Proceedings of the American Society for Engineering Management 2015 International Annual Conference
S. Long, E-H. Ng, and A. Squires eds.

MULTINATIONAL BUSINESS OPTIMIZATION: A SYSTEMS APPROACH

Arnesh Telukdarie,* DEng, PET
University of Johannesburg, South Africa

Ugan Maistry, MEng, PE
EOH Holdings Limited, Johannesburg, South Africa

***arnesht@uj.ac.za**

Abstract
Current developments in technology together with the global village concept have contributed to large international corporates becoming a reality. Growth and centralization, results in the agglomeration of cultures, geographical locations, business units and specialized divisions into a "perceived" single unit. Total business optimization requires the enablement of all business process from the smallest operational unit to corporate, from inbound, in process to outbound functions inclusive of total business management. On a global optimization view the two dimensions of delivery include "shop floor to top floor" and "global, end to end" perspectives.

The current operations of individual production units, independent of global subsidiaries are a distinct challenge as independent operations divert the potential of global assets/ supply optimisation. Crucially is the fact that research, technology development, asset optimisations, planning, corporate (strategy, investment planning, and finance), supply chain and other function of large multinationals are usually centralised. These central functions operate independently with crucial dependencies on operational, site to global, information. The current practice of manual/paper base information is limited specifically to human dependencies such as, obtainability, accuracy, time, and interpretation. These key issues result in a multidimensional and multilayer challenge of total business optimization.

Total business optimization must include, but not be limited to, production, supply chain, human resources, finance, Information management, plant control, research, technology development, together with sales and distribution. The additional complexity of multisite operations must also be included in order to achieve true global, end to end, optimization. There has been development in deployment of limited solutions but replication and accelerated delivery can only be addressed via a standardized approach. This research proposes a standardization, global system approach to this challenge from Enterprise Resource Planning through manufacturing systems down to instrumentation.

Keywords
Business optimization, Systems, Multinationals

Introduction
Business development is usually, but not always, related to short, medium and long term financial benefits. Facilitating optimistic growth targets has directed executives into diverse business growth initiatives. With the advent of globalization, it has become increasing natural to seek growth potential outside of the traditionally defined borders. Accompanying the business perspective comes advancement in information technology bringing with it intense global competition. This has resulted in internationally competitive businesses making significant changes to ensure competitiveness (Cigola & Modesti, 2008).Multinationals have employed various optimization initiatives such as Functional Excellence (FE), Operations Excellence (OE), Balance Score Cards (BSC), Financial Reporting (FR), Custom Satisfaction Surveys (CSS) etc. Business technology perspective includes information management toolsets; Enterprise Resource Planning (ERP), Process Control Systems (PCS), Business Systems (BS) and more recently Manufacturing Execution Systems (MES).

These initiatives has not been totally integrated within the Information Management (IM) capacity inclusive of data automation. The challenge is further exacerbated within the HR area, where the rigid individual "measure" data does not exist. Essentially a total seamless, data enabled business solutions, facilitating near real time decision making is a deficiency. This research focuses on the development of a holistic business solution focusing on IM enablement of business strategy, and resultant data visibility, facilitating real time business optimization. A specialized focus area would be entail technology development can be aligned to this research approach. This could result in accelerated enablement of new technology together with rapid deployment, management and optimization thereof.

Background-Context

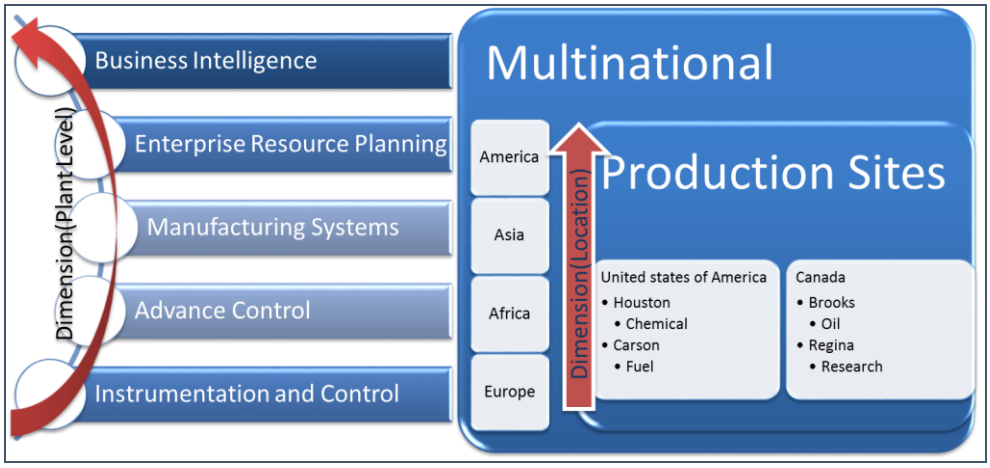
Acquisitions and mergers combined with the potential of organic growth, of national and international businesses, have become an increasingly familiar practice over the last century. This has resulted in the current scenario of the evolution of business into large international corporates. Growth and centralization, always-ensuring business sense, however could result in significant unanticipated exertions. With a low-resolution view, the challenge seems purely functional but with a magnified view, the actual challenges become apparent. Symptoms of the problem include but are not limited to:

- Lack of real time(site to global), business critical data facilitating optimum business decision making
- Total business delivery lacks value chain optimization
- Optimum automated workflows not enabled
- Organization outputs become rigid and limited due to hierarchy constraints
- Apparent gaps in strategy between head office and business units, down to individuals
- The inability of an employee to deliver due to unclear roles, lack of appropriate Information/data
- Low performance together with non-measurement thereof

The symptoms/ problem identification is simple when compared to the resolution thereof. Various attempts have been initiated in resolving the issues associated with efficient functioning of a large conglomerated business. These include functional excellence, cross-functional excellence, lean manufacturing and process excellence. These are only a limited number of potential solutions that have been introduced, in an attempt to overcome these challenges. The success rate of these has been diverse, from significant to non-impacting. The reasons for the limited success includes; organizational politics, positioning, hierarchy, time constraints, lack of IT inclusion, divergent data, the limitations of the proposed solution together with the skills for implementation. The challenge needs to be addressed using a different toolset, a toolset that is independent or has a very low dependency on these limiting factors.

The higher level of this research aims at propositioning a total business solution, inclusive of auto data enablement for optimum business decision making. This would provide role based, mission critical data for optimum business decision making. The two key dimensions of business decision making includes location (Global) and site (Hierarchical), see Exhibit 1.

Exhibit 1: The Two Key Operational Dimensions



At the preeminent level, this research aims at proposing a contemporary approach to improving the situation via the application and development of a more quantitative toolset, with a fully integrated system focus. The total solution proposed includes the exploiting of IT, engineering, mathematical models, statistics and modern business systems hybridized into a feasible, reproducible and sustainable business solution. Loeser et al highlighted the opportunity for business optimization together with the benefits of "green IT" (Loeser, 2013). The potential benefits of IT interventions in manufacturing and energy was also highlighted.

Support Literature

Business development is usually, but not always, related to short, medium and long term financial benefits. Facilitating optimistic growth targets has directed executives into diverse business growth initiatives. With the advent of globalization, it has become increasing natural to seek growth potential outside of the traditionally defined borders. Accompanying the business perspective comes advancement in information technology bringing with it intense global competition. This has resulted in internationally competitive businesses making significant changes to ensure competitiveness (Cigola and Modesti, 2008).

A key initiative among business executives has been the growth of business. Mergers (Nguyen, 2003) result in operating synergies, economic advantages, marketing rationalization, economies of scales benefits together with reductions in expenses (Hazelhurst, 2009). There has been, over the recent history of the financial system, a significant number (Gugler et al, 2003) of mergers (Gugler, 2003) and/or organic growth of companies. Figures in the US for 2003 stood at 4363 mergers and acquisitions with a dollar value of $291.7 Billion (Jeong, 2003). The primary reasons for mergers and acquisitions are to maintain, or increase, market share and/or shareholder value via cost reductions. Mergers and acquisitions have resulted in the development of national companies into large international corporates (Buckley, 2003). The development of international corporate implies decentralization of executives, resources, production facilities together with other resources of a business.

The management of large corporates with a diverse conglomeration of business approaches/strategies/cultures is a challenge (Buckley P.C, 2003). Global time zones, communication, languages, etc. further complicate this challenge. Factors that drive, seemingly simple daily business operations, into added levels of complexity. The functioning of international corporates include the effective management of a diversified business with multiple (Medori D, 2000), global, locations. Encompassing diversity in human resource, cultures, legal requirements, technical capacity, and linguistics together with financial diversities. All of which must be navigated in ensuring business success.

Business Optimization Initiatives

International, corporates seek to streamline the operation of business by adopting business optimization toolsets. Business optimization can be segregated into various focus areas (ANSI/ISA-95.00.01, 2000) including; Production Management; Maintenance Management; Quality Management; Inventory Management.

The operational and production aspects of business management has benefited from various systems such as Operational excellence, Lean manufacturing Six Sigma etc. These systems enjoy structured methods inclusive of advanced systems, mathematical modelling and IT. (ABB, 2005). Operational excellence, lean manufacturing together with other production toolsets has been successful (Lee-Mortimer, 2008) in streamlining business operation via definitive methodologies. An example would include lean manufacturing focusing on creating greater value with reduced effort. (Assembly Automation, 2008). A description of other initiatives are;

1. Operations Excellence: Operational excellence has achieved significant success in improving operations of large businesses, focusing on the operational component of business. Significant improvements in operational are generally achieved. (Livingstone, 2002)
2. Enterprise Resource Planning: The current approach of business is to enable the business delivery via the implementation of an appropriate Enterprise Resource Planning solution (ERP). These solutions, although operating on the business lever, are implemented in areas of specialization (Kakouris A.P; Polychronopoulos G, 2005). Areas of specialization include production, finance, human resources etc. ERP systems such as SAP do not typically create data links into the operations sphere (Hooshang M.B, 2006) but focus on ERP value chain integration.
3. Plant Process Control: The application of process control and advance process control as a specialized manufacturing level solution has contributed significantly to in improving production (MacCarthy et al, 2001). The control based solutions interface with the lowest level instrumentation with programmable

logic controllers and other lower level devices facilitating automated responses to process events. Advances include the application of statistical process control (MacCarthy et al 2001) together with historians etc. Process control systems data is reposited at the plant production level without significant business visibility.

4. Manufacturing Execution Systems (MES): MES is an information and communication system operating across a manufacturing organisation that integrates business and plant systems. Manufacturing systems focus on value chain optimisation seeking to provide data in real time for key preventative action and decision making. The benefits of an MES is summarised below:
    - Central data/information repository across the enterprise,
    - Enterprise wide access to accurate, real-time data,
    - Role-based visualisation reducing information overload,
    - KPI generation to enable and support decision-making process,
    - Improved response to both micro- and macro-economic factors,
    - Optimum utilisation of equipment, personnel and material resources,
    - Support regulatory compliance to safety, health, environment and financial standards,
    - Ensure manufacturing operations quality standards are met.
    - MES as defines by ISA 95 includes four key areas including Operations, Maintenance, Quality,
5. Functional Excellence: A more recent initiative has been Functional Excellence (FE). Functional excellence highlights limitations of large organizations and recognizes opportunities for improvements. The key philosophy has been the optimization of complex business structures with a centralization focus. The key driver had been consolidation into doing things in a single approach, aims at reducing repetitive behavior, with segregation of key functions within strategy, development and production. Functional excellence, like operational excellence together with other initiatives has been found to have significant dependencies. This includes the skills requirements and capacity, among other issues.
6. Human resource: Human resources are the key asset of any business. In order to achieve the best of human resource it is key to identify Capacity vs. the Production Capacity. (Covey, 2004). This is strongly supported by, resources been considered valuable, as aligned to the general business drivers. An employee must be guided through how his/her skills contribute to driving the business forward. An employee may benefit from continuous measure of compliance/enablement relative to the bigger business drivers.
7. Organizational Culture: Organizational culture is a critical factor in formulation and delivery on manufacturing strategy. (Cigola et al, 2008) Employee competence and delivery can be strongly linked to organizational culture. Changing an organizational work culture is not something that can be accomplished through a new mission statement, employee handbook, recruitment policy, or mentoring program. (Katz, 2005)
8. Strategy: The void in knowledge and practice, at large corporates, between global strategy and human resource management was identified as requiring development. Business strategy is currently developed by senior executives. This strategy is, highly dependent on communication (Badomi, 2002) and senior management to role down to employee level. Current strategy development lacks the role down/up effect, i.e. there is significant dilution/ hazy as the strategy is rolled down. Strategy alignment has been recognized to be among the key factors in the operation of an effective business (Devlin, 2002). Marketing and manufacturing strategy must be in unison. The miss-alignment between corporate strategies can prove expensive and time consuming. The delivery of strategy from top floor to the shop floor has been the most significant challenge. Performance of individual, within diverse international organizations, have not necessary conformed to linearity (Buckley, 2003). This has resulted in performance deterioration. Challengers include;
    - **Misinterpretation:** Middle management has been responsible for the enablement of strategic (Dixon, 1995) drivers at business. Key considerations for the enablement of these drivers are the ability/capacity of middle managers to effectively enable these key drivers down the organisation. Relating to this is the skills gap, inclusive of the turnaround and maturity of middle managers to conduct the required task. The resultant effect is non-compliance and or subjective/ill-defined strategically aligned measures.
9. Human resources performance measures: Business finds the need to maintain focus within a diverse environment. Tension is an essential component of the architecture of high-performing organizations.

> Using tension productively, so that employees are neither complacent nor overwhelmed, requires three key skills: picking the right fights, leveraging informal networks, and developing proactive leadership skills (McWilliams, 2001)

Measure of compliance to strategy is a challenge that has eluded research in this area. There has been significant effort with various measure models: Normative quality focused model (Baldomi, 2002) with a focus on division and plant performance measures; Close loop deployment and feedback model; with some simple frameworks to performance measures (Bititci et al, 1997).

In an attempt to close the gap between corporate strategy and employee action, a recent trend has been the development of measures of employee performance against business drivers. These include balance score cards (Flamholtz, 2003) and various other personal assessment tools. There have been significant assessments of the effectiveness of these evaluation systems with some indicating that up to 70% failing. There have been various suggestions on management of the balance scorecard. (Punniyyamoorthy, 2008) There were key gaps identified, these included non-alignment to strategy, failing to comprehensively align to business directions. In some cases were found to be potentially misleading to managers. (Flamholtz, 2003)

The collective effect of the above factors results in low performance together with non-measurement thereof. Various mitigating systems have been attempted to rectify the situation. There are various modern tools that have been adopted to facilitate employee delivery measure *inter alia* Balance score cards **(Van** Der Meer et al, 2004). The optimum use of the human resource skill set lacks a clear systematic management toolset.

Limitations in Total Business Optimization

Research has clearly indicated differences in output capability of multinationals at different physical locations (LI, 2010). Research has shown that various dependencies that influence a facility to have a difference in capability from a similarly managed counterpart within a multinational. Li identified productivity of skilled labor is higher in developed-economy subsidiaries than in emerging-economy ones. The questions relating to technology availability to the skilled labor can be considered a factor. Technology application and its impact on multinationals was investigated (Brambilla, 2009) with results indicating that technology delivered a significantly higher business output than non-technology aligned business. Research results on technology impact on multinational capacity was reinforces by other researchers (Girma et al, 2007) confirming the impact of technology transfer from a multinational to a local business.

Multinational seek to optimize business within the key considerations detailed within this literature search but are limited. These limitations were classified (Presscott, 2009) in studies and include: (1) economic, (2) technological, (3) organizational, (4) geographic, and (5) sociological.

The number of companies rolling out new technologies across the globe is increasing (Quinta, 2008) indicating that geographical location is a key consideration for multinationals. The impact of region on the ability of a multinational to successfully deploy technology has been the subject of various studies. It has been established that region or physical location has a significant impact on technology deployment (Quinta, 2008).

The operational process can be viewed as the first opportunity tier, for integration, delivering on a global solution. The research details an operational event to commence the value add discussion.

An example of the dependencies can be illustrated via a detailed operational scenario.

A production event occurs in the form of a pump break down. The operator manually calls maintenance, requesting a repair. The maintenance team lead, loads onto ERP a request manually. The planner receives the request and incorporates this manually into a plan. This plan is printed (manually downloaded) and an artisan goes out to evaluate the event. Upon inspection a paper (manual) request is made for spares and people. The artisan reviews the design specifications manually. The Artisan reviews the SOP manually. Prior to working on the equipment he manually requests a hot works permit. On completion he manually requests a close out and test. The plant operator is manually contacted and asked to bring the pump back online. This is considered to be part of the online protocols, secondary protocols are captured in the process flow below.

The bold arrows indicate exchanges that have to take place based on a single event. It would be difficult to imagine multiple events across the spectrum of business functions. An attempt would be made to detail a summary of business events dependencies on a cross functional basis, see Exhibit 2.

Exhibit 2. Process Events within a Functional Perspective

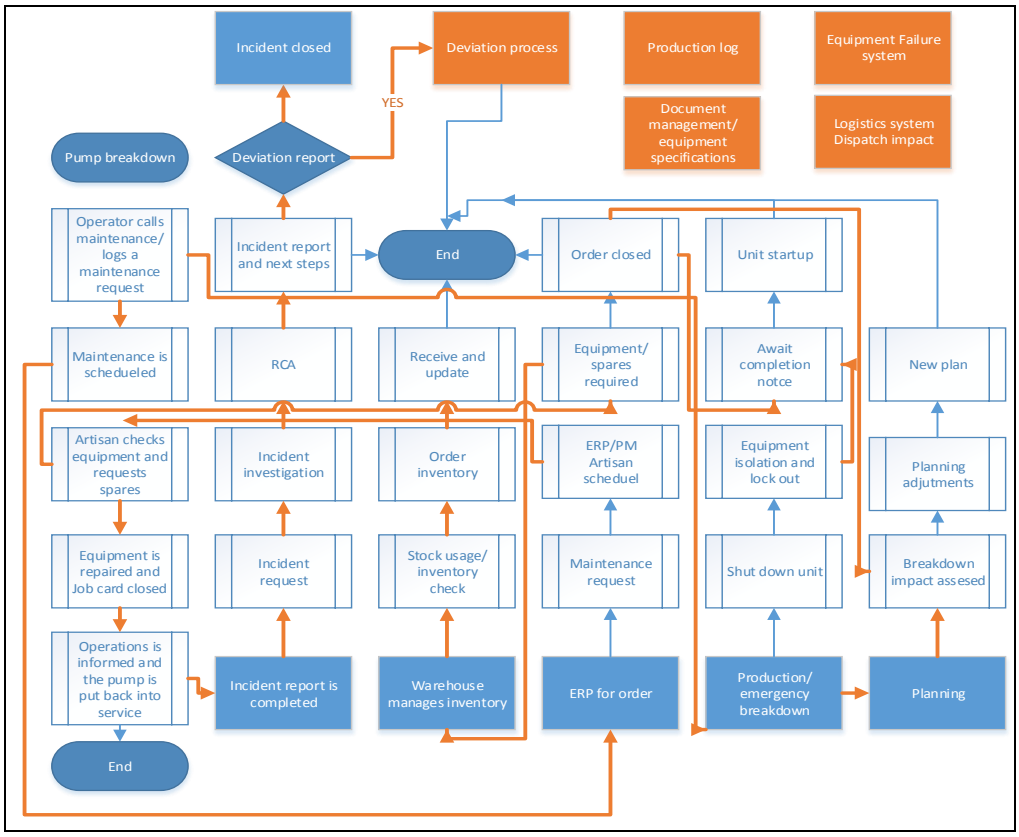


Exhibit 3. Scenario of a Process Event

Production log book is manually updated. The supervisor manually collates and compiles a manual report. This has dependencies of the next shift. This data is then manually rolled into a site and then company report.	The incident has resulted in production output decrease within the value chain. The downstream plant adjusts manually and so the value chain impact continues. This is manual.	This process excludes the maintenance spare management process, financial impact process, and logistics dispatching process. The data and incident record for each of the processes stated as Manual, above is reposited in independent systems.
The event must be investigated manually via maintenance and production. A repot is filed and the incident closed. This data is then manually rolled into a site and then company report.	The reduced production has an impact on a customer dispatch process. The logistics department detects a reduced output and calls the order department manually for customer expectation management.	The overall business operated on an order to dispatch basis. Orders and payments systems have close liaison. The order to logistics systems requires manual interventions. The scheduling systems require manual intervention with significant disjoints from the production systems.
SHE needs to conduct another manual incident process, they receive a manual request. The data is captured manually into excel. This data is then manually rolled into a site and then company report.	The truck and driver scheduled to collect the product is unaware of the delay and is manually informed of the delay, this sets up a chain of logistics impact.	The overall business operated on an order to dispatch basis. Orders and payments systems have close liaison. The order to logistics systems requires manual interventions. The scheduling systems require manual intervention with significant disjoints from the production systems.
The HSE systems requires similar data bur captured at different locations and usually for a variety of reports. The SHE databases are disjointed and sites choose individual systems. The actual reporting is usually manual and KPI and dashboards are not managed in real time.	The Laboratory, in anticipation of product has a delay and hence needs to schedule added people for the product tests on the next shift. This is done manually, together with the required equipment.	Maintenance systems are independent from Enterprise order management and automated warehousing. Maintenance systems are manually updated and schedules are usually through a significant planning department. Historic events are not traced on a number of incidents basis.

The process above could have been achieved in a significantly improved manner with multi system integration. This is becoming common practice across enabled corporate operational sites. This research focus on the integrated system delivery on the process, but on a global scale, where similar process are replicated, reused and maximized. This event is not a standalone, unique or non-replicated, but is a component of the larger operation.

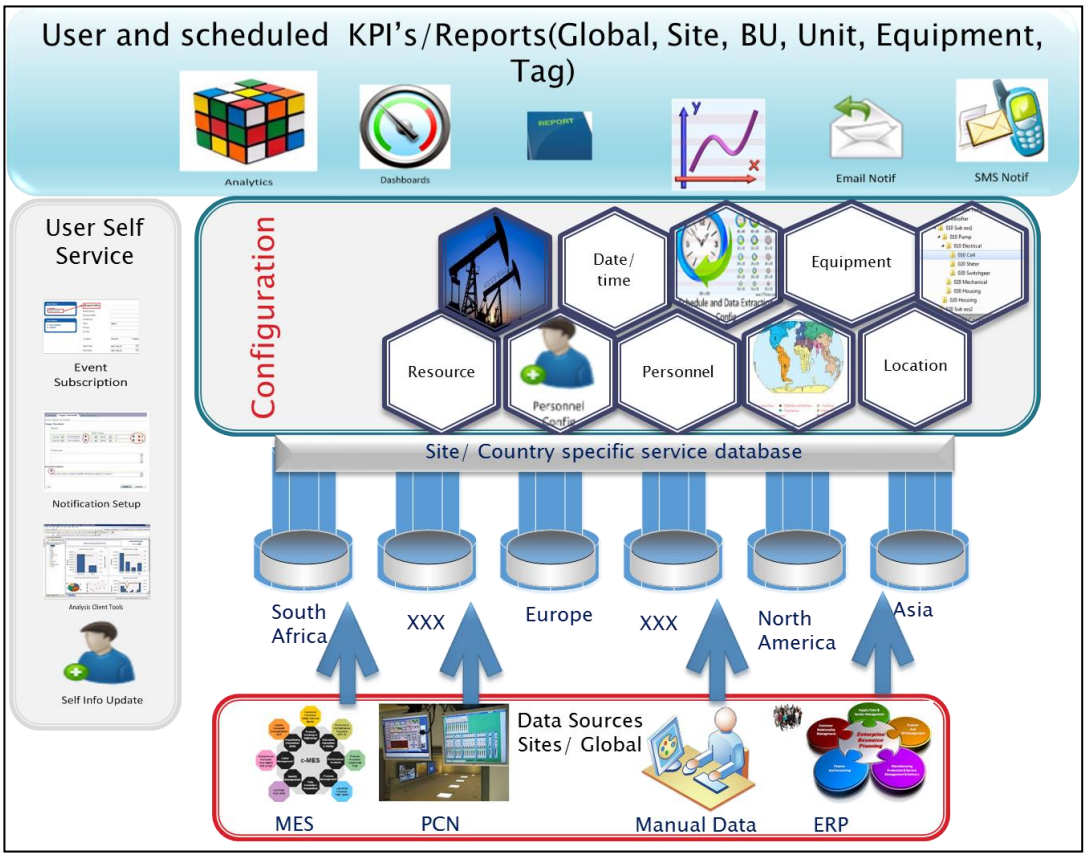
Research Focus: Delivery of a Total Business Solution

A seamless, data enabled business optimization solution brings together the corporate strategy, business solutions, human resources, financial, logistics and Research and Development into an automated solution would drive optimization within multinationals. The key solutioning approach would be based on a global template, wherein the generic business structure enables all requirements. The business may include a diverse product operation with any concoction of products on different sites. The proposed generic template should be fully inclusive but modular, facilitating a self-service reconfiguration. The business model must be dimensioned so as to navigate affinity variables.

Key considerations of the proposed solutions are;

1. All systems on all sites globally are integrated
2. The integration is, initially, conducted on a site specific role up
3. Large sites role up into regions
4. The Global configuration toolset has visibility to all systems, via sites and regions
5. The global toolset services all data, reporting and KPI's
6. All integration, reports, KPIs, once configured migrate to a master service menu. The configuration can then be used as a template with site specific data association. If modified the template carries a different ID.
7. The entire data network must be driven by a reference model, enabled via a plant equipment hierarchy.

Exhibit 4. Global business solution



The proposed research consideration implies a fully connected global business with all system data available and the sharing of knowledge, accelerated time to market and defined common KPI's. The system proposes all operational data into a site historian, all MES data to a virtual MES data structure linked to all ERP data. The key advantages are listed below.

Business specific functional enhancements

- No repeat builds
- Fully integrated global business
- Data available for specific solutions(maintenance, scorecards, management views/reports, automated events, SHE reports etc. logistics, time and attendance, operations (OE, OEE, KPI's)
- Simplification of application landscape
- Extensibility, reproducible
- Single versions of data/ synchronized data
- Single reporting framework
- All data at point
- Consistent data

Summary of additional corporate benefits

- Best practice analysis
- Data is available for every sector of the operation, data is available for every operational unit.
- Performance indicators, in real time
- Companies generally focus on KPI definitions for optimization, monitor and manage. The natural evolution, after a period of time is to conduct a re-evaluation of the KPI, rebuild and monitor. With end to end data connectivity this entire process is significantly shortened, specifically the build component allowing business agility. In reality the KPI's are inherently historical.
- Automated execution of multinational
- Comprehensive historical knowledge
- The integrated data structures would allow for the location of any specific equipment/product knowledge. The knowledge would be expanded into all dimensions from maintenance, operation, safety, documentation, logistics, reliability, efficiencies etc.

The solution proposed has significant impacts on the availability of comprehensive global data, the ability of business (through integration) to develop any initiative, to role up data based on these initiatives (from a global perspective) to roll down initiatives (reports, KPI's, information for doing business, best practices). The research also proposes a build once approach, where all constructs are available for reuse (location agnostic) facilitating accelerated deployment of new initiatives. The proposed research also delivers benefits on infrastructure and standardization (functionality can be centralized). A key business differentiator would be the potential to perform analytics on the Multinational as a whole or any business stream or specific piece of equipment. The business could also link R&D technology development with system development facilitating rapid role out of new technologies.

References

Baldomi J. (2002). communication from the Top, http://intwww.sasol.com/functional_

Punniyyamoorthy M , Muruli R. (2008). Balance score for the Balance Score card, Benchmarking, an Internationa Journal, 15(4), 420-443

Lee-Mortimer A. (2008). A continuous Lean Journey, an electronics manufacturer adopts Kanban, Assembly Automation, 28(2), 103-112

ABB. (2005). ABB Software finds more production capacity, Journal of Assembly and Automation, 25(2)

ANSI/ISA-95.00.01. (2000). Enterprise-Control System Integration Part 1: Models and Terminology

Bititci U.S, Carrie A.S, Mcdevitt L. (1997). Integrated performance measure system: a development guide, International Journal of Operations and Production management, 17(5)

Buckley P.C. (2003). The Changing Globle context of International Business, 1st Ed, New York, Palgrave Macmillan,

Cigola M, Modesti P. (2008). Anote on mergers and acquisitions, Managerial Finance, 34(4)

Covey S. (2004). The seven habbits of highly effective people, 1999, 15th anniversary edition in 2004

Cox J.F, Blackstone J.H. (1998). APICS dictionary, 9 th ed, Falls Church

Devlin G. (2002). How to implement a winning strategy, European Management Journal, 7(3)

Dixon P. (1995). Releasing middle management potential: Part 2, Journal of Executive development, 8(7)
Flamholtz E. G. (2003). Putting Balance and Validity into the Balanced Scorecard, Journal of Human Resource Costing and Accounting, 7(3)
Gugler K, Mueller D C, Yurtoglu B. B, Zulehner C. (2003). The effects of mergers: an international comparison, International Journal of Industrial Organization, Volume Issue 5, 625-653
Hazelhurst E. (2009). Local mergers, acquisitions up 122%, Independent on Line, Business report, July 21,
Hooshang M.B. (2006). What Managers should know about ERP/ERP II, Management research news, 29(4), 184-193.
Jeong I. (2003). A cross sectional study of the relationship between international diversification and new product performance, International Market Review, 20(3)
Kakouris A.P, Polychronopoulos G. (2005). En ter prise Re source Plan ning (ERP) System: An Effective Tool for Production Management Management research news, 28(6), 66-78
Katz J.H, Miller F. A, http://intwww.sasol.com/functional_excellence/ research/Making_Inclusion_a_Way_of_Life .pdf
Laitinen E.K. (2004). Towards a Microeconomic Approach of the Balance Scorecard, Managerial Finance, 30(6)
Loeser F, Erek K, Zarnekow R. (2013). Green IT Strategies: A Conceptual Framework for the Alignment of Information Technology and Corporate Sustainability Strategy, ISBN 978-1-4666-1972-2, 58
Li, B. (2010). Multinational production and choice of technologies: New evidence on skill-biased technological change from China Economics Letters, 108(2), 181-183
Livingstone M, D. B. (2002). Utilising performance measurement to drive operational excellence in a post-merger environment. Journal of Facilities Management , 1 (2), 131-141.
MacCarthy B.L, Wasusri T. (2001). A review of non-standard applications of statistical process control (SPC) charts, International Journal of Quality and Reliability Management, 19(3), 295-320
McWilliams A, Van Fleet D.D, Wright P. M. (2001). Strategic Management of Human Resources for Global Competitive Advantage, Journal of Business Strategies
Medori D, Steeple D. (2000). A framework for enhancing and measuring performance measure, , International Journal of Operations and Production management,15(2)
Mirella D, Fabrizio P. (2009). Takeover activities in the last european merger wave: a cross-country comparison, Corporate Ownership & Control; Spring Vol. 6 Issue 3, 8-25
Nguyen H, Kleiner B. H. (2003). The effective management of Mergers, Leadership and Organisational development
journal, 24/8, 447-454
Nuran Acur N, Gertsen F. (2003). The formalisation of manufacturing strategy and its influence on the relationship
between competitive objectives, improvement goals, and action plans, International Journal of Operations and Production Management, 23(10)
Turner G. (2000). Using Human Resource Accounting to bring Balance to the Balanced Scorecard, Journal of Human Resource Costing and Accounting, 5(2)
Van der Meer-Kooistra J, Vosselman Ed G.J. (2004). The balanced scorecard: adoption and application, Advances in Management Accounting, Emerald Group Publishing Limited

About the Author(s)

Dr. Arnesh Telukdarie holds a Doctorate in Chemical Engineering from the Durban University of Technology, South Africa. Dr. Telukdarie is currently a Senior Lecturer in the School of Engineering Management at the University of Johannesburg and a Professional Consulting Engineer. Dr. Telukdarie has over 20 years of industrial experience, research interest includes Manufacturing and Corporate Systems.

Mr Ugan Maistry holds a Bachelors in Technology (Engineering) from the Durban University of Technology, a Bachelors in Science (IT) and a Bachelors in Commerce from the University of South Africa. Mr Maistry is currently a Divisional Director at EOH Holdings (responsible for growth and strategy) and the Managing Director of Twenty Third Century Systems, an EOH subsidiary company resident in Zimbabwe. In Mr Maistry's career, spanning 20 years, he has successfully delivered on major Energy, Mining, Transport and Logistics and Local Government projects in Africa.