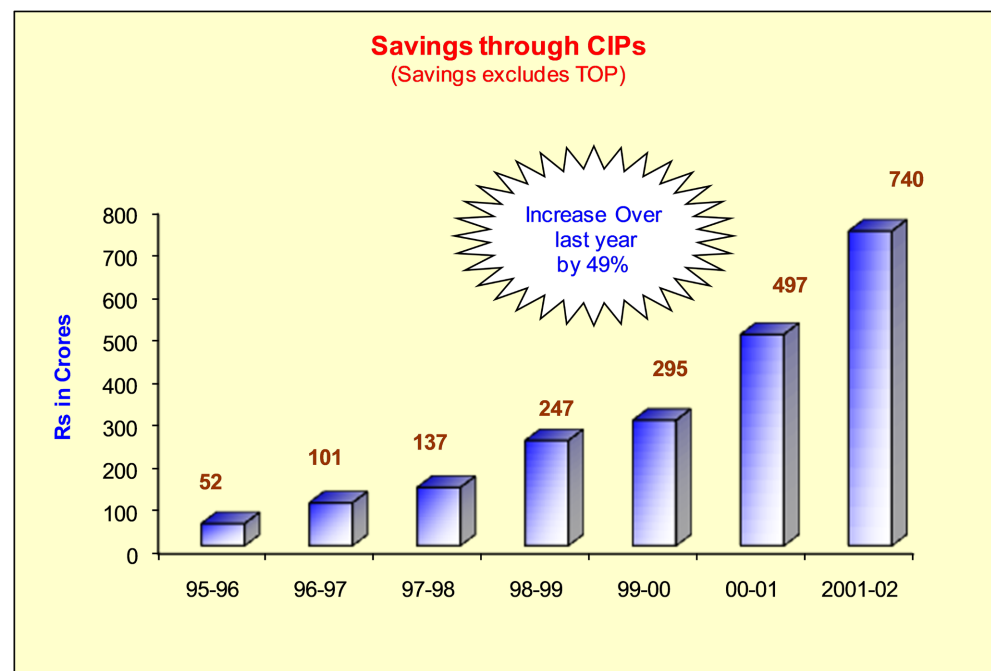


Figure 16. Showing the cost savings (in Rs Crores) (Rs 1 crore = 10 million Rs) each year, due to implementation of TQM as part of the OS wheel.

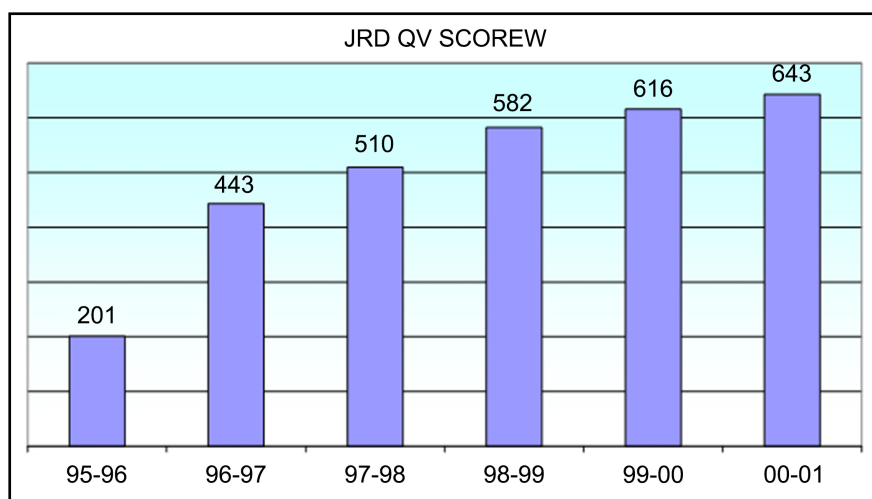


Figure 17. Scores in the JRD QV (The Tata business excellence model award system). Tata steel won the JRD quality value award in 99/00.

Overall, the use of the OS Wheel was hugely successful. The same was fine-tuned and refined over the next five years, during which time the company won the Deming Application Prize in 2008

(<http://www.tata.com/article/inside/TXbvQ9Qd!%24%24%24%24!Cs%3d/TLVVr3YPkMU%3d>) and the Deming Grand Prize in 2012

(https://www.tatasteel.com/media/4959/pressrelease_press-release-9-oct-12_52e9293678.pdf), the only steel company in the world, outside Japan, to be so honoured. Recently, Tata Steel was adjudged as the “steel industry leader” globally by the Dow Jones Sustainability Index 2018 (DJSI). Tata Steel is also the only India-based company to emerge as a winner among all 60 sectors evaluated for DJSI 2018.

(<http://www.tata.com/company/releasesinside/tata-steel-dow-jones-sustainability-index>)

4.3. The OS Wheel Concept Applied in Other Companies

The knowledge sharing between Tata companies, under the aegis of TBEM, was facilitated throughout the Tata group by Tata Quality Management Services (TQMS). At the annual TBEM conferences, to which all Tata companies were invited, presentations were made on the OS Wheel and other concepts developed by member companies, and these were then adopted as appropriate by other member companies. The OS Wheel or equivalents were adopted by companies, such as, Tata Motors, Tata Chemicals, TCS and others, who designed their own versions based on the Tata Steel best practice. The work done by, in the years 2005 to 2010 is almost exactly similar to the OS Wheel adopted by Tata Steel. Other companies who also used the concept include Bharat Heavy Electricals Limited, Bharat Electronics Limited, Larsen and Toubro, Tata Chemicals, The Tinplate Company of India Limited, HP (India) who all developed their own versions. Ford Plastics (Australia) [28], Unilever and others, outside India,

are also examples. Thus, the OS Wheel is a successful best practice which can help CMI to create integrated organisations, under the umbrella of the BEF.

4.4. Limitations of the Research and Future Course

Although a longitudinal study over 16 years, still, this research is limited to the iron and steel industry, and, in particular, to the Tata Iron and Steel Company Limited, which operates under a specific set of circumstances. While the OS Wheel is not specific to Tata Steel and is applicable in all cases where a CMI company is on the BEF journey, however, the elements of OS Wheel mentioned in the paper, and the kind of results achieved, may not be replicable entirely. Only Baldrige winners can hope to achieve the same or similar kinds of successes. The specific success of Tata Steel is also, in part, due to the cultural ethos of the company, developed over a hundred-year Tata legacy. This culture is unique.

OS itself is undergoing changes. For example, the “boundary perspective”, proposed by Fiorentino [65], extends the impact of OS to the region between the external market and the firm. This is strategically important due to the development of concepts like outsourcing, agile manufacturing, toll manufacturing, “responsive supply chains” and international operations strategy [66]. These, and other factors, need to be included, to enlarge the scope of the OS Wheel.

It is important that companies on the BEF journey share their best practices, so that, others can also make use of the methodologies. This will increase the sustainability quotients of such companies, which, in turn, will make environmental protection that much more effective. More attention of academics on such best practices will help institutionalise them.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] Baldrige Excellence Framework (2018) Baldrige Excellence Framework—Manufacturing, Service, Small Business, Non-Profit and Government, 2017-2018. <https://www.nist.gov/baldrige>
- [2] Harshak, A., Aguirre, D. and Brown, A. (2010) Making Change Happen, Delivering Sustainable Organisational Change. Booz & Company, New York.
- [3] El Shenawy, E., Baker, T. and Lemak, D.J. (2007) A Meta-Analysis of the Effect of TQM on Competitive Advantage. *International Journal of Quality & Reliability Management*, **24**, 442-471. <https://doi.org/10.1108/02656710710748349>
- [4] Barnes, D. (2001) Research Methods for the Empirical Investigation of the Process of Formation of Operations Strategy. *International Journal of Operations & Production Management*, **21**, 1076-1095. <https://doi.org/10.1108/EUM0000000005586>
- [5] Rytter, N.G., Boer, H. and Koch, C. (2007) Conceptualizing Operations Strategy Processes. *International Journal of Operations & Production Management*, **27**, 1093-1114. <https://doi.org/10.1108/01443570710820648>

- [6] Steve Smith, W. (2009) Vitality in Business: Executing a New Strategy at Unilever. *Journal of Business Strategy*, **30**, 31-41. <https://doi.org/10.1108/02756660910972631>
- [7] DeFranzo, S.E. (2011) What's the Difference between Qualitative and Quantitative Research? <https://www.snapsurveys.com/blog/qualitative-vs-quantitative-research/>
- [8] Silverman, D. (2014) Interpreting Qualitative Data. Chapter 1, Sage Publications, London.
- [9] (2010) UN Global Compact and Accenture CEO Study—A New Era of Sustainability.
- [10] Millar, C., Hind, P. and Magala, S. (2012) Guest Editorial, Sustainability and the Need for Change: Organisational Change and Transformational Vision. *Journal of Organizational Change Management*, **25**, 489-500. <https://doi.org/10.1108/09534811211239272>
- [11] Dahlgaard, S.M.P., Dahlgaard, J.J. and Edgeman, R.L. (1998) Core Values: The Precondition for Business Excellence. *Total Quality Management*, **9**, 51-55. <https://doi.org/10.1080/0954412988550>
- [12] United States General Accounting Office (1991) Report to the Honorable Donald Ritter, Member, US House of Representatives, 1-41.
- [13] Jayaraman, R. (2013) Succeeding Through People: An Overview of How Business Excellence Practices Have Changed the HR Landscape. *Prabandhan-Indian Journal of Management*, **6**, 5-12. <https://doi.org/10.17010/pijom/2013/v6i1/59944>
- [14] Muhammad, A., Searcy, C., Garvare, R. and Ahmad, N. (2011) Including Sustainability in Business Excellence Models. *Total Quality Management*, **22**, 773-786. <https://doi.org/10.1080/14783363.2011.585784>
- [15] Park, S.M.D. and Dahlgard, J.J. (2007) Excellence-25 Years Evolution. *Journal of Management History*, **13**, 371-393. <https://doi.org/10.1108/17511340710819606>
- [16] Stata, R. (1989) Organizational Learning—The Key to Management Innovation. *MIT Sloan Review*, **30**, 62-74.
- [17] Evans, J.R., Ford, M.W., Masterson, S.S. and Hertz, H.S. (2012) Beyond Performance Excellence: Research Insights from Baldrige Recipient Feedback. *Total Quality Management*, **23**, 489-506. <https://doi.org/10.1080/14783363.2012.669547>
- [18] Kotter, J.P. (1996) Leading Change. Harvard Business School Press, Brighton, MA.
- [19] Kotter, J.P. (2007) Leading Change. Why Transformational Efforts Fail. *Harvard Business Review*, January 2007, 1-9.
- [20] Kotter, J.P. and Cohen, D.S. (2002) The Heart of Change. Harvard Business School Press, Brighton, MA.
- [21] McAdam, R. and Leonard, D. (2005) A TQM Dynamics Perspective on Baldrige and Business Excellence Model Comparisons. *Total Quality Management & Business Excellence*, **16**, 771-791. <https://doi.org/10.1080/14783360500077757>
- [22] Ojha, A.K. (2000) Total Quality Management: How Can We Make the Implementation Effective? *Vikalpa*, **25**, 19-29. <https://doi.org/10.1177/0256090920000204>
- [23] Petersen, P.B. (1999) Total Quality Management and the Deming Approach to Quality Management. *Journal of Management History*, **5**, 468-488. <https://doi.org/10.1108/13552529910290520>
- [24] Sullivan, W., Sullivan, R. and Buffton, B. (2001) Aligning Individual and Organizational Values to Support Change. *Journal of Change Management*, **2**, 247-254. <https://doi.org/10.1080/738552750>
- [25] Ragsdell, G. (2000) Engineering a Paradigm Shift. *Journal of Organizational Change*

- Management*, **13**, 104-120. <https://doi.org/10.1108/09534810010321436>
- [26] Franklin, M. (2014) 3 Lessons for Successful Transformational Change. *Industrial and Commercial Training*, **46**, 364-370. <https://doi.org/10.1108/ICT-04-2014-0027>
- [27] Vora, M.K. (2013) Business Excellence through Sustainable Change Management. *The TQM Journal*, **25**, 625-640. <https://doi.org/10.1108/TQM-07-2013-0080>
- [28] Graetz, F. (2000) Strategic Change Leadership. *Management Decision*, **38**, 550-564. <https://doi.org/10.1108/00251740010378282>
- [29] Sigalas, C. (2015) Competitive Advantage: The Known Unknown Concept. *Management Decision*, **53**, 2004-2016. <https://doi.org/10.1108/MD-05-2015-0185>
- [30] Ferdousi, F., Baird, K., Munir, R. and Su, S. (2018) Associations between Organizational Factors, TQM and Competitive Advantage: Evidence from an Emerging Economy. *Benchmarking: An International Journal*, **25**, 854-873. <https://doi.org/10.1108/BIJ-05-2017-0110>
- [31] Elshaer, I.A. and Augustyn, M.M. (2016) Direct Effects of Quality Management on Competitive Advantage. *International Journal of Quality & Reliability Management*, **33**, 1286-1310. <https://doi.org/10.1108/IJQRM-07-2014-0086>
- [32] Ahire, S.L., Golhar, D.Y. and Waller, M.A. (1996) Development and Validation of TQM Implementation Constructs. *Decision Sciences*, **27**, 23-56. <https://doi.org/10.1111/j.1540-5915.1996.tb00842.x>
- [33] Jagadeesh, R. (1999) Total Quality Management in India-Perspective and Analysis. *The TQM Magazine*, **11**, 321-327. <https://doi.org/10.1108/09544789910282381>
- [34] Jayaraman, R. (2013) Impact of TQM on Operational Excellence. *ZENITH International Journal of Business Economics & Management Research*, **3**, 61-70.
- [35] Jayaraman, R. (2014) Impact of Business Excellence practices on Technology Management in India-Perspectives and a Case Study. *MERC Global International Journal of Management*, **2**, 33-50.
- [36] Garvin, D.A. (1987) Competing on the Eight Dimensions of Quality. *Harvard Business Review*, November-December 1987, 101-109.
- [37] The, D. and Corbitt, B. (2015) Building Sustainability Strategy in Business. *Journal of Business Strategy*, **36**, 39-46. <https://doi.org/10.1108/JBS-08-2014-0099>
- [38] Patterson, V., Knott, J. and Melnick, R. (2016) Achieving More with Less: Henkel's Factor 3 Strategy. *Journal of Business Strategy*, **37**, 3-11. <https://doi.org/10.1108/JBS-04-2015-0042>
- [39] Wernerfelt, B. (1984) A Resource-Based View of the Firm. *Strategic Management Journal*, **5**, 171-180. <https://doi.org/10.1002/smj.4250050207>
- [40] Priya Datta, P. and Roy, R. (2011) Operations Strategy for the Effective Delivery of Integrated Industrial Product-Service Offerings: Two Exploratory Defence Industry Case Studies. *International Journal of Operations & Production Management*, **31**, 579-603. <https://doi.org/10.1108/01443571111126337>
- [41] Shavarini, S.K., Salimian, H., Nazemi, J. and Alborzi, M. (2013) Operations Strategy and Business Strategy Alignment Model (Case of Iranian Industries). *International Journal of Operations & Production Management*, **33**, 1108-1130. <https://doi.org/10.1108/IJOPM-12-2011-0467>
- [42] Lewis, M. and Slack, N. (2013) Operations Strategy. Pearson, London.
- [43] Sting, F.J. and Loch, C.H. (2015) Implementing Operations Strategy: How Vertical and Horizontal Coordination Interact. *Production and Operations Management*, **25**, 1177-1193. <https://doi.org/10.1111/poms.12537>

- [44] Ahmed, N.U., Montagno, R.V. and Firenze, R.J. (1996) Operations Strategy and Organizational Performance: An Empirical Study. *International Journal of Operations & Production Management*, **16**, 41-53.
<https://doi.org/10.1108/01443579610113933>
- [45] Anwar, J. and Hasnu, S.A.F. (2017) Strategic Patterns and Firm Performance: Comparing Consistent, Flexible and Reactor Strategies. *Journal of Organizational Change Management*, **30**, 1015-1029. <https://doi.org/10.1108/JOCM-03-2016-0053>
- [46] Burnes, B. (1996) No Such Thing as ... a "One Best Way" to Manage Organizational Change. *Management Decision*, **34**, 11-18.
<https://doi.org/10.1108/00251749610150649>
- [47] Bamford, D.R. and Forrester, P.L. (2003) Managing Planned and Emergent Change within an Operations Management Environment. *International Journal of Operations & Production Management*, **23**, 546-564.
<https://doi.org/10.1108/01443570310471857>
- [48] Berman, S. and Dalzell-Payne, P. (2018) The Interaction of Strategy and Technology in an Era of Business Re-Invention. *Strategy & Leadership*, **46**, 10-15.
<https://doi.org/10.1108/SL-10-2017-0096>
- [49] Mills, J., Platts, K. and Gregory, M. (1995) A Framework for the Design of Manufacturing Strategy Processes: A Contingency Approach. *International Journal of Operations & Production Management*, **15**, 17-49.
<https://doi.org/10.1108/01443579510083596>
- [50] Kaplan, R. and Norton, D. (1992) The Balanced Score Card: Measures That Drive Performance. *Harvard Business Review*, January-February 1992, 71-79.
- [51] Kaplan, R. and Norton, D. (1993) Putting the BSC to Work. *Harvard Business Review*, September-October 1993, 133-147.
- [52] Kaplan, R. and Lamotte, G. (2001) The BSC and Quality Programs. HBS Publishing, Reprint Number B0103D.
- [53] Kaplan, R. and Norton, D. (2001) Transforming the BSC from Performance Measurement to Strategic Management: Part I. *Accounting Horizons*, **15**, 87-104.
<https://doi.org/10.2308/acch.2001.15.1.87>
- [54] Kaplan, R. and Norton, D. (2001) Transforming the BSC from Performance Measurement to Strategic Management: Part II. *Accounting Horizons*, **15**, 147-160.
<https://doi.org/10.2308/acch.2001.15.2.147>
- [55] Kaplan, R. and Norton, D. (2004) How Strategy Maps Frame an Organization's Objectives. *Financial Executive*, **20**, 40-45.
- [56] Kaplan, R. and Norton, D. (2006) How to Implement a New Strategy without Disrupting Your Organization. *Harvard Business Review*, March 2006, 100-109.
- [57] Gumbus, A. (2005) Introducing the BSC: Creating Metrics to Measure Performance. *Journal of Management Education*, **29**, 617-630.
<https://doi.org/10.1177/1052562905276278>
- [58] Dror, S. (2008) The Balanced Scorecard versus Quality Award Models as Strategic Frameworks. *Total Quality Management*, **19**, 583-593.
<https://doi.org/10.1080/14783360802024366>
- [59] Muthuraman, B. and Jayaraman, R. (2014) Driving Business Strategy in Large Organisations through BSC. *Vikalpa*, **39**, 1-19.
<https://doi.org/10.1177/0256090920140101>
- [60] Irani, J.J. (2003) Business Excellence for Corporate Sustainability. *Tata Search*, 1-6.
- [61] Muthuraman, B. (2003) The Quest for Excellence: Tata Steel in the New Millen-

- nium, *Tata Search*, 7-16.
- [62] Chase, R.B., Shankar, R. and Jacobs, F.R. (2014) Operations and Supply Chain Management. 14th Edition, McGraw Hill, India, 884.
 - [63] Lee, R.G. and Dale, B.G. (1998) Policy Deployment: An Examination of the Theory. *International Journal of Quality & Reliability Management*, **15**, 520-540.
<https://doi.org/10.1108/02656719810203659>
 - [64] Collins, J. (2001) Good to Great. Random House Business Books, 197-204.
 - [65] Fiorentino, R. (2016) Operations Strategy: A Firm Boundary-Based Perspective. *Business Process Management Journal*, **22**, 1022-1043.
<https://doi.org/10.1108/BPMJ-06-2015-0087>
 - [66] Prasad, S., Babbar, S. and Motwani, J. (2001) International Operations Strategy: Current Efforts and Future Directions. *International Journal of Operations & Production Management*, **21**, 645-665. <https://doi.org/10.1108/01443570110390381>